The Cheetah *Acinonyx jubatus* in Africa

NORMAN MYERS

Report of a survey in Africa from the Sahara southwards
IUCN/WWF Joint Project

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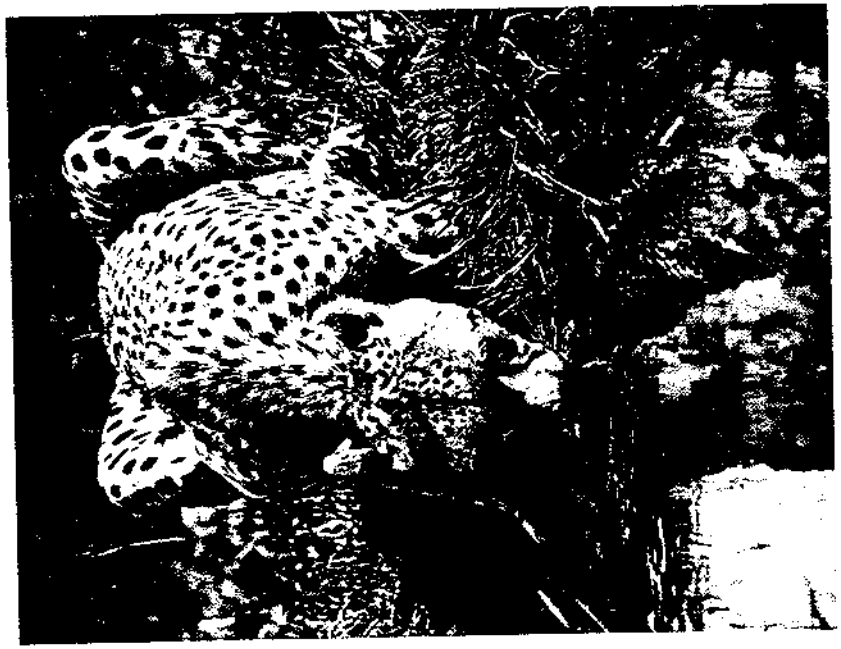

Photographs by Norman Myers

Foreword

Increasing human pressures on ever-dwindling wild areas make it necessary to re-examine constantly the use man makes of these areas and of the wildlife they contain. IUCN is concerned that economic demands to not override other values and unnecessarily destroy natural communities or lead to the extinction of species of plants and animals.

The trade in the skins of spotted cats has resulted in the exploitation of wild animals at a rate which, particularly in the case of the cheetah, is likely to bring many, if not all, of their present populations to extinction unless remedial action is taken. IUCN in association with its sister organization, the World Wildlife Fund, commissioned Dr. Norman Myers to undertake a status survey of cheetah and leopard in Africa, south of the Sahara, and to assess the extent and nature of the threats to their survival. The International Fur Trade Federation voluntarily imposed on its members a moratorium on the handling of the skins of several species, including the cheetah, for a period of three years and contributed towards the cost of the survey.

The present publication has been prepared by Dr. Myers as a result of his enquiries and field investigations. The views expressed, the conclusions drawn and the recommendations made are those of the author.

It is clear that the cheetah is in danger of extinction and that urgent action for its conservation is called for on the part of those governments with territories within its range. This will involve the adoption of land-use policies, possibly including fiscal or financial incentives, which will permit the cheetah to coexist with livestock over large areas of open country, since it is unlikely that the cheetah can survive, except as a precarious relict species, within existing national parks and reserves or any probable extension of them.

IUCN proposes that governments concerned should take early action to ensure the survival of the cheetah in Africa.

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Summary

ECOLOGY AND ETHOLOGY

In many respects the cheetah* is at the other end of the cat spectrum from the leopard: which means that it is much less capable of adapting to man-dominated environments. It is diurnal, does not conceal its food, does not scavenge. So it must hunt more frequently than the other large predators. Its hunting techniques in open environments frequently lead to its being deprived of its prey. A slight injury while defending its kill from another carnivore, may leave it unable to hunt again before starvation ensues.

Disease and other sources of mortality seem to bear heavily on all age classes of cheetah. Although reproduction and recruitment rates are no worse and often better than for other felids, numbers never approach those of any large predator in Africa, except possibly wild dog. Its population density rarely rises above one to 60 square kilometres, while one to 250 km^2 is not uncommon in marginal environments.

The species is adapted to open savannah, but can also subsist in moderately bushy environments. The optimal habitat is probably a semi-arid area such as the Sahel, where there is little carnivore competition. The cheetah has probably never enjoyed the wide distribution of the lion or a fraction of that of the leopard.

RESPONSE TO HUMAN PRESSURES

The ecological and behavioural factors that restrict the cheetah's range, likewise make it susceptible to pressures from man's modification of its habitats. It seems more disturbed by man's mere appearance in the landscape than are most other large predators. As its prey species are far more limited than the leopard's, and it is altogether less adaptable to changes, it also tends to decrease more sharply if herbivore numbers decline. Its only advantage over the leopard is that its skin is not nearly so highly valued, but due to its more uncertain status even moderate poaching pressures can prove critical.

With the progressive upgrading of subsistence pastoralism to commercial ranching, the cheetah is squeezed out of huge tracts of rangeland ecotypes. This is aggravated by the market for live cheetah, which induces ranchers in South West Africa and Rhodesia to dispose of any cheetah on their properties whether or not their livestock are being predated. Extensive areas of savannah are therefore likely to follow the trend in South Africa, where the cheetah has been eliminated from almost all its former range, despite the fact that since it is little inclined to scavenge it is not very liable to fall victim to poison.

Even more significant, however, than modern ranching for the cheetah's future is the over-spill of human populations from the more fertile zones. Landless peasants are tending to colonize the next most favourable biome-the savannah grasslands. Thus even in Zambia, where the overall population

* Scientific names of all species mentioned in the text are listed in the Appendix.

pressure is limited and unlikely to increase for some time to come, there is still a significant migration into the alluvial floodplains: although these comprise less than 10% of the country they coincide with all except the most marginal habitat available to the cheetah.

PRESENT STATUS

For the purpose of obtaining a working figure for cheetah numbers, the report attempts a biome-by-biome estimate. At best, however, this can provide only a rough approximation of totals. Subject to this qualification, it is calculated that in the whole region the number may be slightly over 15,000, but of these two-thirds survive in savannah and subdesert zones south of 15°s. On the basis of virtually unanimous reports from the field, the number was appreciably greater, perhaps twice as large in 1960. Unless effective conservation measures can be applied, the cheetah could well again decline by half within another decade at most, and thereafter the decline will continue with increasingly critical consequences in face of human population pressures.

FUTURE MEASURES FOR CHEETAH CONSERVATION

Because of its vulnerability to a spectrum of limiting factors, the cheetah faces precarious prospects if its distribution is reduced to relict pocket populations. Parks as ultimate sanctuaries represent a doubtful strategy: not only will protected areas encounter progressive pressures in years ahead, but the present network contains only 3000 cheetah at most. Because of density factors and related constraints of the cheetah's ecology and ethology, the species would prove much more difficult, not to say expensive, to safeguard through exclusive protection measures than the tiger, were total cheetah numbers ever to fall as low as 2000.

The best opportunity for conservation seems at present to lie in some form of multiple-use pattern of rangeland development. Cheetah needs should be integrated with those of intensified livestock husbandry. Possible methods to this end include reducing livestock losses from cheetah, and extending compensation for such depredations as occur. Eventually, these measures could well be implemented through an institutional framework similar to the World Heritage Trust, directed in this case at species rather than biotopes and ecosystems: the two approaches would of course overlap to some extent, but without special measures mere rangeland management and conservation are unlikely to be enough to ensure the cheetah's perpetuation. What is wanted is the widest possible acceptance of the conservation of the common property resource represented by the cheetah as part of mankind's patrimony.

Meantime, the cheetah should be accorded every form of absolute protection.*

* A summary of specific recommendations and suggestions to that end made in this report will be found at the end of the last Chapter.

CHAPTER I

Introduction

AIMS OF THE SURVEY

The survey was instituted to assess the present status of the cheetah in Africa. The principal aims have been to review the cheetah's distribution and numbers, and to evaluate these in the light of such factors as exploitation by the international fur trade and the extensive and intensive modification of wildlands. Special emphasis has been placed on trends and projections of land-use patterns in Africa, in order to determine dynamic aspects of the cheetah's status. It was hoped that as a result of the investigation, more effective measures than any hitherto applied to the conservation of the cheetah could be suggested.

GEOGRAPHIC SCOPE

The cheetah has been virtually eliminated from North Africa, and its numbers in the Sahara must be considered low. The survey was thus in effect restricted to Africa south of the Sahara. This did not mean that every country in that region had to be investigated. Some of them have not contained cheetah during documented times, and in several others the distribution of the species is believed to be so limited as to be no longer significant.

METHODS AND PROCEDURES

A survey in an expanse of Africa three times as large as western Europe, or about the size of the U.S.A., requires a carefully defined methodology. An investigation on this scale allows little opportunity for techniques such as are appropriate for intensive study of a discrete population of a predator species. Marking of individual animals for Lincoln Index censusing permits satisfactory estimates in specific localities, but does not lend itself to a survey of the cheetah population of even a comparatively well-known and accessible country such as Kenya, let alone East Africa or the sub-Saharan zone as a whole.

Further techniques, such as analysis of hunters' success ratios, are useful only for establishing the rough range of a species or its relative densities in different regions. They say little in terms of absolute parameters unless a comprehensive stock of data is available from several years for specific areas. Similar constraints apply to spotted-skin export figures. These reveal nothing of significance except when a substained harvest over an extended period can be taken as prima facie evidence of substantial populations. In any case, export data are extremely hard to come by given the covert nature of most of the trade concerned. Fur dealers outside Africa tend likewise to be reluctant to assist with information about its dimensions.

In the event it was concluded that detailed data were not the essential aim of the investigation. Recommendations for long-term conservation of the cheetah do not depend on precise quantification of populations. It is usually enough to know whether they exist in significant numbers in particular parts of

the range. Thereafter it is necessary to establish whether the populations are expanding in numbers, declining, or stable. Extensive enquiries should enable this to be ascertained, albeit in rough terms: no more is required at this stage. Insofar as the survey has attempted to identify trends over a considerable period for several regions of Africa, density indications and preliminary predictions have been assumed to be the most important key to the formulation of a conservation policy. Special attention has therefore been paid to accumulating information on trends, changes and constraints on the cheetah's long-term status, in contrast to the approach of emphasizing numerical assessments of the position as of 1973, with little regard for progressive pressures. A population of 50 cheetah in a particular area today is of little significance if the habitat is to be turned into maize fields in a few years' time.

LAND-USE TRENDS

A further salient feature of the approach adopted in this survey has been analysis of land-use trends throughout the cheetah's range. Cheetah habitats are more limited than the leopard's, the lion's or the spotted hyena's, and they are among those undergoing most rapid modification in developing Africa. If the survey's findings indicate that half the cheetah's range will probably be given over to exclusively competitive activities within the next 10 years, a reasonable assumption is that the cheetah's total numbers will be cut by half. Density patterns show some variation, but in the main, the assunption holds good. It implies that if the cheetah is already under some degree of threat, its status can be considered as likely to become at least twice as precarious within another 10 years.

Nevertheless, since it became apparent during the course of the survey that the cheetah could well be reduced to remnant totals within the near future, some assessment of existing numbers became appropriate. Using distribution data and density indicators, it was possible to arrive at some very preliminary estimates of totals country by country. They do not represent much more than informed guesses, based on little in the way of detailed evidence but depending much more on extrapolation from one area to another and various forms of associative indicators. The results are therefore a very crude approximation though founded on the experience of many responsible observers. Insofar as their views almost invariably point to the conclusion that the cheetah's status is deteriorating, this method of estimating cheetah numbers is considered worthwhile. It is particularly important to establish 'top limits' and 'bottom limits' for cheetah totals for the purpose of formulating conservation programmes. Furthermore, whatever qualifications are attached to present estimates, they will probably enable the future situation to be judged with more accuracy. Cheetah habitat is shrinking or deteriorating so rapidly that 1980 is likely to see a gross reduction in the range of the species, so any estimates that can be made ahead of time and perhaps permit some modification of the process, are certainly justified.

PERSONS CONSULTED

Sources of information tapped for the Survey included wildlife officials at national and regional level, park wardens, field scientists of various disciplines, anti-poaching personnel, professional hunters, private wildlife

organisations, trappers, poachers, fur trade dealers, wildlife cropping units, and anyone else with relevant experience. No less than 648 of them were directly interviewed and another 304 consulted through correspondence. This body of opinion was supplemented by an even larger number of persons engaged in activities not directly related to wildlife but with field experience in wildlife areas of Africa, including local government authorities, ranchers, veterinarians, livestock officials, forestry personnel, farmers of various kinds, police and army personnel, trade and customs officials, anti-malaria teams, and aid personnel from countries outside Africa. This second-tier source of information involved well over 1,400 interviews and conversations, and almost 300 letters.

Caution must be a paramount feature of a survey using information derived from the opinions of even authoritative persons with extensive experience, such as those in the first of the two categories referred to above. Many people are able to contribute reliably on the basis of direct observations in the field, but many others tend to confuse observation with interpretation, until it is all too easy for bias to creep in—no matter how well intentioned the individual.* This applies even more to persons in the second group. Nevertheless, when attempting an extensive assessment of the cheetah, the investigator is obliged to rely heavily on any sources of information available.

It is in fact not too difficult to sift out unreliable contributions. Inaccurate sources turned up as regularly in group one as in group two, and are not included in the totals given. At intervals in any interview, questions can be asked, whether of fact or interpretation, to which the interviewer knows the answers. This helps to identify the unreliable observer. The questioner can likewise use cross-examination or play the devil's advocate in order to determine the degree of conviction behind an observer's statement.

SELECTION OF COUNTRIES VISITED

Africa south of the Sahara comprises 41 countries. Distribution and density patterns of the cheetah vary considerably from country to country, and the survey's itinerary had to be planned accordingly.

I eventually visited most of the countries which still have substantial cheetah numbers viz. Mali, Niger, Sudan, Ethiopia, Zambia, Botswana, and S.W.Africa, in addition to Kenya, Tanzania and Uganda with which I was already familiar after 14 years residence. I also visited Rhodesia and South Africa, to ascertain which specific features of agricultural development had contributed to the massive decline in cheetah numbers in recent years, and to assess whether these and other depletive influences could be avoided elsewhere in Africa. South Africa exports more dressed furs and goods made from cheetah skins than the rest of Africa put together. Another ten countries were visited more briefly, making 22 in all, and I engaged in extensive correspondence with a further six.

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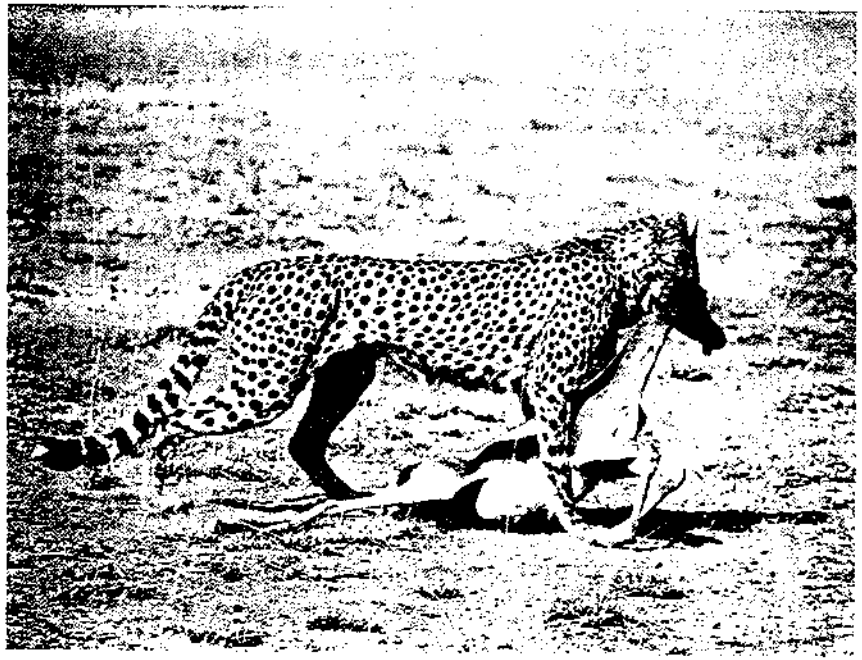
* These reservations apply especially to inquiries regarding spotted cats on which people tend to hold pronounced views. Prejudice on this topic tends to work in both directions. Some people insist that disaster is imminent, while others assert that cheetah will proliferate whatever happens. To some (uncertain) extent, these two inclinations cancel each other out.

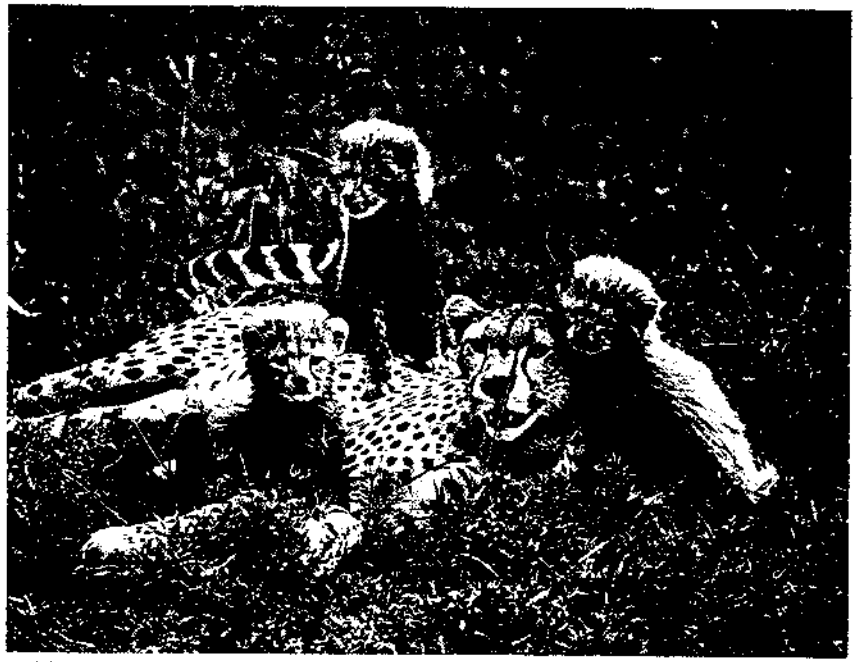
SPECIAL ROLE OF EAST AFRICA IN THE SURVEY

A survey on this near continental scale seemed to call for a design model on which to base investigative methods. The first six months were accordingly spent in East Africa, the varied physical features and biogeography of which were conducive to an initial analysis of cheetah distribution and density in relation to different biotopes. Moreover, while this region still sustains large numbers of wildlife, many of them in protected areas, it also exhibits very varying degrees of human disruption of wildland environments. Another asset is that it contains a relatively large number of people professionally engaged in the wildlife field and representing a considerable fund of experience. The region therefore offered an opportunity for designing a methodology for intensive application within East Africa and extensive use thereafter in the region-by-region investigation.

The early emphasis on this design aspect proved useful in defining a hierarchy of relevance for information inputs and interpretative analysis. For example, an examination of the situation across a spectrum of biotic associations in Kenya, Tanzania and (to lesser extent) Uganda, permitted identification of significant components of the 'status' concept. Criteria had to be determined for 'plentiful', 'rare' and, especially, for 'adequate'; 'threatened' as applied to cheetah needed to be defined in a manner quite different from, for example, the leopard: being so disparate in ecology and ethology, the two species turn out to require a radically different approach in assessing what degree of threat is tolerable to each. A framework of this kind is essential to establish the safe minimum conditions for the perpetuation of a population. For example, in relation to breeding requirements, how difficult is it for a male to find a female at the right time and how is the process affected by territorial behaviour? If a local population can be demonstrated to comply with the minimum conditions for survival, there is less need to determine in detailed fashion the specific extent of its range before concluding that it is in no immediate danger. At the same time, the assessment of 'danger' must be as dynamic as the situation in the area in which the population survives, and must take account of disruptive processes which are accelerating or accumulative.

Of course, massive reservations attach to extrapolating design features from an East African model to a survey of regions covering almost 20 million square kilometres. But the guidelines developed from the original experience did serve as a check on information accumulated elsewhere. Conversely, the material collected over extensive tracts of the sub-Saharan zone could often be used as a corrective feedback to some of the analytical judgments derived from the East African section of the survey.





CHAPTER II

Ecology and Ethology: Considerations of Relevance to the Survey

For conservation reasons it is imperative to establish the facts regarding the ecology and ethology of species of which the survival is in doubt, and perhaps especially of the predators whose value and function are too little understood and appreciated.

Thus, for the cheetah, one needs to know how its population density responds to different biotopes and other factors, how its numbers are regulated, what it preys upon, how that prey reacts to the predation pressure and how this in turn affects the cheetah itself. Similarly, it is necessary to know something of its social organisation, how its behaviour patterns compare with those of other predators, and how far they reflect local environmental conditions. Of central significance is the way these ecological and behavioural attributes are related to each other and to the total picture of the cheetah's activities.

Despite several additions to the literature in recent years, there is still a great deal to be learned about this species. Travellers' tales have contributed little, as compared for instance with those about leopards, which has significant implications: the cheetah has apparently never occurred in such numbers as to be frequently encountered, and has usually been too shy to be observed closely.

The following sections of this Chapter aim at summarising what is known, with the emphasis on those aspects which seem most relevant to practical conservation measures. For further details of the cheetah's life history the interested reader should refer to Adamson (1969 and 1971), Bruce (1971), Easton (1974), Ewer (1973), Graham and Parker (1965), Labuschagne (in prep.), McLaughlin (1970), Schaller (1972) and Wrogemann (in prep.).

TAXONOMY

The taxonomic status of the cheetah has been described by Smithers (1968). There has been some dispute about whether subspecific distinctions are valid, but no conclusive evidence has been put forward to alter Swynnerton's and Hayman's belief (1950) that there is insufficient differentiation to justify racial recognition.

Within the felid group, the cheetah stands well apart from the rest. It is obviously adapted to open or semi-open environments, which would, however, presumably lend themselves best to a social carnivore for hunting, efficient exploitation of food supplies, care of the young, etc. The lion has moved somewhat in this direction, the cheetah rather less so; neither shows a capacity for cooperative hunting comparable to that of the canids. The evolutionary background of this is discussed by Kleiman and Eisenberg (1973), and diagrammatic and tabular representations of the consequential behavioural differences between cheetah and lion, leopard, wild dog, hyena and two jackals, are to be found in Estes (1967) and Schaller (1972).

HABITATS

The cheetah is able to use a wider variety of habitats than is sometimes supposed. If woodland savannah is included as well as grasslands, plus various combinations of the two, around half of Africa south of the Sahara could constitute cheetah range. Distribution is not of course solely determined by vegetation patterns,—prey availability and carnivore competition being among many other limiting factors. Some woodlands, such as more humid sectors of the *miombo* zone, are too thick to suit cheetah; or grasslands, as in miombo dambos, may be too sour to support antelope of the right size for its hunting capabilities.

Land-use activities on the part of man have recently reduced the cheetah's distribution drastically. While it may indeed have been widespread throughout half Africa a century ago, it is now 'very localised' (Dorst and Dandelot 1970). The limitations imposed by man seem bound to increase markedly in future, since open savannah is more suitable for human occupation than the denser thornbush, scrubland or other biomes of equally little use to cheetah.

Being thus better adapted to open environments, especially arid areas in which there is less competition from other carnivores, perhaps the cheetah's optimal habitat is to be found in scattered bush areas like the Sahel, along the southern fringe of the Sahara. Here the cheetah has enough open spaces to deploy its speed and adequate stocks of gazelle prey. The cheetah's only killing method is a stranglehold on the throat and it pursues its prey over a moderate to lengthy distance at high speed, before attacking it at its most vulnerable point, the windpipe, when oxygen debt levels are high (Parker, pers. comm., 1972). Completely open grasslands, such as parts of the Serengeti, give similar opportunities, but at the cost of more harassment from other predators and with less cover where the cheetah can consume its food and lie up.* This greater risk of being robbed, if not injured, by the throng of carnivores sharing the same environment, may well make the Serengeti-type grassland a far less than optimal habitat.

In fact the cheetah is frequently found in bushlands. Sometimes it inhabits these areas because there are no alternative habitats nearby, as is the case in Kenya's northern frontier region, in Botswana and in the Kruger national park in South Africa.

In S.W. Africa the cheetah is found in dense bush country, even in outright forest of the thick dry type. In Wankie Park in Rhodesia, cheetah are often found feeding in woodland patches, though this is presumably because the cheetah's main prey in the park, impala, is woodland dependent. The same applies in Ruaha Park in Tanzania, where, in addition to impala, dikdik, essentially a species of the bushland/grassland ecotone, constitute the prey. Cheetah are sometimes encountered in the Arusha and Lake Manyara Parks in Tanzania, both almost entirely bush/forest biotopes.

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* This need for cover is not very pronounced. A cheetah lying up in a thicket will, when a man approaches, leap out of its hiding-place and run off. It thus betrays its presence before the intruder has become aware of it. This is at variance with the idea that the cheetah's flushing distance is greater than its observation distance, implying that many a cheetah sees the passerby without being seen itself. These traits are of obvious importance when trying to gauge cheetah numbers in various habitats.

These examples should not be taken as evidence that cheetah can subsist as satisfactorily in dense vegetation. Nevertheless, in several parts of Kenya, as in Tanzania and Zambia, cheetah have been noticed at the fringe of forest patches, on the prowl for suni, duiker and similar forest-dwelling species. They penetrate a little way into the forest vegetation if need be, but having made a kill they are quick to return to a more spacious environment. Uplands with a fairly dense tree cover usually, at lower levels and in changing soil conditions, phase into grassland, where the cheetah has an opportunity to use its speed* and the type of prey it requires is at the same time present in greatest numbers. This applies also to riverine tracts in thornbush country, as in Botswana, where grassland and vleis are interspersed with thicker scrub and bush vegetation along the draingage lines.

In the main, the principal vegetational limitation to cheetah distribution seems to be not woodlands or bush growths but tall grass. Hyparrhenia grasslands in Uganda and southern Sudan seem to exclude the cheetah sharply, although it may be quite common in short-grass areas within the tall-grass zones.

DENSITY ACCORDING TO HABITAT TYPES

The question of density presents many problems. Such scant information as is available suggests 1 cheetah to 100-125 km^2 in the Serengeti (Schaller 1972), 1 to 70 km^2 in Kruger Park (Pienaar 1969), and roughly 1 to 6 km^2 in Nairobi Park (McLaughlin 1970). In the Amboseli reserve, the average has usually been around 1 to 30 km^2, though with an increase toward the end of the dry season when prey populations converge on the swamps (Western, pers. comm., 1972). By contrast, the Masai steppe around Tarangire produced only 11 cheetah sightings by Lamprey (1964) in 4 years. The total was put at under 20 cheetah, giving a density of 1 to 400 km^2. In Timbavati Reserve on the border of Kruger Park, with plenty of impala prey, the warden estimates about 30 cheetah in 600 square kilometres of bush. Kalahari Gemsbok Park holds around 150 cheetah in its 9600 square kilometres, but the cheetah are concentrated along the riverine habitats (Labuschagne, pers. comm., 1972).

These figures are sometimes used to support the idea that cheetah density is generally 'low'. The word implies a comparison with other felid predators. Schaller (1972), commenting on the Serengeti situation, remarks that cheetah reproduction seems adequate and an ample supply of food is generally available and accessible, so 'some unknown factor or factors keep the population depressed and seemingly stable at a low level.' One could equally say that if the population is stable, it has reached equilibrium level with whatever limiting factors operate in its environment. However that level may appear when viewed alongside other predators, it is presumably 'right' for cheetah. A higher density could lead to over-much intraspecific fighting, since the

* The cheetah's hunting capacity does not depend entirely on sheer speed, as is often suggested. On the East African plains a chase sometimes gives the impression that if a gazelle jinks aside during the flat out phase of pursuit, the cheetah cannot do otherwise but go tearing on past the fortunate prey. This may be the case when the cheetah is at top speed, but in Kalahari Gemsbok Park sand spoor shows how a cheetah can pursue a hare over a figure-of-eight course several times before finally catching it (Labuschagne, pers. comm., 1972).

cheetah's territoriality appears to be based not on strict geographical ranges but on avoidance systems (Eaton 1970). The spacing arrangements could lead to an undue number of encounters at densities higher than the 'poor' or 'low' or 'depressed' levels which seem characteristic. The cheetah, much more than the lion, leopard, wild dog or hyena, is unusually susceptible to slight injury, since a mere bruise can slow it down to the point where it can no longer catch prey. Moreover, the cheetah seems unduly prone to disease; densities other than 'low' could lead to pandemic catastrophies. At the same time, there is an obvious danger of the density in some particular area falling too low for the species to maintain itself. At what stage are individual cheetah too sparsely scattered for males to find females at breeding time with sufficient regularity? This question is all the more pertinent to a species whose members constantly move from one locality to another, instead of remaining within a defined home range or territory.

HUNTING BEHAVIOUR IN RELATION TO HABITAT TYPES

As already noted, when several cheetah are hunting together, they do not cooperate in the intermittent manner of lions or the invariable manner of wild dogs. Perhaps this is an indication that the cheetah is basically adapted to hunting in habitats with a modicum of cover, in which stalking techniques dependent on individual stealth pay off best. If the cheetah were principally, let alone exclusively, a hunter of the open grasslands, the stalking proclivity would surely have taken second place to social hunting systems. The latter have of course been notably developed by other predators whose favoured habitat is clearly open savannah, notably spotted hyena and the wild dog. All this surely points to the cheetah having evolved a special capability of surviving in bush habitats in the absence of more open grasslands.

Having fed off its kill, the cheetah does not share the stereotyped felid behaviour of protecting the carcass until another day. It makes no attempt to scratch leaves, twigs or soil over a kill with a sweeping movement of its forepaw (nor does it employ a similar movement, or any movement at all, to cover its faeces). This could be construed as evidence that the cheetah's behavioural characteristics were firmly established, in patterns from which it still shows little divergence, during the lengthy period of the Tertiary when it was possibly the only large predator of its type roaming the savannahs and able to consume its prey at leisure without risk of being robbed. On the other hand, in Kalahari Gemsbok Park, with its sparse vegetation, cheetah are reported to make a gesture of dragging the kill a short way before starting to feed. This could perhaps be a vestige of a habit developed in areas where it would obviously have considerable survival value. On the other hand, in the Kruger National Park, Wrogemann (pers. comm. 1972) saw a cheetah make no attempt to drag an impala it had killed into bush cover a dozen yards away. It was still feeding on the carcass next day.

FOOD SOURCES

Cheetah feed off all manner of items, though usually off medium-sized or small antelope (see: McLaughlin 1970, Mitchell *et al.* 1965, Estes 1967, Pienaar 1969, Schaller 1972 and Kruuk 1972). In Kalahari Gemsbok Park,

where suitable-sized antelope are limited to springbok, the most frequently taken species are hare and spring-hare (Labuschagne, pers. comm., 1972). This is a surprising indication of the cheetah's behavioural plasticity, and it certainly improves the chances of the species survival if it can manage on a diet of small mammals, rodents and the like, when its 'normal' prey is eliminated.

Since its prey tends to be rather small-sized and, as discussed in the next section, it is frequently robbed soon after making a kill, and since it makes no attempt to secure the remains of a carcass until another day, the cheetah is obliged to kill more often. This makes it vulnerable to shifts in the make-up of prey populations, especially in ranching country and despite the fact that it preys on domestic stock even less than the leopard. Reports of its depredations seem to be confined to commercial ranching enterprises, enough to suggest that there is a real distinction and that subsistence pastoralists are comparatively unaffected. When a rancher reduces wild herbivores on his property, whether deliberately or through competition for range resources, the cheetah is obliged to take whatever it can find.

CHEETAH AND SCAVENGERS

The cheetah is robbed of its prey often enough for the phenomenon to be a significant factor in cheetah density and distribution. It loses prey to almost all other major carnivores, while it scavenges from none. Hyenas and jackals not only monitor vulture movements to lead them to a kill but are also known to follow cheetah tracks in the sandy terrain of biotopes such as Kalahari Gemsbok Park for the same purpose. In several parts of East Africa, the principal scavenger of cheetah kills is certainly the spotted hyena. This may well account for the rarity of cheetah in Ngorongoro Crater in contrast to the Olduvai Gorge, nearby, where cheetah are relatively plentiful and hyena few. The bushy nature of the Gorge area is presumably not dense enough to deter cheetah but favourable to the biting insects which hyena generally avoid. Another area with very few hyena, the Nairobi Park, carries an exceptionally high density of cheetah, as already noted.

This relationship between cheetah and hyena densities is borne out by the experience of Pienaar (pers. comm., 1973), '... cheetah in the Kruger Park suffer intense competition in certain areas from more dominant predators such as hyenas, leopards and lions.... Recently a cheetah female with four cubs, during a period of a few days, lost three.... successively to a lion, hyena and martial eagle. Adult cheetahs are often robbed of their kills by hyenas, leopards and even lions, and are also severely injured or killed in the process.... One of our highest density areas for cheetah, i.e. the Pretoriuskop tall-grass savannah, has probably the lowest density of associated, more dominant predators in the Park. Hyenas, particularly, are not abundant here... I think it would be certain that hyenas have a limiting influence on our local cheetah population, varying in intensity from one area to another. But that is probably equally true at different levels for leopards and lions.'

Apart from hyenas, therefore, lions as well as leopards readily appropriate carcasses and the same applies to wild dogs (Kruuk 1972; Schaller 1972). In general, the larger, more powerful or more numerous the 'robber' species, the more prone it is to stealing the kill of some other predator. The over all significance of this as a limiting factor for cheetah deserves a study to itself (see Myers 1975a).

POPULATION DYNAMICS: CUB MORTALITY

The only aspect of the cheetah's population dynamics upon which substantial information is available and which relates to the purposes of this Report, is cub mortality. As mentioned previously the cheetah's reproductive potential seems to be higher than for most other large carnivores of Africa. But since its numbers do not remotely match those of the others, considerable cub mortality must take place.

Cheetah litters seem to average 5 or 6. Often only half or less of the cubs survive to join the adult population. Part of the reason for their extreme vulnerability is to be found in the unprotected 'nursery space' of open country and the wide-ranging habits of the mother. Data are lacking on cub mortality by age categories, though in Serengeti the smallest cubs seem to come off worst (Schaller 1972). In Kalahari Gemsbok Park, mortality is highest among immobile cubs and next highest among moderately mobile cubs (Labuschagne pers. comm., 1972). In environments of high predator density, such as savannah grasslands, cub mortality is bound to be accentuated in a species where adults provide only a fraction as much protection as would lions, leopards, hyenas and wild dogs. The high cub mortality in such environments is incidentally a further indication that optimal cheetah habitat is more likely to be arid environments with far lower numbers of predators as well as prey.

IMPLICATIONS FOR CHEETAH CONSERVATION

This summary of cheetah ecology and ethology has indicated the range of limiting factors for the species. A preliminary conclusion is that scarcity is the norm. In former times, with extensive areas of suitable habitat available, this could have meant some degree of stability for cheetah populations and security for the species. In the present situation, as the habitats disappear, the same attributes could prove critical.

A further conclusion is that more information is needed on a number of aspects. They include population dynamics, with special reference to reproductive and recruitment rates, age-specific mortality rates, and mean lifespan and longevity; population structures; sex ratios and ratios of actively breeding adults; distribution and density by habitat types; components of prey species; competition between carnivores; the cheetah's role as a predator, with reference to limiting or regulatory impact on various prey species by age, sex, and social status; and functional relationships, reflecting the interactions of several of these categories, e.g. litter size and cub survival in relation to prey abundance, hunting conditions and other environmental factors such as unusual weather conditions.

These bio-ecological factors need to be investigated as broadly as possible, qualitatively at first but with eventual quantification. Such conservation-directed information is urgently required, given that the cheetah needs to be studied on a comparative basis across a spectrum of biomes in order to delineate its niche in a variety of situations. This will help to establish how far curtailment of range and numbers can go before the species reaches the point of no return. In short, pressures which eliminated the cheetah over the greater part of its range in Asia and presumably contributed to its demise in Europe, namely the disappearance of something to eat and somewhere to live, are fast gethering force in Africa and it is essential that the possibility of controlling them be determined.

Cheetah research along these lines will, however, mark a departure from the customary studies of discrete populations. It should in fact be ecosystem-oriented rather than species-oriented. Results may not produce the same kind of detail as would intensive investigation of the cheetah in a single area, but they will be directly relevant to its conservation needs.

CHAPTER III

Cheetah Status by Regions

(a) **EAST AFRICA** (see Fig. 1 and Table 1 for summarised data).

This is perhaps the most heterogeneous region of Africa. Its topography and climate are unusually varied and it includes examples of all major biomes from sub-desert to humid forest. Consequently its biotic associations, notably its wildlife, present unequalled diversity both qualitatively and quantitatively.

Kenya

One of the most notable trends in this country at the present time is a growing spillover of human population from more fertile areas into the savannahs. For instance, the population of the eastern plateau, including the environs of Tsavo Park, is growing at 10-35% per year (Wisner & Mbithi 1972). Masailand too is changing rapidly, not only as a result of ranching schemes but also of an influx of people from elsewhere. Nevertheless, half the country, mainly north of the equator, remains little affected.

Early in this century, cheetah were found in several areas though very localised (Stewart & Stewart 1963). In most places they appear uncommon, and over much of Kenya one was lucky to see a cheetah even in suitable habitats. Game Department reports before World War I speak of the 'alarming decline' in the species and the need for special protection measures, which indicates that even in a country which was still largely wilderness, the cheetah was hardly ever numerous and could often be considered rare.

The cheetah's range, however, was not much reduced until around 1960, except in ranching areas where its natural prey had slowly dwindled since the 'forties. More recently intensified ranching methods have caused its widespread disappearance from previously well-established habitats. Throughout much of Masailand, wild predators are now under pressure from upgraded pastoralists or commercial ranchers like those in the Laikipia area, who are steadily removing cheetah from their properties by every available means (even though the cheetah is a protected animal).

The main area for cheetah is now the northern frontier region. This dry thornbush country is only moderately suitable habitat but little intensive development is foreseen and human population pressures are slight. It is here that, in addition to parks and reserves, the cheetah in Kenya has the best change of surviving. As long as suitable prey remains available, cheetah should hold out in good numbers for at least the next decade. At present Grant's gazelle and gerenuk are found throughout this northern zone, as are dikdik and duiker but, due to the harsh environment, in smaller populations (except perhaps for dikdik) than in the more productive savannahs to the south. In several sectors, also, notably around Mandera and Marsabit, gazelle have been reduced by guerrilla intruders and seem to be slow in making a recovery. This has probably contributed to the low numbers of cheetah now seen compared with 1960. But in the plains below Moyale, cheetah are widespread, without being numerous, and towards Lake Rudolf, in the environs of Ileret and Allia Bay, recent travellers describe it as regular if sparse, which applies also to North Horr and in the Chalbi Desert. In Samburu country, cheetah are seen from time to time, not so often as to suggest a

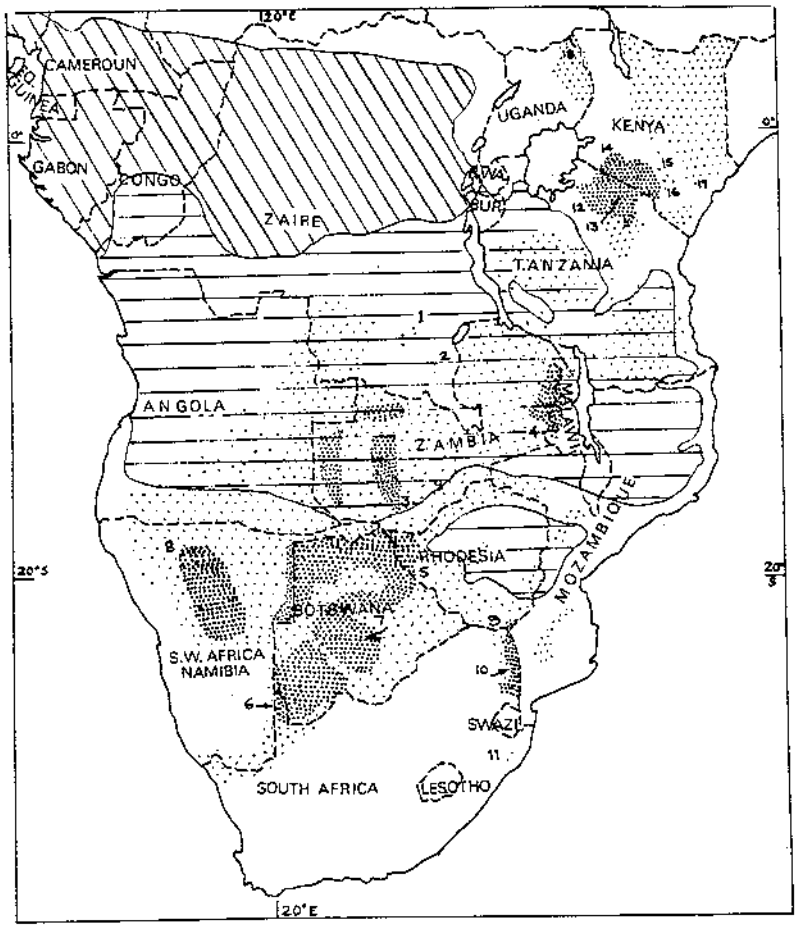

Fig. 1 Cheetah distribution in East, Central and Southern Africa

Rainforest zone : oblique hatching
'Miombo' zone : horizontal hatching

Heavy stippling : cheetah density and stability satisfactory
Light stippling : cheetah density and stability low to moderate

Protected areas

1. Upemba
2. Kundelungu
3. Kafue
4. Luangwa Valley
5. Wankie
6. Gemsbok Game Reserve and Kalahari Gemsbok
7. Central Kalahari
8. Etosha
9. Gonarezhou
10. Kruger
11. Hluhluwe & Umfolozi
12. Serengeti
13. Ngorongoro
14. Mara
15. Nairobi
16. Amboseli
17. Tsavo
18. Kidepo

TABLE 1 EAST AFRICA

Country (with area in square kilometres)	*Land-Use Trends*	*Cheetah Range*	*Protected Areas*	*Estimate of Cheetah Numbers*	*Remarks*
Kenya (582, 000)	Progressive settlement of some savannah zones	localised except for 250, 000 km^2 of arid ecotopes in north	extensive network, but cheetah populations total only a few hundred	under 2000, range 1000–3000; probable decrease of 500–700 by 1980	20, 000 km^2 of northern frontier territories afford little-disturbed range for cheetah, but poaching has been extensive
Tanzania (942, 000)	Only certain sectors experiencing land-use pressures, but include Serengeti/ Ngorongoro region	grassland steppe of Masailand; localised areas of miombo woodlands	extensive network but cheetah populations total only a few hundred	1000 or less, range 500–1500; could fall as low as 400 by 1980	Some poaching in Masailand and parts of south
Uganda (236, 000)	Only limited parts will remain in relatively undisturbed natural state by 1980	25, 000 km^2 of arid ecotopes in north-east	fair network, but cheetah only in Kidepo Park	170, range 100–250; little change expected by 1980	Little poaching

Summary for East Africa: Slightly over 3000 cheetah, within range 1600–4750; could fall below 1800 by 1980.

considerable stable population but more than if they were merely transients from outlying areas. They have even been reported from the forest fringes on Mt. Marsabit.

In Kenya poaching has had less effect on cheetah than on leopard, in part because they do not come so readily to a baited trap, and in part because a skin is worth only half a leopard skin at most (penalties are equally diminished: a man with 10 cheetah skins was on one occasion fined the equivalent of U.S. $37, and permitted to keep the skins).

If the present situation continues, cheetah should persist in the extensive arid environments for a good many years. Assessing their numbers, however, is problematical. Informed guesses on cheetah density in bushland habitats probably err on the low side, since many cheetah may be overlooked. On the other hand, their density can hardly be expected to be high in marginal biotopes where suitable prey species are likely to be thin on the ground. On the basis of various attempts to put a figure on cheetah populations in similar environments elsewhere, an average density of 1 animal to 130-150 km^2 areas free from poaching or 1 to 250 km^2 otherwise could fall within the range of probability. A region of 250,000 km^2 could thus support as many as 1400 cheetah, certainly over 1000. The rest of Kenya may at present support another 500 giving an overall figure for the country of 1900 or, say, at least 1500 but probably substantially less than 3000.

Any surviving populations outside the northern frontier districts will be mostly confined to protected areas by 1980. In the north, some populations could become depleted in minor to moderate degree, especially if Kenya tries to exploit the area as rangelands. However, the end of the decade should still see 1200 cheetah in Kenya if illegal hunting can be kept under control.

Uganda

Cheetah exist only in the north-east. They are widespread in Karamoja, and range westwards for a short way into Acholi and Teso Districts. They used to extend somewhat further west, though still not as far as Kabalega Park. The limiting factor seems to be tall hyparrhenia grasslands, presumably unfavourable to the cheetah's hunting methods rather than limiting the range of acceptable prey species. In Kidepo Park, near the junction of the Uganda, Sudan and Kenya Borders, cheetah do occur in a similar tall-grass savannah zone, but keep to scattered short-grass areas along rivers and ridges.

Poaching does not seem to be a factor of any consequence except in the north where, as with leopard, a few have been killed for sale across the border in southern Sudan.

The cheetah's range in Uganda is thus less than 25,000 square kilometres of semi-arid thornbush. A density of 1 to 150 km^2 would be high for such a harsh environment, but can be accepted considering that conditions for the population are relatively undisturbed compared to those of southern Kenya and northern Tanzania. This would give a total of around 170, within a probabl range of 100 to 250. There will no doubt eventually be some decline in number under the crude influence of human population growth, even if the programmes for upgrading livestock husbandry remain in abeyance.

Tanzania

Although Tanzania still has vast areas of comparatively undisturbed wildlands, many of these are already experiencing a rapid spread of human activities (Moore 1971). Within 15 years Tanzania could lose the distinction of possessing more numerous and magnificent wildlife spectacles than any other country in Africa.

Rather more than the southern one third of the country is covered by miombo woodland (the wildlife carrying capacity of which is discussed in the next section of this chapter). Open grassland comprises only 10% of the country, wooded grassland over 27% and bushland and thicket country 16%. Thus there should be a moderate number of suitable biotopes. Secondary grasslands are increasing as a result of burning by both pastoralists and cultivators, though they often contain little wildlife and should not be automatically regarded as suitable cheetah habitat (Vesey-Fitzgerald, pers. comm., 1973).

The cheetah has never been distributed outside the northern half of Tanzania in worthwhile numbers. Twenty years ago, it occurred in a wide variety of districts (Swynnerton & Hayman 1950), but by the 1960s it had virtually disappeared from many areas, and by 1970 was only rarely recorded outside parks and reserves. Miombo woodland is moderate habitat at best for the species, which is found infrequently even in short-grass zones such as those of the Selous Reserve. In Ruaha Park, small numbers survive in the lower reaches of catenal habitats along water courses but they have been declining in the last few years with only 2 sightings in 1971 and 1972. From 1949 to 1964, cheetah were seen in miombo woodlands around Lake Rukwa and its floodplain, but as the wild herbivores of the woodland faded away, so too the cheetah.

In the grassland savannahs of northern Tanzania, notably Masailand, cheetah are more widespread. They occur in Tarangire Park, though they wander out of this narrow sanctuary to destruction in the hinterland. In the Serengeti Park, the population totals only 250 (Schaller 1972). Ngorongoro Crater features sporadic transients, but Olduvai Gorge and its environs supports a seemingly resident population of moderate numbers. Poaching pressures, reputed to be severe on leopard throughout the region, have had little effect on the cheetah, mainly because it is not susceptible to the usual methods used for leopard, viz. baited traps and poison.

The constriction of range during the past ten years is likely to continue at an increasing rate in the next ten. By 1980, or not much later, the cheetah could be more or less confined to reserves.

For the purpose of estimating present numbers, the Serengeti and Ngorongoro can be credited with 300 cheetah, with perhaps another 100 in the rest of Masailand including Tarangire. Cheetah are still occasionally seen near or in Arusha Park and could comprise a further 50, making a total of 450 in northern Tanzania. Any estimate for southern Tanzania is more problematical, since distribution is much more patchy, while densities in Miombo woodland are largely unknown except that they are low or very low. As an approximation, though it must be stressed that it is a very rough one, a figure of 500 cheetah is possible. This would bring the Tanzania total to 950, say 1,000, within a range of 500 to 1,500.

Unfortunately the probable figure for southern Tanzania by the year 1980 can already be suggested with confidence: virtually nil, since human population expansion is likely to occupy the fertile floodplains of the miombo zone before the woodlands proper, thus eliminating cheetah habitat. In the north, assuming that the integrity of the Serengeti is maintained, the total could remain around 250 or even rise to 300 if the western woodlands are opened

up yet more. Conceivably 50 cheetah could survive in the Ngorongoro Conservation Unit, supposing that the plains to the west of Olduvai are not developed for Masai ranching. A few cheetah will no doubt hang on in Tarangire Park and elsewhere, but only a few. The end of the decade could see no more than 400 cheetah left in Tanzania.

(b) THE MIOMBO WOODLAND ZONE (see Fig. 1 and Table 2).

The miombo woodlands span Africa from Angola to Tanzania. They cover an area the size of U.S.A. east of the Mississippi River. The zone includes large areas of Zaïre, Angola, Rhodesia, Mozambique, Tanzania and Malawi, as well as pretty much the whole of Zambia. Dominated by the small-leafed and generally tall trees of the Leguminosae genera *Brachystegia* and *Isoberlinia*, it constitutes one of the largest expanses of homogeneous vegetation in Africa, if not the whole world. Conveniently for purposes of this survey, its uniform character allows certain bio-ecological generalisations.

The only major disruption of the monotonous stretch of miombo is to be found in waterlogged valleys and drainage lines, known in East Africa as mbuga and further south as dambo. In the more level terrain these dambos broaden into floodplains characterized by acacias and sour* grasslands. These are practically the only areas where cheetah can exist in appreciable numbers. But while the miombo ranks among the biomes least disturbed by man, the dambos are a focus for human activities. The region is sparsely inhabited for the most part, and the base-line populations of 1973 suggest that another ten years will not see much change. But the grassland patches in dambo alluvials are much more easily exploited by agricultrual man, whether cultivator or pastoralist, than are woodlands with dry, infertile soils and frequent tsetse infestation. Floodplains and related habitats account for perhaps 10% of the miombo region, yet they support the greater part of the rural human population, and this tendency is likely to become more marked.

The trend bodes badly for the cheetah, which may find itself eliminated by 1980 from favoured and moderately suitable habitats in the zone. Furthermore the presence of tsetse fly has meant that fewer livestock are raised than in the countries to the north where tsetse is not so prevalent. Human communities reveal a consequently greater need for wild protein, so that the relatively few ungulates depending on the dambos are subject to much hunting, reducing food resources of an equally selective predator such as the cheetah. How long these limitations have affected cheetah numbers, before man's more recent and broad-scale disruptive influence, is not known. Now under human impacts of the past ten years, zebra, eland and Lichtenstein's hartebeest have deserted many of the floodplains and several other species, such as puku and waterbuck, more or less restricted to them, have presumably been unable to adapt to other environments and simply disappeared.

These trends must lead to a marked decline in overall carrying capacity for wildlife in the miombo, especially as the productivity of species in the

* 'Sour' because unpalatable in the dry season. This is why miombo grasslands do not support nearly such large totals of herbivores as the plains to the north. In addition, most of the zone has only one rainy season, not two as on the equator, which means that the protein content of miombo grasses can fall to less than 1% for 3 to 4 months of the year and may only attain 10% for a mere two months (Brown 1965).

TABLE 2 MIOMBO WOODLAND ZONE

Country (with area in square kilometres)	*Land-Use Trends*	*Cheetah Range*	*Protected Areas*	*Estimate of Cheetah Numbers*	*Remarks*
Angola (1, 247, 000)	Agriculture little problem to wildlife except in so-called parks	100, 000 km² at most, in south	Extensive network, but probably ineffective	500, range 200-1000; could fall to half present total by 1980	Severe poaching in the past; new situation not yet stabilised
Zambia (753, 000)	Pressure on alluvial floodplains and dambos, but miombo woodlands little affected	Virtually entire country, though concentrated in floodplains and along dambos	Parks total 60, 000 km², but fair numbers of cheetah only very locally	800, range 500-2000; below 800 by 1980	Little poaching
Mozambique (778, 000)	Agriculture exerts little pressure	Three discreet areas, totalling 75, 000 km² at most	Gorongosa Park contains no cheetah	200, range 100-300; could be all but eliminated by 1980	Extensive poaching in the past; new situation uncertain.
Malawi (118, 000)	Only the mountain chain (about one quarter of country) undisturbed	2600 km², all in parks; formerly much wider distribution	Kasungu and Nyika Parks contain cheetah	50, little change anticipated by 1980	Poaching traditional, now being curbed
Summary for Miombo Woodland Zone:			1500 cheetah, within range 800-3300; could fall well below 1000 by 1980.		

woodlands is so largely dependent on complementary valley systems (Metzke 1971). A community of 50,000 people living in a floodplain might cause direct disturbance through cultivation to well under 50,000 hectares in any one year, supposing a field is abandoned every five years. During a period of 25 years, they might cultivate as little as 2%, of the total ecosystem centred on the valley water-courses. But their activities would be none the less disruptive if the river systems include extensive networks of tributaries, such as are often to be found in hilly miombo. No matter how small the streams, each possesses a zone of lush vegetation which contrasts with the uniform woodland of the interfluves. It is this interspersion and diversification of vegetation types in the valleys which is responsible for and supports an array of wild herbivores. Destruction of the former leads directly to the decline of the latter and so is likely to have an adverse effect on the already sparse cheetah population of miombo woodlands.

Angola

Appreciable areas of Angola could remain little changed for some time* and more good wildlife habitat could still exist in ten or fifteen years time than in most parts of sub-Sahara Africa, though this should not be taken to mean that it will necessarily support large stocks of animals. Much of the inland plateau, covering at least three-fifths of the country, lies in the miombo biome. In the north there is a belt of savannah and a few patches of rainforest, while in the south-west an arid zone extends to the border with S.W. Africa and is part of the Kalahari sands system.

Outside parks and reserves, mammals have been severely depleted in many areas. This may sound unlikely in so large a country with such sparse human populations. But Huntley (1973) stated that in 130,000 km of travelling he saw hardly anything beyond a few dikdik, impala and klipspringer. As a measure of the intensity of poaching at that time, an amnesty in a single locality produced 6,500 hides of various animals, 180 leopard and cheetah skins, 242 elephant tusks and 126 rhino horns (exclusive of what been shot by military personnel).

A few cheetah exist in the south, in the limited range of wooded savannah near the border, although over-grazing has led to erosion and widespread bush encroachment, making the habitat increasingly unsuitable. A few cheetah also live in the miombo belt, but as elsewhere in this biome are infrequent. One of the troubles has been the cheetah's exceptional vulnerability to motorised hunters. All in all, it would be surprising if Angola now contains as many as 1,000 cheetah. Indeed Huntley (pers. comm., 1973), puts the number at certainly under 500, probably less than 200. He believes the species will disappear everywhere except in strictly controlled reserves within the next two decades.† Huntley's figure may seem low considering

* It proved impossible to visit Angola during the survey. Much information was provided and collected by a locally resident wildlife ecologist, B. J. Huntley, but this of course preceded the recent major political developments. It is hoped, nevertheless, that the data provided here will be of baseline value and also assist the incoming government to establish a sound policy.

† Fortunately there is less immediate competition from livestock interests than in any of the countries of the southern third of Africa. This situation will not last, however, since the development of the cattle industry is sure to be an early objective of the new Government.

the amount of suitable cheetah habitat available, but his general findings are supported by every observer consulted. For the moment his upper limit of 500 can be accepted with a strong probability that it may well have fallen by half as a result of various developments by 1980. Finally, it is worth noting that despite the fact that in the past the cheetah was nominally protected, with a minimum fine for contravention of the regulations equivalent to U.S. $330, there were only 34 game rangers in the whole of this huge country and the network of parks and reserves, though impressive on paper and still featuring provisionally in the UN List, was largely ineffective. It is to be hoped that in view of Angola's great potential in relation to the development and management of wildlife resources, the new Government will give urgent attention to policy in this field as soon as reasonably settled conditions are established.

Zambia

Zambia lies entirely within the miombo biome, except that mopane* patches occupy moderately extensive areas bordering the Zambezi and the Luangwa valleys. Cheetah are probably still widespread but distinctly uncommon. They are likely to become very rare if not extinct over much of the country in the medium-term future.

Ansell's records up to 1960 suggested the principal foci of cheetah to be in the Luangwa Valley and Kafue Parks, with a more scattered population along the Angola border. By and large this still obtains, though totals have declined in many areas, especially where prey has been grossly reduced or where the habitat has been occupied by human communities. Ten years ago, cheetah were easily seen in the Kafue Flats, but now they are thought to have disappeared completely despite an abundance of lechwe, oribi, guineafowl and other suitable prey. The cause of this is probably a combination of poaching, human disturbance of the habitat, and lack of the right prey at the right time of year. This process could be repeated throughout much of the country during the next decade or so, as people extend their search for arable land. The impacts are likely to remain localised for some years yet, but the pressure is certain to be directed at the fertile alluvial flats in floodplains. If these are largely given over to human occupation by 1980, as is possible, the great proportion of good cheetah habitat in Zambia will have been eliminated.

The low or very low density of cheetah in miombo applies particularly to sectors where the trees grow so close together as seriously to impede a cursorial style of hunting. For similar reasons populations of the cheetah's preferred prey species tend to be poor, and this is aggravated when the medium-sized antelopes concerned are expelled from the dambos, on which they emerge to graze at night and largely depend, by increasing human occupation. The cheetah could soon find itself with so few suitable prey creatures that its own numbers fall, perhaps to a level at which breeding relationships can no longer be readily formed. This sequence of events is likely to operate adversely to cheetah populations over much of Zambia's woodlands in the next decade or two.

Despite its exceptional size, the Zambian network of protected areas is unlikely to be particularly helpful in securing the cheetah's future. The animal is rarely seen in the 22,400 km^2 of the Kafue Park and is not so regularly

* Mopane woodland features sweeter grass than miombo, so supports larger number of wild herbivores and possibly greater densities of predators.

sighted in the Luangwa Valley as ten years ago. The Isangano Park contains suitable grassland, as does Liuwa Plain Park, while Kasanka Park features some floodplain flats, but all three contain few cheetah.

An estimate, however provisional, of cheetah numbers in Zambia is more difficult than for many African countries since the species is not confined to small discrete localities. It is none the less concentrated on more favourable ground, such as floodplains and dambos and these biotopes could be reasonably estimated to cover 15% of the country (Republic of Zambia, 1971), though at least one-third are so heavily occupied by agriculturists that the cheetah has virtually disappeared. This works out at 40,000 km^2 of moderate to good cheetah habitat, though subject to some human disturbance almost everywhere outside the protected areas. At a density half that of seemingly optimum habitats elsewhere, such as the Serengeti, this implies 300 cheetah. If the cheetahs scattered through the much more extensive woodlands are put at another 500, Zambia's total would therefore be around 800.

In a country of such extensive and not very well documented wildlands these figures are subject to severe reservations. Compared with Angola and Mozambique, the range of a plausible estimate could be much wider, say from 500 to 2,000. It is inconceivable that the total could be higher than 2,000, given the spread of human occupancy and activities during the past five years. Wherever this has occurred, as in the Kafue Flats and the Benguela Swamps (Bell & Grimsdell 1973), a significant decline in wildlife has been noted. More crucial still for the cheetah's status, these trends seem bound to continue. If so, total numbers in Zambia will surely drop below 800 by 1980, whether or not they come anywhere near the upper figure of 2,000 at the present time.

Mozambique

Almost half of Mozambique is low-lying coastal plain, while four-fifths is covered with miombo woodland. Large parts will probably feature low human densities with only marginal modification of natural environments for at least the remainder of the present decade.*

The cheetah's status in Mozambique is poor and deteriorating, although at least in the present century, it has probably never been widespread or numerous. It is now confined to three localities: south of the Zambezi River extending westwards from Cabora Bassa; astride the River Pompue as far as the headwaters of the River Pungue to the west of Gorongoza Park; and from the River Save in a narrow strip as far south as the River Sangutane. Altogether these amount to 70,000 km^2. The Rift Valley extension from the Lake Malawi trough, petering out through Mozambique into the Indian Ocean near Beira (the Gorongoza Park lies in this sector), could once have contained cheetah, though it certainly does not now.

Cheetah have been heavily poached in Mozambique. Numbers were also no doubt taken by sportsmen, being more easily located than leopard and serving to console the disappointed hunter who fails to bag the latter. Yet, not only could the cheetah not be hunted legally, but its skin could not be exported

* Similar considerations apply to the information on Mozambique as to that on Angola, in particular the fact that it was gathered together on a rather circumscribed visit to the country and through the good offices of K. L. Tinley, then government wildlife ecologist, well before the recent political changes. Again, it is hoped that the data will nevertheless be useful to the country's new independent government in formulating a more effective wildlife policy.

(though customs officials inspecting a visitor's baggage might be incapable of distinguishing cheetah from leopard). Until recently, the Portuguese soldier was probably a frequent culprit, being only too ready to supplement his severence pay at the end of a tour of duty by selling a spotted skin or two in Lisbon.

Due to these pressures, cheetah density probably does not exceed 1 to 250 km^2, which would work out at a total of under 300 cheetah for the whole country. Even this figure was thought to be too high by every authority consulted: the more usual estimate was 100-200. For purposes of this report, I propose to accept the figure of 200. Certainly the various adverse factors will exert progressive pressure, particularly in such areas as Cabora Bassa with its huge development project. A not unduly pessimistic conclusion suggests that the cheetah could be reduced to critically low levels in Mozambique by the end of the current decade.

Malawi

Malawi, which only partially comes within the miombo zone, was one of the smallest countries considered in the survey, with a rural population as high as that of almost any equivalent area in sub-Saharan Africa. A good part of the country is mountainous, enhancing the pressures on cultivable lowland and thereby on any remaining habitats suited to the cheetah's needs. The species has not in fact been recorded south of Dedza for the past 50 years (Hayes, pers. comm., 1972). This is somewhat surprising, since in the extreme south, around Masanji, dry open bush country occurs, which could be considered suitable habitat and which, until very recently, due to the harsh environment, has been sparsely populated.

In most of Malawi, cheetah have always been rare or very rare. They disappeared from the environs of Lilongwe, Kota Kota and the rest of the central sector before World War II. For some time now they have been confined to Kasungu and Nyika Parks, with possibly no more than 50 individuals altogether. Kasungu's 2,050 km^2 features two large prides of lion and plenty of hyena, which probably limits cheetah numbers. But the population could be considered moderately secure, since it probably links up with those of the Luangwa Valley in Zambia. In Nyika Park cheetah are almost certainly not confined to the plateau, conventional accounts to the contrary, though their range is still far too small to allow any expansion in numbers. Total cheetah habitat in Malawi totals 2,600 km^2 at most, which, on the basis of favourable stocking rates, supports the estimate of only 50 animals.

Poaching in Malawi has tended to enjoy the status of 'traditional enterprise', and cheetah, like leopard, have been moderately affected. Unlike leopard, however, cheetah have not been numerous enough for decades to make systematic hunting worthwhile.

(c) SOUTHERN AFRICA (see Fig. 1 and Table 3)

This region comprises Botswana, Rhodesia, S.W. Africa and South Africa, an area the size of Western Europe, much of it ranchland savannah and often still supporting satisfactory wildlife numbers. Although the livestock industry is undergoing modernization and intensification, wildlife could be safeguarded through rigorous reassessment of its values. Rhodesia and South Africa represent the approach which has usually insisted that there is only one solution to 'farming in a zoo', viz. eliminate the wildlife. Botswana and S.W. Africa, being less developed, afford an opportunity for a different strategy.

TABLE 3 SOUTHERN AFRICA

Country (with area in square kilometres)	Land-Use Trends	Cheetah Range	Protected Areas	Estimate of Cheetah Numbers	Remarks
Botswana (601, 000)	Big-scale livestock raising accentuates natural desiccation and encourages spread of bush	At least two-thirds of the country	115, 000 square kilometres; 500-1000 cheetah	2000, range 1000-3000; some reduction by 1980 due to bush encroachment	Little poaching
Rhodesia (391, 000)	Intensifying methods and narrowing profit margins in livestock industry aggravate antagonism towards wild predators	Largely reduced in the low veld & protected areas; formerly extended over most of the country	Only Wankie and Gonarezhou Parks contain substantial populations, estimated at 140; but Matetsi bloc perhaps has another 60	400, range 250-500; will probably fall to 200 by 1980 when confined to protected areas	Ranchers increasingly disposing of cheetah, whether actual marauders of livestock or not
S.W. Africa (824, 000)	Intensifying methods and narrowing profit margins in livestock industry aggravate antagonism towards wild predators	110, 000 square kilometres of ranchland north of Windhoek, also Gobabis area & Etosha Park; formerly occupied area twice as large	Etosha Park contains a few dozen cheetah; Namib Park too arid	1500, range 1000-3000 could be reduced below 1000 by 1980	Quota of 130 live spotted cats (made up almost entirely of cheetah) available for export annually. Total drain, including fur trade demands, could be as high as 500
South Africa (1, 221, 000)	Intensifying methods and narrowing profit margins in livestock industry aggravate antagonism towards wild predators	Parts of Eastern Transvaal lowveld, northern sector of Cape Province, Zululand Reserves; former range reduced by 90%	Kruger Park contains 250, Kalahari Gemsbok Park 150, Zululand Reserves 100	700, range 600-800; could well fall to 500 or less by 1980	Cheetah still (early 1974) considered vermin

Summary for Southern Africa: 4600 cheetah, within range 2850-7300; could be reduced to 3000-3500 by 1980.

This divergence is all the more important in that Botswana contains more wildlife than almost any other country south of the equator, while S.W. Africa harbours substantial numbers of cheetah in its ranchland savannahs.

Botswana

The western parts of Botswana receive around twelve inches of rain, the eastern around nineteen. The central two-thirds are largely waterless, and support only minimal human populations. The Okavango Delta in the north is much better watered, but as yet little developed.

Three-quarters of the country's exports are made up of livestock and livestock products (Richter 1969), and it will remain dependent on livestock for many years to come. Management of most of the 1½ million head of cattle is still very poor (Thomson 1971), causing extensive veld deterioration (Jarman & Butler 1971). This is indicated by decline of perennial grassland in favour of scrub savannah, lowered water tables, disappearance of natural springs (Paris 1970), and streams petering out in the dry season but giving rise to flash floods during the rains (Campbell & Child 1971). In several areas, modification of biotopes just in the past few years has occurred 'on an alarming scale', leading at times to 'the almost total disappearance of wildlife' (Smithers 1971). Some habitats are characterized by bare ground, totally devoid of living vegetation, and 'mopane browsed clear to the height reached by goats. At walking height the untouched vegetation obscures the view, yet by bending down below the graze-line one can see several hundred yards in any direction' (Smithers 1971). The overall deterioration could in part be due to climatic trends, but this is unlikely in areas where bush growth has been spreading rapidly in apparent response to heavy over-utilization in recent decades.

The impoverishment of a delicate environment affects communities of wild grazers, which have been stimulated to eruptive peaks in the degraded grasslands following the expansion of livestock herds. Early travellers along the Nosob River on Botswana's south-western border speak of throngs of impala but few springbok. Now the situation is reversed; springbok numbers reached such a high level following World War II that they engaged in massive migrations, in possible contrast to their former habits (Child & le Riche 1969). But it now looks as if wildlife and livestock alike are existing on borrowed time.

The past ten years have seen the launching of a borehole programme in the semi-desert regions. This process will probably continue at an increasing rate, allowing cattle into marginal habitats where unregulated exploitation can quickly exert far-reaching effects (Parris 1971). The trends can readily be seen in the one-quarter of Botswana which has recently suffered a spread of bush growth (Strang 1973), especially typical of land on which white settlers have had the capital and technology to impose their will. In the medium-term future, there is no doubt that more African cattle-owners will also acquire the means to open up new areas for grazing—probably with similar results. While Botswana conceivably contains as many wild animals at present as the whole of the rest of the region dealt with in this section, there is therefore a strong probability that the numbers will markedly diminish. The main point of interest for our survey is, of course, whether the cheetah will decline any more rapidly than other major species.

Cheetah are reputed to exist in much of Botswana. The Kalahari, which covers at least two-thirds of the country, should provide suitable habitat except in places where bush growth has become too dense and cancelled out

the advantages of the semi-arid environment* Nevertheless, the cheetah is nowhere more than sparsely distributed. The eastern sector from the Nata River and the northern parts of the Tati Concession, south to near Debeeti, now contain none, though some are still found in the extreme eastern extension of the Bamangwato Reserve in the Tuli Circle area and northern Tuli Block farms. From Debeeti south to the Baralong farms and in the east of the Bakwena and Bangwaketse Reserves, cheetah have been eliminated completely or have never existed (Smithers 1971).

The cheetah is protected under the Conserved Animal legislation of 1968, which strictly limits hunting or capture. Before this, tribesmen killed around 50 cheetah a year in defence of livestock; in the next four years the number dropped to 7. Perhaps because of a decline of suitable wild prey, cheetah are alleged to account for more depredations on livestock than leopard. At present, a moderate number of cheetah skins, put by officials at 20, leaves the country illegally each year. The number is almost certainly small enough to cause little trouble and the most serious threat undoubtedly lies in habitat changes. These are affecting large areas and seem likely to persist, resulting in a considerable reduction of the cheetah's range in the medium if not short term.

The spotted-skin trade has had little influence on the situation during the past 15 years. The Ngamiland Trading Company, the largest skin dealers in the 1960s, handled only 30 cheetah skins in 1968 (compared with 300 leopard skins); prices offered were around one-fifth that offered for average leopard skins. Botswana Game Industries and other traders also confirm that there has never been much of a market for cheetah skins. Despite frequent enquiries in the countryside, I could not find a single cheetah skin on sale or anyone interested in supplying one if I was prepared to wait.

It is unusually difficult to arrive at a reasonable estimate of cheetah numbers in Botswana, given its huge size and the lack of detailed studies. The figure proposed here is an exceedingly rough approximation, aimed at disposing of suggestions that Botswana contains 'tens of thousands of cheetah' or 'virtually none' (both assessments are often quoted). Something like two-thirds of the country constitute possible cheetah habitat, including the sectors of the arid zone not undergoing bush invasion and the Okavango delta region in the north-west (this is not one big marsh but well-watered savannah). The third comprised of arid habitats totals around 170,000 km^2 and perhaps averages one cheetah to 250 km^2 (Smithers's distribution map (1971) suggests a density well below that of the better-watered though more bushy northern sector). The maximum number of cheetah which these rough-and -ready figures indicate would approach 700.

The north and north-west, while not such open country as the Kalahari, nevertheless supports higher prey populations. If this is indeed a factor in determining cheetah numbers, the region might well carry one cheetah to every 150 km^2 in perhaps two-thirds of the region, adding up to a further 800 cheetah. Finally, the 180,000 km^2 of generally much thicker bush cover, which also includes most of the European ranching country under more intensive development, could perhaps support as many as 500 cheetah, though Smithers found that cheetah are sparse at best in these environments.

* Much of the official information on cheetah in Botswans came from A. C. Campbell, Acting Chief Game Warden in mid-1972, and Dr. W. von Richter, F.A.O. Ecologist, who has worked on a survey of carnivores in Southern Africa (Richter 1972).

The overall total would thus amount to around 2,000, though such a figure inclines towards the optimistic. It is difficult to see how numbers could possibly reach 3,000. Conversely, they could hardly total less than 1,000. Either way they tend to confirm that the known level of exploitation for the skin trade in the 1960s could have made little difference.

16% of Botswana has been, or is in the process of being, set aside as national parks and game reserves (Campbell 1973). The standard of management of these areas should eventually satisfy international criteria for national parks, except for the portion of the central Kalahari destined as a wildlife utilization project for Bushmen. Several of the designated areas exceed 12,000 km^2, but probably do not constitute self-contained ecological units. Nevertheless, the total of about 115,000 km^2 to be protected through park or reserve status, is a substantial proportion of national territory and means not only freedom from poaching (though this will be difficult to control over such large areas) but more importantly exclusion from agricultural development. If all goes well the protected areas alone could support well over 500 cheetah, perhaps as many as 1,000.

Rhodesia

The Rhodesian situation is of importance for this survey as an example of the influence of rather intensive agricultural development in largely savannah country. Under upgraded methods of ranching, many parts of Rhodesia now carry more head of cattle.* This change has contributed to increasing conflict between stock-owners and wild predators. The advent of poisoning campaigns could trigger off a sharp depletion of predator numbers. In addition there are moves toward allocating additional state land both to white settlers and African tribal communities. The general opinion is that as a result of these trends the next ten years will see a marked decline of larger wildlife species and notably the predators.

Cheetah were once well distributed in Rhodesia (Dorst & Dandelot 1970; Smithers 1966). Now they are virtually eliminated from the high veld, though seen fairly regularly as recently as 1969 at Norton and Hartley 50 miles west of Salisbury. Largely limited therefore to the less settled areas in the west and south, they are also steadily disappearing from the low veld as it becomes more developed. A few cheetah are still to be found in the Chizarira Game Reserve south-east of Lake Kariba, but, in the view of the Wildlife Research Officer there, its tall grass biotopes are only marginally suitable for the species. A few more survive in the eastern ranches of the Zambezi Valley and Mashonaland, but their prospects are precarious. Less than 5 years ago, occasional cheetah were seen south of the Rhodes Matopos Park near Bulawayo, and others in the vicinity of Figtree and just south of Kezi near the Botswana border (Wilson 1969). But by 1972, none had been seen in these localities for at least two years, except for sporadic sightings in Rhodes Matopos Park itself and in nearby parts of the Tuli Controlled Area (Grobler, pers. comm., 1972).

Of over 40 ranchers in different parts of Rhodesia who kindly contributed information, almost all insisted that cheetah numbers on their land had appeared to increase in recent years. This could be because cheetah have immigrated from more densely settled land elsewhere, or merely reflect the

* The 5,120 km^2 Liebig's Range, for example, increased its holding from 35,000 to 55,000 head in ten years.

fact that more livestock losses now come to light with better kept records of domestic herds. Thus Liebig's Ranch lost 3 head of stock to cheetah in 1970, 3 in 1971, and 13 in 1972; another rancher, also in the West Nicholson lowveld of the south-west, stated that in twenty years he had lost only an occasional beast to cheetah until 2 calves were taken in 1969, 6 in 1970, 8 in 1971 and 14 in the first seven months of 1972. The Liebig's manager was emphatic that cheetah have not only increased in the past few years but have extended their range to cover almost the entire property. Several other West Nicholson ranchers asserted the same, and in fact the farming community is agitating to have cheetah removed from the protected list in order to allow ranchers to despatch them without formality.*

The fact is that ranchers are already taking the matter into their own hands. Twenty-eight ranchers admitted that they had shot cheetah during the past two or three years, without mentioning the incident to the authorities. This seems to have become common practice wherever cheetah are found in ranchland. Not only are troublesome individuals eliminated, but any cheetah sighted is likely to receive the same treatment if the farmer believes he is justified in taking such measures to reduce increasing livestock losses. It is quite probable that since 1970, as many as 100 cheetah a year have been thus destroyed in the low veld. The number is now reported to be declining, but perhaps only because fewer cheetah remain. Ranchers protest that they have little alternative to shooting cheetah without going through lengthy formalities for permission to destroy a marauder.

As a result of the situation,† it is widely believed that cheetah will soon be mainly confined to the Wankie and Gonarezhou Parks. Unfortunately the hinterland of Gonarezhou is now scheduled for big-scale irrigation and other intensive farming projects. This will inevitably lead to the progressive erosion of wildlife in one of the finest remaining natural areas of the country. All that would be left would be a small, 1, 500 km^2, sanctuary for cheetah in the most favourable part of its present range.

The other cheetah refuge referred to, namely the 14, 430 km^2 Wankie National Park, by far the largest protected area in Rhodesia, will eventually form part of the Matetsi/Chobe Park/Victoria Falls Park/Wankie Park complex astride the Rhodesia/Botswana border, a conservation bloc of around 30, 000 km^2 altogether. A large part of Matetsi contains cheetah, and the population could

* The cheetah is fully protected in Rhodesia, but an individual may be killed if the loss of a domestic animal can be attributed to it and is authenticated by the wildlife authorities. This system leaves open far too much scope for abuse, not least, as one dealer reported, because the high price (up to U.S. $200) that can be demanded for a live cheetah cub (quite illegally) is a strong incentive to pick on a mother with cubs as the culprit if a calf or sheep is predated.

† As outlined here, it was corroborated by most of the experts consulted. It is only fair to add that Wildlife and Conservation Department officials in Salisbury dissented: they discounted many of the reports, maintaining that the cheetah's situation and prospects in the ranchlands were generally better than before. One piece of evidence adduced was based on skin export figures: only 10 cheetah skins were legally exported between 1968 and 1972, compared with 301 leopard kins. Against this, however, must be weighed the fact that in June-August 1972, during the survey, 34 cheetah skins said to have been purchased from Rhodesia, but lacking documentation so presumably illegally, were noted in the premises of fur-dealers in the southern African region.

increase as the area receives better protection. Wankie itself, according to preliminary data compiled by a member of the Wankie Research Unit, J. L. Rushworth, has plenty of suitable prey available and an estimated 60 cheetah The population is possibly increasing, since impala, at present mainly confined to 2, 300 km^2 at the northern end of the park, are steadily spreading along the eastern boundary and the cheetah is following suit. There are also limited numbers of cheetah in the south of the park, but in the Kalahari sands habitat, covering half the total area, hardly any are to be found, possibly because of the small population of prey species in this almost waterless zone.

The Wankie cheetahs could build up to 100 or more, so that with perhaps 60 cheetah in the 3, 800 km^2 Matetsi range, the whole area would afford protection to a fair-sized population for some time to come, always assuming it remains secure from competitive land-use pressures. A rough estimate of a further 40 cheetah in Gonarezhou Park brings the present total for the two areas to 200. Other parts of the country, notably the lowveld, probably make up a further 200, though the number could conceivably be as high as 300. But as already mentioned the prospects are that the latter will be brought virtually to zero within a few years, following what has already happened in the highveld and in South Africa and the hardening attitudes towards cheetah held by the modern livestock industry.

For purposes of the survey the country's total is therefore put at only 400, with a probable fall to 200 by 1980.

S.W. Africa (Namibia)

With only two-thirds of a million people, half of them in the northern one-tenth of the country, much of South-West Africa is desert (the Namib) or semi-desert (the Kalahari). Most of the rest is too arid for anything but low-density stock raising, or pastoralism in predominantly African areas of the north. The Kaokoveld in the north-east is so dry that it contains only 5, 000 wild herbivores at most, though livestock holdings are seasonally considerable. Ovamboland, in the north-central sector, has been so over-grazed that wildlife has been virtually eliminated, except in the Etosha Park area which contains moderate numbers of zebra and other herbivores. Okavango and Grootfontein B Districts, north of the Kaokoveld and extending eastwards into the Caprivi Strip, receive more rainfall than the rest of the country and support lush vegetation, but the human population is too dense to allow much wildlife.

Outside these areas most of the land is occupied by European-run ranches, many of them over 70 km^2 in extent, some twice as large or more. In a region where drought is the rule rather than the exception, a large number of farms are left unoccupied. This means the government is in the fortunate position of being able to buy back considerable areas as *de jure* if not *de facto* game reserves. The ranchland totals approximately 10, 500 km^2, mostly on the south-eastern fringe of the Namib desert and along the southern border. Parks, game reserves and other government land total 24% of the country, much of it in savannah or semi-arid zones. This is important for the cheetah, since these open environments should provide something approaching optimum habitat provided prey numbers are maintained. S.W. Africa could thus support reservoirs of wildlife of considerable proportions, persisting well into the future, taking into account the low levels of population pressure and development.

Cheetah used to be widely distributed (Shortridge 1934). Now they are much more restricted, their range having been cut by at least one half. They used

to be well established in the Caprivi strip, the highlands of Damaraland and western parts of Namaqualand, also around the Orange River, but are now rare in all these areas. They are only thinly scattered in the Kaokoveld (Owen-Smith 1971), while the coastal strip of the Namib desert has always been too poorly stocked with prey to support many predators. Cheetah are still plentiful in the eastern sand-veld, notably around Gobabis towards the Botswana border.

Elsewhere, the main cheetah stronghold is the ranching country north of Windhoek. This extends north from 24°S. and is more heavily bushed than the southern grassland where, however, the open habitat has allowed cheetah to be more easily shot out and has experienced heavier hunting over a longer period. In addition, jackal-proof fences have been built to protect Karakul lambs, and likewise exclude cheetah. In fact, farmers in the south have long considered their area a predator-free zone, having eliminated lion, hyena, wild dog, jackal and (so far as they are able) leopard.* Cheetah are now seen very rarely in this region.

The more bushy environments to the north support not only fair numbers of livestock, but at least 40,000 greater kudu, providing a modicum of calf prey for cheetah in what is theoretically a less favourable habitat. As a result, at least 110,000 km² are still moderately good, which means that S.W. Africa supports, by comparison with other parts of savannah Africa except Botswana, exceptional numbers of cheetah.

During the past few years, more prominence has been given to cheetah on the northern ranches. This may be in part because of allegedly increased depredations on livestock, possibly more noticeable at times of diminishing profit margins.† There is also the possibility that numbers have risen as a result of intensive trapping compaigns against hyenas and jackals, both of which prey on cheetah cubs. Whether or not the situation warrants a predator control programme of the present dimensions§ has yet to be established. Prior to the recent trend toward live-capture, a farmer finding a cheetah raiding his livestock killed the animal in the knowledge that he would be lucky to receive the equivalent of U.S. $50 for the skin. For a live-caught female he can now expect about U.S. $270, and for a male U.S. $140.

This new factor of 'live-export' of cheetah undoubtedly imposes a considerable drain. The Department of Nature Conservation allows an export of 130 live spotted cats each year, but no details are available of the methods used for determining the quota except that it was established 'on the basis of best information available at the time.' The system is obviously open to abuse. Every livestock loss is supposed to be investigated, but, according to my information, this is done in only about half the instances. Since there is no restriction on sales, only on export, captures can soon reduce the total number

* Neither cheetah nor leopard have hitherto received any official protection, being treated as 'vermin'. However, protective legislation was proposed at the end of 1973, although its enactment has not yet been confirmed.

† As an authentic measure of losses sustained the case of a 18,500 km² ranch north of Windhoek, carrying 2,300 head of cattle, can be quoted: in 1971, it lost 43 calves valued at about U.S. $550.

§ Their hostility to wild predators was demonstrated during the second half of the 1960s by the dumping of poisoned meat in the Namib Naional Park to dispose of the few predators surviving there.

of cheetah over an extensive area.* On a 200 km² ranch near Omaruru 20 cheetah were trapped recently within a short space of time: this would represent an unusually high density of cheetah anywhere, let alone in a habitat where conditions are far from optimal. It seems likely that some of those captured were temporary visitors to the ranch, especially as, at the end of the operation, the farmer found himself with a good number of cheetah still on his property.†

Another weakness of the quota system is that it seems very uncertain whether the figure of 130 is strictly observed. Thus one official told me that cheetah exported to South Africa do not fall within the quota, since S.W. Africa is administered as a province of the Republic (no customs checks exist on the border, so in any case cheetah could be taken out freely). But another official seemed certain that exports to South Africa do fall within the quota. The two commercial firms exporting cheetah also disagree with one another in exactly the same way. What does seem clear is that, in the past few years, almost 100 cheetah have been sent to Natal, 36 to Kruger National Park, and at least 50 to game farms, safari parks and similar establishments in South Africa. In addition, 36 cheetah were released in Etosha Park, in 1971 alone, and others have been disposed of to game farms within S.W. Africa itself. If, as seems probable, a further 130§ cheetah per year have been exported elsewhere, it looks as if at least a thousand, perhaps more, cheetah must have been captured for commercial sale during the years 1965-72.

In the view of some observers, the present traffic in wild-caught cheetah could bring its existence in the ranchlands to an end by 1980. Many farmers would no doubt consider this as the aim of the whole operation. In the meantime, the market for so-called 'farm-caught' cheetah is exceedingly attractive and, more serious, the demand for live cheetah is growing in Europe and the North America at a time when the stocks in S.W. Africa are surely dwindling. Within a few years, demand could easily exceed supply and there would then be inducement for dealers to seek live cheetah from other countries, where the populations are smaller and more sharply declining.

The Delfs organisation, one of the two animal exporters in S.W.Africa, is certain the world market could absorb at least 500 live cheetah annually from

* Unfortunately S.W. Africa was the only one of the 38 countries approached which witheld official recognition of the Survey. This denied the Survey the benefit of the quite exceptional experience that must have been gained by the authorities through supervision of the live-capture trade. An investigation into the status of all wild felids in the country is now being undertaken, but no information has been released of the date for its completion or publication.

† As an indication of the financial return available, Mr.A. T. Port of Valencia Ranch (22,000 hectares) live-trapped 154 cheetah during the period 1954-72, also 186 leopard. In 1971, he lost 102 sheep and 60-70 calves, at approximately U.S. $13 each worth about U.S. $2,500. During the same year, he live-trapped 14 cheetah and 11 leopard. Had he sold the cheetah to commercial dealers (he prefers to release his captured cats in Etosha Park) he would have received approximately U.S. $2,800. Had he killed the leopard and sold the skins, he would have received, at an average rate of U.S. $250 per skin, U.S. $2,750. He could therefore have made a 'profit' of approximately U.S. $3,000 over his livestock loss.

§ The quota of 130 spotted cats is filled almost entirely with cheetah. For a variety of reasons, there is less overseas demand for leopard.

that country alone. A senior staff member believes the quota of 130 a year is much too low, and that many are shot in default of a market outlet. A live cheetah can be sold for the equivalent of U.S. $750 f.o.b. Although much more is paid to a rancher for a female than a male cheetah, there is no differentiation in the international market since, while the demand for females is far greater, the exporter has to keep males for a much longer time. In mid-1973, over 20 males had been in the Delfs compound for 18 months, incurring a considerable charge for food and other maintenance expenses. Many more males than females are caught, partly because traps are usually set near 'play trees' where males come to urinate and engage in other marking activities. Delfs uses female faeces to bait the trap. He believes that the sex disparity could be due in part to the possibility that females are more wary of traps and in part to the fact that female cheetah with cubs are more vulnerable to people who go out with packs of dogs to hunt them for sport.

The other organization engaged in the live-capture business, the Schulz enterprise, claims that there are more farmers than ever with 'cheetah to sell'. Schulz concludes that cheetah are therefore on the increase, rather than that they are becoming more prominent due to decline of wild prey populations or to the commercial incentive presented by the live-capture opportunity. Whereas Delfs finds that three-quarters of cheetah captured are males, and Port, who engages in live-capture activities on a non-profit basis, puts the figure at nine out of ten, Schulz thinks it is only as high as two out of three and is due to a marked disparity in sex numbers at birth, though he apparently has no data to substantiate this.

To arrive at a working figure for present cheetah totals in S.W. Africa, a figure of one cheetah to 150 km^2 is applied to the 110,000 km^2 of moderately suitable cheetah habitat in the northern ranchland sector.* This produces a figure of slightly less than 750 cheetah and if the rest of the country is reckoned to support another 750, the total could be about 1500.†

Allowing for natural mortality (possibly reduced by man's predation pressures), plus the occasions when dog packs worry a cheetah to death or ranchers do not want to be bothered with live-trapping and find a quicker solution in the gun, the figure of up to 130 cheetah exported live each year could represent a substantial off-take. Perhaps a further 100 per year would have to be added to cover casualties caused by live-capture operations and surplus and unwanted males killed for what their skin will fetch. There seems to be no doubt that the fur trade does contribute a further moderate off-take: Conversations with Windhoek dealers suggested a figure of 50 skins a year and another 50 skins in made up articles.

However, it is of course possible that the total population exceeds 1,500 although it is hard to believe that the figure could be as high as 3,000. Even so, if account is taken of all the factors mentioned, the existing export quota of 130 a year could well represent more than a sustainable yield. The annual

* The figure is based on discussion with Labuschagne, who has investigated cheetah ecology in similar environments, as well as with ranchers in S.W. Africa, and also from off-take figures for cheetah control programmes in the country over the past decade.

† Official estimates put the total at 500 cheetah, but this is clearly too low unless the export quota fixed for wild caught cheetah is admitted to be obviously bound, if maintained, to bring about the extinction of the species in the country.

increment of young cheetah represents a harvestable crop, but the size of that crop cannot be established with even moderate accuracy on the basis of existing knowledge of cheetah reproductive capacity, recruitment rates and population dynamics generally.

Since S.W. Africa is undoubtedly the main source of wild-caught cheetah and some hundreds must have been exported in recent years, it is pertinent to remark that a sufficient stock of mature cheetah should now be available in North America and Europe to determine whether future requirements can eventually be met through captive breeding. As long as wild-caught replacements are readily available, there is inadequate incentive for breeding research on the appropriate scale. At present most captive cheetah are 'wasted' on commercial display of numerous animals in a single compound, to ensure that the public gets its 'money's worth'. If the supply from Africa were cut off, replacement of stocks would have to depend on captive breeding programmes and a new supply and market equilibrium would eventually be established. There thus seems little valid reason for continuing, let alone extending, an export quota system which, in any case, with coming into full effect of the Washington Convention on Trade in Endangered Species of Wild Fauna and Flora, will die a natural death. Since S.W. Africa contains significant numbers of cheetah, almost certainly more than any other country of Africa with the exception of Botswana, a special responsibility rests on the authorities in the light of the present status and deteriorating prospects of the species in the continent as a whole. While a rancher anywhere should be at liberty to protect his legitimate interests, the control policies deserve rigorous scrutiny to ensure that those interests are not exceeded and that other long-term interests not only of the local community but also of the rest of Africa and the world, are equally safeguarded.

South Africa

With few wild predators outside parks and reserves, the importance of South Africa for this survey is that it provides a measure of trends which will overtake much of Africa well before the end of the century. It also constitutes by far the largest centre in the continent for the fur trade, the channel through which spotted skins from half a dozen countries make their way to international markets.

South African ranchers have long insisted that they could not 'farm in a zoo', and have tried to eliminate wild carnivores wherever they were to be found. Part of this destruction may have been necessary to safeguard legitimate agricultural interests, but much of it far surpassed what could be justified in terms of strict farming economics. The prevailing attitude has too often been that a wild predator is a creature which may, one day, attack somebody's cow, so that it is common sense to take the precaution of eliminating every predator one meets. Legislation is now under consideration to give the cheetah better protection, but no details are yet available.

The cheetah has never been very widespread or numerous in South Africa in the past (Roberts 1951; Stevenson-Hamilton 1947), although it probably once ranged over much of the eastern Transvaal lowveld (Pienaar 1963), parts of Natal and the northern sector of Cape Province. In 1966, cheetah were sighted near the Brak river in the Zoutpansberg region of the extreme northern Transvaal, but none have been reported since. Limited populations occur in the Timbavati, Sabie Sand and Groot Letaba Game Reserves and, at least till the late 1960s, some survived on big ranches throughout the eastern Transvaal lowveld, notably in Letaba and Pilgrim's Rest districts, as well as

Cheetahs are still to be found in the north-east, centre-east and west of Upper Volta, but less and less commonly. They are now regularly seen only in the north-east, where vegetation changes have been smallest. Trade in spotted cat skins is not great, though dealers from Europe sometimes find it worth their while to visit Ouagadougou in search of them. Few local traps seem capable of catching a large felid since they would have to be of more solid construction than those used for antelopes, but the hunter who finds a cheetah or leopard in his trap, is unlikely to release it considering the price he can get for a skin.*

Upper Volta may be an instance of an area in which poaching of wild herbivores, together with other adverse factors such as vegetational changes and increasing demand for land by human communities, could well impose limits on wildlife. The protein hunger in West Africa, now aggravated by a drought which has reduced the supplies of meat from domestic herds for probably several years to come, will exercise progressively more pressure on the dwindling numbers of wild ungulates. Cheetah will do well to last out the present decade, except possibly for occasional immigrants from the north.

The cheetah's range in Upper Volta is now restricted to patches along the northern border, apart from the four reserves in which a few apparently survived at least into the late 1960s. Even before the drought, total numbers must have been low, to judge by the few sightings, the poor prey stocks and the invasion of cheetah habitat by agriculture. But considerable numbers of pastoralists from the north have been forced to take refuge in the Sahel zone, greatly increasing the pressures on the land within the last few years. Whether any cheetah at all now remain in Upper Volta could be considered doubtful; at the risk of erring on the high side, the total is put at 100.

Niger

At least half the country is desert and another 40% within the semi-arid Sahel zone. A fringe of Sudano-Guinean savannah stretches along the southern border. During the 1960s there was much tree destruction throughout the drier regions, leading to erosion of the thin topsoil (Jones 1973). Dust storms, previously almost unknown, became a daily occurrence in many parts of the country by 1970. Around Agadès, at the southern foot of the Aïr massif, moderate tree cover existed as recently as 1964; now it is an almost treeless plain. To the west and south of the massif, the grassland is degraded (Jones 1973): valleys, such as those of the great Talak plains used to be moderately fertile in the wet season, but are now largely barren.

Wildlife is mainly concentrated in the Parc du W, shared with Upper Volta and Dahomey, and in isolated mountain tracts. The Aïr, smallest of the four major mountain ranges of the Sahara, although 400 kilometres north to south and 200 kilometres west to east, still features addax, scimitar-horned oryx, dorcas and dama gazelle, Barbary sheep, baboon, hyena and cheetah, though of these only the dorcas may be described as common (Jones 1973). Cheetah are reputedly also found near Agadès and in the environs of Lake Tchad, and a handful are still said to survive in the Parc du W (Poche, pers. comm., 1972). According to the Tuareg in 1972, cheetah were still 'common' in the remoter

* Legal hunting of all predators is permitted December—April, but figures for recent years indicate that scarcely half a dozen of both cheetah and leopard are taken, or at least reported. Until the mid-1960s, a bounty was paid for wild predators killed.

parts of the Erg du Ténéré, the vast waterless area of shifting dunes east of the Aïr (Swift, pers. comm., 1973). On the other hand, scimitar-horned oryx and dorcas gazelles are reduced to remnants. However, dorcas are still common elsewhere (Swift, pers. comm., 1973), notably south of the Ténéré in a tract of smaller dunes between rocky outcrops, and the dama gazelle is also still found throughout the area, especially around the edges of hills. Likewise Barbary sheep and baboons survive, both of which can serve as prey for cheetah. But of them all, only the dorcas remains really common locally. The Tuareg attribute the decline to a vast increase of hunting, largely by Europeans from desert-equipped vehicles, during the past five years.

One of the escorts of the overland lorries which now ply several times a year between London and Nairobi, reports that during the course of 12 trips he has seen cheetah near the desert 'piste' between Agadès and Tamanrasset in the Hoggar mountains of Algeria, as well as eastwards on the way from the Hoggar to Djanet and Libya. They have in fact been noted on both sides of the Niger/Algerian and Niger/Libyan borders, some in lowland country, others in the foothills of the mountains. Conceivably in these remote parts of the central Sahara there could be moderate numbers of cheetah surviving, provided they are unmolested by the nomads. But in Niger, as in Mali, the Tuareg are taking to killing the adults and catching cubs for sale to traders, on the grounds of growing attacks on domestic stock following the decline of wild prey species. Thus herdsmen in various areas, notably Kel Adrar, complain that cheetah take many goats and sheep, though these depredations may often be attributable to jackal. As for the wild herbivores on which the cheetah primarily depends, the nomads are reputed to kill no more than they can eat.

More people seemed to own tame cheetah in Niger than in any other African country I visited. One man at Arlit had three. When enquiring about spotted cat skins in Niamey, Maradi and other Niger towns, I was frequently asked if I would like a cheetah cub,—easily available without delay. By contrast, one poacher commented that cheetah populations had been so drastically reduced during the past few years that it was no longer worthwhile going to hunt them. As previously mentioned, there has been a progressive increase in hunting from vehicles since the mid-1960s. It is now practised on a 'huge scale' (Jones, pers. comm., 1972). This is especially true of the French miners in the Aïr, who are seriously depleting the populations of various species, notably addax and scimitar-horned oryx (Jones 1973). Illegal hunting is particularly prevalent in the extreme north (Jones 1973): near the Algerian border vehicle tracks are met frequently meandering from one bit of grassland to another, indicating that the driver has been looking for game.

Hunting of any sort is forbidden in Niger, but there are few enforcement resources. At Agadès, three wildlife rangers with one Land Rover and petrol for 1,000 kilometres per month are supposed to patrol an area of half a million km^2. As is often the case, they are poorly paid and open to corruption: they are discounted by the French mining communities in the Aïr mountains and in Agadès, which hunt more than ever and seem to think they can do so with impunity. Nor is illegal hunting unknown among the troops operating near the Algerian border and a few local officials. Even Algerian army units have been known to trespass from the north and return over the border with vehicles loaded with addax and gazelle carcasses plus a cheetah or two when they find one.

In Niamey I saw only eight cheetah skins (and a few dozen leopard skins). But I was shown scores of serval skins, without seeking them out, and repeatedly offered genet and even civet cat skins. The serval cat is reputed to have de-

TABLE 4 WEST AFRICA

Country (with area in square kilometres)	*Land-Use Trends*	*Cheetah Range*	*Protected Areas*	*Estimate of Cheetah Numbers*	*Remarks*
Mauritania (1, 210, 000)	Sahel zone severely desiccated and over-used.	? Those parts with sufficient vegetation to support domestic livestock, viz. 500, 000 square kilometres	—	300, range 100-500; may decline as result of desiccatory processes in environment	Not as badly hit by drought as other sectors of the Sahel; little illicit hunting by expatriates and officials
Mali (1, 240, 000)	Sahel zone impoverished, inducing pressure on woodlands	Mainly the Sahel, i.e. central one third of country	—	300 in Sahel, range 200-500, (could be others in desert); will decline to low levels by 1980 unless wild prey stocks recover	Recovery of prey stocks dependent on development patterns & assistance schemes for nomads. Will environmental over-loading be relieved temporarily or permanently?
Upper Volta (274, 000)	Sahel zone impoverished, inducing pressure on woodlands	Sahel sector in north	Four parks contain perhaps 50 cheetah	100, range 0-100; very doubtful if any will survive until 1980	The country is undergoind invasion by large numbers of nomads from the north, which will substantially increase pressure on the cheetah's range within a few years
Niger (1, 267, 000)	Sahel zone impoverished, inducing pressure on woodlands	Mainly Sahel zone, and Aïr mountains	Parc du W possibly contains a few cheetah	200, range 50-400; could decline to low levels by 1980 unless prey stocks recover	As for Mali; plus illegal hunting by expatriates and army officers
Tchad (1, 284, 000)	Sahel zone impoverished, inducing pressure on woodlands	Sahel zone, or one third of country (northern half is desert and remaining sixth in the South is woodland)	Ouadi Rimé-Ouadi Achim Reserve, 48, 900 km^2, should offer protection but still ineffective	400, range 250-500; could be virtually eliminated by 1980	As for Niger.
Cameroun (475, 000)	Some exploitation of forest; no pervasive pressures in north as yet	75, 000 square kilometres in north	Contain moderate numbers of cheetah	400, range 200-600; decline by 1980 less likely than in other parts of West Africa	Some poaching by Europeans from Tchad

Senegal, Nigeria and Central African Republic no longer contain cheetah totals of significance for this survey. No other country of West Africa is known to have had cheetah for at least 20 years, if ever.

Summary for West Africa: 1700 cheetah, within range 800-2600; could decline below 500 by 1980, due to physiobiotic degradation of the Sahel. This excludes the small numbers, perhaps a few hundred, which may still survive in the Sahara and which are therefore less subject to adverse consequences from human activities.

Central African Republic

As shown in Fig. 2 the whole country falls within the Sudano-Guinean woodland zone, except for small patches of rainforest in the south-west and of Sahel in the north-east corners.

Until 1960, wildlife stocks in the north and east were as big as anywhere in Central Africa. Since then, however, poaching has steadily increased, though wildlife is probably still comparatively abundant. The poachers come mainly from Tchad and the Sudan, but also include local residents at all levels of society. Poaching has already led to one game reserve being abandoned, the Nana Barya. Incursions from the north are made partly by simple meat-seeking nomads and partly by more sophisticated trophy-hunters. The drought in the Sahel undoubtedly accentuated the influx of the first-named category.

Cheetah populations in the C.A.R. have, from all accounts, never amounted to more than token figures, since habitats are almost all marginal except in the extreme north-eastern tip. In the light of the widespread degradation of Sahelian habitats in recent years the number of cheetah surviving could be from none at all to 100 or so, and for the purpose of this report can be ignored.

Cameroun

Most of the northern half of the country lies in the woodland savannah biome, merging into the Sahelian at its northernmost tip.

The view was expressed (Flizot, pers. comm., 1973), for the only time and in the only country visited during the entire survey, that cheetah numbers may not have declined appreciably during the past decade. This is partly because cheetah are often found in areas which enjoy protected status, and partly because the more arid areas it prefers have hitherto been in little demand for development in a country where extensive fertile and well-watered land is available (Corfield & Hamilton 1971). This situation could persist for another decade or more.

On the basis that potential habitats cover roughly 75,000 km² or one-sixth of the country, and that density could average a cheetah to every 125 km² (a low figure, since spasmodic poaching occurs and habitats at the southern limit of the known range are only marginally suitable) a total population figure in the region of 600 cheetah emerges. Discussion with local wildlife officials indicated this was almost certainly too high, though nobody would commit himself even to a rough guess at a more realistic estimate. For purposes of this report, I propose to adopt a figure of 400, which as previously stated could be maintained until 1980, at least, if illegal hunting is controlled.

Remainder of West Africa

Cheetah have not been known for at least 20 years, if ever, in Gambia, Guinea, Sierra Leone, Liberia, Ivory Coast, Ghana, Togo or Dahomey. A few are reported still to exist in Nigeria, in the Yankari Game Reserve and in a new reserve to the east of Yola near the Cameroun border, or wandering into the country from Niger in the north.

(e) NORTH-EASTERN AFRICA (see Fig. 3 and Table 5)

The region covers 4.3 million km², two and a half times as much as Western Europe. Almost 2 million km² are made up of desert or semi-desert, and another 700,000 comprise the Ethiopian Highlands. The rest is woodland savannah and, in southern Sudan, sudd. Much should be admirable country for

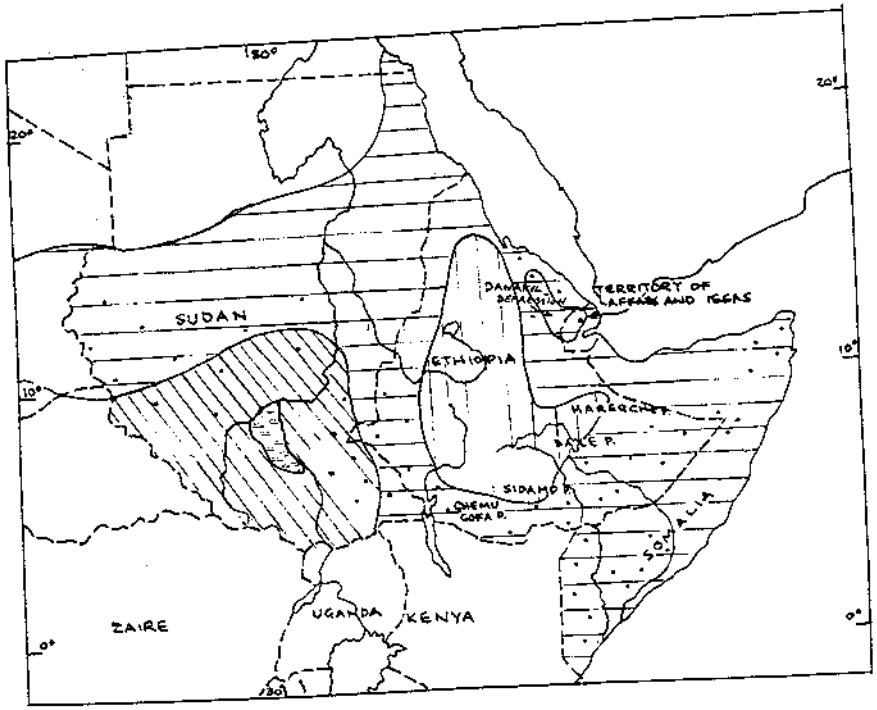

Fig. 3 Cheetah Distribution in North-Eastern Africa

Woodland zone : oblique hatching
'Sahel' savannah or arid steppe: horizontal hatching
Ethiopian highlands: vertical hatching
Wide-spaced stippling indicates the generally sparse character of the cheetah population in the region.

cheetah. In times past, large numbers probably ranged across at least three-quarters of the region. During the course of the present century, however, the arid territories of the Horn of Africa have undergone extensive over-exploitation and habitats are now thoroughly degraded, so much so that in some parts they no longer support even the small mammals and rodents on which leopard can subsist. In Sudan, the biomes south of the desert are under similar pressure to those of the Sahel and woodland zones in West Africa, resulting in reduced carrying capacity for livestock and wildlife alike.

Sudan

This is a country of 2½ million km² with a population of only 17 million people who none the less exert a considerable influence upon the environments.

About half Sudan lies in the Thirst Zone, if this is taken to include not only the desert but a strip of Sahel centred roughly on Khartoum's latitude of 16 °N. Throughout this Sahelian zone there are now permanent settlements, as a consequence of land shortage elsewhere, and the result has been a rapid de-

A Foreign Legion Officer who used to patrol the desert from Dakar in Senegal to Tindouf in Algeria, much of it included in what is now Mauritania, told me that cheetah were still occasionally found in parts of that sector as late as 1960. He had maintained contacts with the desert people since giving up his military career, and had the impression that wildlife was not in such severe straits as in countries to the east. Herbivores are still to be found in good numbers and the cheetah is far from unknown. These views are confirmed by Swift (pers. comm., 1973) who, on a trek across Mauritania in early 1973, heard that cheetah are still widespread in several regions, though rarely seen (which may be because they are scarce or because they are shy of man and his vehicles). A long-experienced hunter at Bir Moghrein in the north-west informed him that 'lots' of cheetah live in the gravel plains and dunes to the east, presumably in the northern part of the Majabat et Koubra, and he believed these reports to be reasonably reliable.

According to nomadic tribesmen, questioned in Mali, who had some experience of Mauritania, hunting is limited in that country to occasional killing of gazelles for food. The nomads are not bothered by wild predators, and do not bother them. Moreover, up till now there has been no appreciable slaughter of desert wildlife by mine employees, although if the extensive mineral resources begin to be exploited on a large scale, the situation could deteriorate in the way that has already caused such devastation in Niger.

Given that almost 40% of the country provides sufficient vegetation to support nomadic pastoralists, one could calculate that over 500,000 km^2 should be capable of supporting wildlife. If the biotas are tolerably undisturbed, it would not be unreasonable to suppose that they may contain several hundred cheetah. A guess, albeit pretty random, would put the number at not less than 100 though hardly more than 500 (the latter figure representing a density of 1 cheetah per 100 km^2 of suitable habitat). In keeping with the need to form working estimates, however approximate, of cheetah populations, a figure of 300 can be adopted.

Senegal

Senegal's northern one-third lies in the Sahel, the rest in the Sudano-Guinean woodland zone. Cheetah are classed as rare by everyone questioned and several asserted there were none. But in fact they are still seen from time to time in the reserves, some of them perhaps only transients from outside the country, but suggesting the possibility of at least a relict surviving. The decline of the species began at least 30 years ago and around 1950 extraordinary measures were promulgated for its protection. However, since then it has been seen ever more rarely, despite the fact that more travellers are penetrating into remote areas. Elderly tribesmen with whom I spoke confirmed its present rarity and agreed that it had enjoyed better times. Others believe it may never have been much more numerous, since Senegal is on the margin of its range. For purposes of the survey, the present population must be discounted.

Mali

The southern quarter of Mali, roughly south of 15 °N, lies in the Sudano-Guinean zone, the middle one third in the Sahelian; the rest is desert.

Until the drought set in about 1971, a fair amount of wildlife survived but there may well have been a drastic change under human pressures on the carrying capacity of the environment.

The cheetah is quite widespread north of the River Niger. The limit of its distribution to the south is roughly 13 °N, though in the past it seems to have ranged into the woodland zone where it could live off reedbuck, warthog, etc. in place of gazelle (FAO, 1969). To the north it extends a good way into the sub-desert, and within the desert proper will be found wherever wadi beds provide enough forage for antelopes such as dorcas, dama and red-fronted gazelle. In Tombouctou the Tuareg say that cheetah are still fairly often seen throughout the Sixth Region, viz. the desert tract making up the northern third of Mali extending far across the Sahara. In the Adrar des Iforas mountains, at the eastern end of this sector, sightings are quite frequent (Swift, pers. comm., 1973) and have been made beyond Kidal, well south of the mountains.

As in other parts of the Sahel, the Tuareg hunt cheetah occasionally. There is some alleged dealing in live cubs, and a tendency among local Europeans to keep cheetah as pets. In Bamako I found only two cheetah skins on sale, another one in Mopti and none at all at Tombouctou or Gao, which would be the obvious centres if the Tuareg were regularly trading in them.

The principle threat to cheetah lies in the elimination of their natural prey. At present hunting of desert wildlife is not nearly so pronounced as in Niger, though it may become so if oil prospecting increases. The drought devastated the vegetation of the Sahel zone, but if conditions improve and grazing recovers while domestic stock are still reduced in numbers, there could be a temporary bonanza for wild herbivores. But if the nomads rebuild their herds to greater totals than ever, the prospects for gazelle and other desert wildlife must be reckoned moderate at best. The critical factor could be the number of wells opened up: livestock cannot range far from water sources, so that patches of vegetation are usually left to the wild species which can do without water for long periods.

The cheetah population of the Mali Sahel is difficult to determine. Distribution is wide but very sporadic. Judging by the number of localities from which they have been reported, one might guess, for 'order of magnitude' purposes, that they may total about 300, or at most about 500. They seem certain to decrease, unless development patterns and assistance to pastoralists take a new turn which pays greater attention to the requirements and interdependence of man and wildlife if both are to survive.

As in the case of Mauritania, a few cheetah may possibly also exist in favourable pockets of upland or mountain areas in the Sahara.

Upper Volta

The great part of the country lies within the Sudano-Guinean woodland savannah with only a small slice of the north coming within the Sahel zone. At least, that is what the vegetation maps used to indicate, but as a result of the drought, the semi-arid belt has shifted southwards and the woodland zone has been subject to increasing pressure from people retreating before the drought: this has reduced its carrying capacity and productivity, and made it more susceptible to desertification. Since the 1940s surface water supplies have failed more regularly, drying up quickly when the rains finish and often becoming mere gullies in which water only flows in flash floods after storms. Grassy patches in the woodland have given way to bush, more shrubby in the west and dominated by thornbush in the east. These changes, which are continuing at an ever speedier tempo, can have significant consequences for the cheetah. Its hunting methods are hampered in thicker bush and its staple diet, the medium-sized antelopes of the grasslands, give way to small browsers such as dikdik.

clined drastically in the Park du W during the past 15 years (Poche 1973) and it may be that demand for its skin is linked with the growing scarcity of leopard and cheetah and some tightening of import regulations for leopard and cheetah skins in North America and a few countries of Europe. Caracal are likewise on the decline, according to reports from tribesmen and game guards (Poche, 1973), but in this case probably because of their alleged depredations on livestock, although some skins are also sold.

Every authority consulted in or about Niger agreed that the human population and its impact on the environment will keep on increasing, that wildlife will continue to diminish, and that cheetah will decline towards virtual extinction within a few years.

At first glance of the map, one might suppose that the mountain massifs in central and northern Niger could contain wildlife populations of which nobody would be aware without rigorous research. But the ranges are better described as hilly country dissected with valleys. In these valleys with their better vegetation cover and concentration of wildlife, it should not be too difficult to determine whether many animals remain or not, especially in the case of a species such as the cheetah as opposed to dama gazelle or even addax. If an average of five sets of cheetah tracks per day were to be encountered in a variety of 200-300 transects over the course of a week, the status of the species could reasonably be supposed to be fairly good: not so, if all one sees is a single track in three weeks. Thus, one the basis of my experience, a figure of 50 (Jones 1973) would be nearer the mark than, say, 500. In fact, after appraising each major region of the country and extrapolating from the less than conclusive evidence obtained on various transects, I arrive at a figure of 200. There could conceivably be more, notably if the remote mountainous area near the Libyan border supports a good population, but equally 200 could be a substantial over-estimate.

What is fairly certain is that there were many more cheetah only a few years ago—and that a few years hence there will be far fewer than now. The decline will continue even if all hunting could be strictly controlled, since cheetah numbers in marginal environments seem to be determined as much by prey numbers as by human predation, unless poaching is universal which is unlikely in a country as vast and harsh as Niger. The herbivores which form the principal prey species seem certain to decline in the wake of environmental deterioration in the arid regions and of the rapidly increasing pressure on the fertile strip in the south.

Tchad

The southern quarter falls within the Sudano-Guinean woodland zone, the next to the north within the Sahel, and the rest desert. Even before the drought the Sahel zone was suffering from desertification and, with the consequent pressure on the southern region, Tchad is open to environmental degradation on a large scale.

Cheetah are rarely seen south of 10 °N but extend to 18 °N (Anna 1973). Their main habitat is the Sahel strip, where they are easily visible in open plains and can be pursued by motorised poachers. Their reputation for being easily domesticated also makes them a ready target for townsfolk wishing to keep them as pets, sometimes on the excuse that a few may thereby be preserved. This unfortunate notion has tended to spread from the European community in N'Djaména to France, so that French army personnel returning home are tempted to smuggle cubs on military aircraft. It is believed that as many as 100

may have been exported in this way over the past 5 years, though this figure is low compared with similar exports from Somalia, Djibouti and S.W. Africa in the same period. However, each cub probably represents another two which died in transit and every five cubs caught equally probably involved the death of the mother (both conservative estimates), so the trade, small as it is, may well have contributed as much to the cheetah's decline as the fur trade.

In view of the limited number of places in the Sahel zone of Tchad where the cheetah seems to be found, it is surprising that any survive except in the remotest wadis of the desert zone. The species has certainly not been anything but rare for some years. An experienced field worker, Prof. H. Gillet of Paris, has recorded that on nine 3-4 month visits between 1957 and 1965, he saw cheetah only once. Other European visitors and residents told him that on their travels in Tchad at all seasons they could expect to see cheetah only once or twice a year. A similar assessment has been made by Mr. Anna, former Director of Wildlife with 15 years experience of the country.

With the end of the civil war which beset the country, illegal hunting may have somewhat abated, although much depends on the attitudes of military personnel. Unfortunately, there is evidence of more preying by cheetah on domestic stock in some areas, possibly because its usual food has disappeared, which encourages herdsmen to follow the bad example set by those who should have known better and kill cheetah on sight. The leopard can find alternative wild prey when antelopes become scarce and rarely causes trouble to pastoralists; not so the cheetah. Furthermore, even if a complete stop could be put to hunting and trading in skins, desiccation of its environment and the decline of prey species will still make the cheetah's survival problematical.

The total number of cheetah in Tchad is estimated by Anna at 200. The Sahel zone comprises about 250,000 km^2, of which very little is out of reach of domestic stock. Fifty years ago there could scarcely have been more than 1000 cheetah in the Sahel, with perhaps another 500 in the desert and the woodland zones. This would support an estimate of less than 500 for the entire present population; as few as 200, as suggested by Mr. Anna, could hardly allow an offtake by the cub and skin trade of a probable 50 units per year unless much more than the annual increment is being exploited and the stock is being steadily eroded. Although it is quite likely that the harvest has indeed been eating into capital as well as adsorbing the interest, the fact is that the capital component of the annual offtake cannot have been large, otherwise populations would have been depressed to a level bordering extinction and no longer allowing a sizeable offtake to be sustained, even in a period as brief as the mere ten years during which current levels of exploitation have prevailed.

A revised population figure of 400, within the range of 250-500, is therefore proposed, although it remains true that the pressure on the species could soon bring its total in most of the Sahel zone to a level beyond which it could no longer maintain these numbers. In that event only residual groups would hang on in vegetated pockets of the desert zone, until such time as the last oases are denied to wildlife by man.*

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* Desert nomads claim that cheetah are fairly frequent in the wadis around Kharma, Achim, Hawach and other localities in the north, notably where there are dorcas gazelles and larger game birds.

TABLE 5 NORTH-EASTERN AFRICA

Country (with area in square kilometres)	*Land-Use Trends*	*Cheetah Range*	*Protected Areas*	*Estimate of Cheetah Numbers*	*Remarks*
Sudan (2, 506, 000)	Sahel zone impoverished; woodland zone and moist south under progressive pressure from agriculture	300, 000 km² of savannah woodland in south (Sahel discounted since too impoverished)	Cheetah very rare or non-existent in all parks & reserves	1200, range 500-2500; could decline by half by 1980	Little poaching following government ban on trade in cheetah skins in 1972, with deterrent sentences
Ethiopia (1, 222, 000)	Agricultural pressure widespread and now affecting lowland areas	500, 000 km² of lowlands in east and south	Danakil reserve assists cheetah marginally	1000, range 500-1500; could decline to 300 or less by 1980	Poaching extensive; prey stocks severely depleted; spread of cultivators into lowland habitats
Somalia (638, 000)	Pervasive environmental degradation for past century has depleted biotic productivity; governmental stress on livestock industry	Formerly entire country; now reduced by half to two-thirds	Several projected reserves could contain 50-100 cheetah	300, range 150-500; could be virtually eliminated by 1980	Gross environmental degradation; prey severely reduced in almost all areas
Summary for North-Eastern Africa: 2500 cheetah, within range 1150-4500; could drop below 1000 by 1980.					

terioration of its carrying capacity (Cloudsley-Thompson 1971; Wicken 1973). Southwards are a block of woodland savannah, with a human population growing more rapidly than elsewhere in the Sudan, and the bulk of the country's wildlife.*

The increasing pressures of man on environment has accounted for the decline in wildlife stocks in recent years. A 'dramatic decrease' is reported in the gazelle population of the Blue Nile Province during the 1960s (W. P. Dasmann, pers. comm., 1972): the Butana Plains were once the home of vast herds of gazelle, but only a few scattered groups were present at the wet-season gatherings of 1971. This decline has been partly due to range deterioration under expanded herds of domestic livestock, but more to the meat hunger of farm workers on agricultural schemes in the East Blue Nile to Kassala region, notably around the Dinder and Rahad Rivers (Republic of Sudan, 1971). Similar degradation affects most of the vulnerable zones with less than 1, 000 mm rainfall and the consequences for a savannah-ranging creature such as the cheetah are obvious.

Throughout the country, little wildlife is to be seen outside the parks and reserves (Cloudsley-Thompson 1973), except possibly in the far south. Towards the Uganda border, where rainfall rises to 1, 500 mm, the type of vegetation is better able to withstand human pressures and socioeconomic advancement has been negligible for much of the past twenty years, so game stocks seem more satisfactory. Several wildlife experts from East Africa visited the southern sector during the course of 1973, and reported good numbers of zebra, sitatunga, giant eland, bongo, buffalo, grey and yellow-backed duiker, waterbuck, kob, lechwe, topi (tiang), leiwel hartebeest, oribi and gazelle in several areas. There are even plenty of white rhinoceros, which suggests that the civil war damped down poaching instead of stimulating it. But long grass makes this zone unfavourable habitat for cheetah and very few were seen.

In fact cheetah are no longer to be found in worthwhile numbers anywhere in the country. In the Sahel zone they have been reduced by disappearance of their natural prey, and by harassment if not hunting by nomad herdsmen; in the woodland zone they survive wherever the tree cover is light or interspersed with grassland, but such areas are few and far between. In the Blue Nile region, where gazelle have been eliminated by poaching, cheetah have all but disappeared completely.

A minor trade in cheetah skins developed during the late 1960s, but never flourished, through a network of organised suppliers as in Tchad or Ethiopia. The main centres were El Fasher in Darfur, El Obeid in Kordofan and Gedaref in the Blue Nile province. During the civil war, skins could not be obtained regularly from the south, although some went out through Ethiopia possibly to raise funds for insurgents. But outside the south, few cheetah were to be found, so turnover does not seem to have amounted to more than 200 skins a year at the height of the fur-trade boom around 1968, and it dwindled to less than 100 a year by the time the government imposed a strict ban on cheetah skin dealings in 1972.

Any attempt to assess the cheetah population of the Sudan is justified only

* The official classification of the country's 2½ million km² is: 730, 000 desert, 490, 000 semi-desert, 690, 000 dry woodland savannah, 350, 000 wet woodlands, 250, 000 flood zone and 6, 000 montane (Republic of Sudan, 1971). The government intends to designate 5% of the country as forest reserve, but up to 1973 had accorded protection to only 0. 5%.

by the desirability of having some sort of figure to help arrive at an approximate African total. The Sahel sector can be omitted from any reckoning since, according to best reports, it was more degraded by overgrazing, even before the recent droughts, than any other part of the entire Sahelian zone. Traders in Khartoum had not heard of a cheetah skin from the Sahel since before 1960.

With this exclusion, about half the country or 1¼ million km² could be described as within the cheetah's range and it is reasonable to assume that it may occur at low densities in perhaps one-fifth of the southern half of the country. The rest of the southern sector can be discounted since, as in the Blue Nile region, the cheetah's natural prey has disappeared or, as in the greater part of the woodland zone, only small patches provide suitable habitat. On the basis of one cheetah per 150 km², which is the highest density that can be expected, one arrives at a figure of 1,600. Making allowances for some poaching (a few skins are reported to find their way to the Addis Ababa market from southern Sudan) and in the light of the extreme infrequency with which cheetah were sighted by the visitors to the south in the early part of 1973, the total may be put at 1,200.

This calculation is subject to more reservations, as well as applying to a larger area, than the similar calculations for all other countries covered by this report. There could be many more than 1,200 cheetah; there could equally well be far fewer—though almost certainly there could not be more than 2,000 or fewer than 500. Until more is known about the enormous tract of country involved, it is impossible to arrive at a more exact answer to the problem, and although the estimate is based on reports received from more than 20 observers who have lived in or visited the Sudan in the last five years, I only propose any figure at all with great hesitation, and recognize that it constitutes one of the most unsupported conclusions of the entire report. As elsewhere, however, it can be asserted with more assurance that cheetah populations will be depleted in the years ahead. The human communities which are colonizing the woodland biomes prefer just those open habitats favoured by cheetah.

Ethiopia

Ethiopia has long been renowned as one of the main centres in Africa for the distribution of cheetah and leopard skins onto world markets. These skins have repudedly come not only from Ethiopia itself, but from Kenya, Somalia, Sudan, Uganda and more distant countries, many of them illegally taken. How this trade or indeed wildlife conservation generally will be affected by the recent political upheaval remains to be seen.

Two-fifths of the country is lowland savannah or semi-desert, most of which has been affected by the drought that recently devastated the Sahel. Cultivators are now spreading into the sectors with sufficient rainfall and in which malaria has been brought under control. At the same time the lowlands support much of the wildlife, i.e. the Danakil depression in the north-east, the Ogaden in the east and a strip along the southern border. This huge tract of about 500,000 km² could once have contained great numbers of wild animals. Until recently it experienced only moderate habitat disruption at the hands of pastoralists and, in some areas, notably the south-west around Lake Rudolf and the Omo River, wildlife had remained fairly plentiful.

But in lowland Ethiopia, as in highland areas, there is now gross environmental deterioration (Brown, L. 1969; Brown, G. 1970). In particular, there has been

a degradation of grasslands and spread of bush making for a less favourable habitat for many wild herbivores and their attendant predators, especially gazelle and cheetah. In Borana in the south, for example, both were common ten years ago, but gazelle have almost vanished and cheetah only very rarely seen in the past five years. In the huge expanse of the sparsely-inhabited Ogaden, large species are now extremely scarce, the principal agents of their disappearance having been not meat-hungry peasantry but sport-hunting military.

But according to reliable authorities with long experience in Ethiopia, cheetah though scarce still seem to be moderately widespread (e.g. Bolton 1973). They have been seen in places as far apart as the Somali border area of Hererghe (Harrar) Province and the Ghemu-Gofa Province and the Borana area of Sidamo Province in the extreme south. There are reputed to be good numbers still along the Omo River, though Surma poachers have been infiltrating heavily since 1970. Small remnant populations, as compared with 10 years ago, also survive in the Ogaden, southern Bale Province and the Danakil depression. One wildlife expert recently toured these three extensive areas without seeing any, but it is probably still to be found in most of the dry lowlands, although decreasing everywhere. Part of the problem is that prey populations are also showing a marked decline.

The main stronghold for cheetah may now be the Danakil and its prospective reserve. Although wildlife totals there have thinned out in recent years, there are still impressive numbers of hartebeest, Grevy's zebra, oryx, gerenuk, Soemmering's gazelle, wild ass,* warthog and ostrich. There are supposed to be plenty of lion and leopard, and some cheetah. Fortunately the area is uninhabited, being a buffer zone between two nomadic tribes, the Adol and the Isso. It is virtually waterless during the dry season, and can only be used as wet season grazing. But, like the Sardo Reserve in Wollo Province, which once featured vast herds of Soemmering's and Speke's gazelle, oryx, ostrich and wild ass, the Danakil is now subjected to weekend 'sport hunters' from Dessie and Assab. The Awash-Tendho Highway now under construction could exert a considerable influence on wildlife along its entire length, making a recently inaccessible region vulnerable to hunters as well as bringing pastoral settlements permanently into the area.

Cheetah skins are not seen nearly so frequently in markets of the big towns as are leopard skins (by far the most common skin of all is serval, a trend replicated in other parts of Africa since some control of the leopard and cheetah trade was introduced in certain consumer countries). Nevertheless, I saw several hundred cheetah skins on sale in different parts of the country. The lowlands around Djibouti are also still plundered for cheetah cubs in the expectation of obtaining a high price on the European market. This trade is no longer in American hands as it was in the late 1960s, but depends from start to finish on a network of local entrepreneurs. Based on an estimated 100 live cubs exported to Europe annually, the trade could well be exerting a de-

* This species is a good indicator of the possible future for desert herbivores. Once widespread in north-eastern Africa, it now totals a few hundred in Ethiopia and a few score (if that) in Somalia. Its decline is attributable not so much to man's weapons but to his herds seeking forage and water. Other species are more tolerant of competition than the wild ass, but the pressures are becoming greater. Were the cheetah to receive the best possible protection from hunting there would still be little hope for its future if its natural prey steadily disappeared.

pressive influence on cheetah populations over a broad sector of the hinterland (see under Afars and Issas for further details).

The tentacles of the spotted cat skin trade extend deep into the countryside. In small villages in southern and eastern Ethiopia, two or three cheetah and/or leopard skins are available immediately upon request. On many the bloodstains have not yet turned black, suggesting that the skins have been recently obtained, a regular turnover and poor preparation. The supply seems slightly easier in the south than the east, perhaps because skins exported through Djibouti find a more ready and speedy outlet. Travelling southwards over the last 450 km from Dilla to the Kenya border, one is told that skins are easier to obtain the further one gets from the large towns and certainly observance or enforcement of the law seems to become steadily less conspicuous.

In February, 1972, I spoke in Addis Ababa to a man who runs a small stall in the extensive city market. He took me to his home nearby, where he had 24 cheetah skins and over 100 leopard skins in stock. They had all, he said, been obtained in the past few months and he would have no difficulty in meeting an order for 20 cheetah and 20 leopard skins a month from a single dealer, and he could go as high as 60 skins of each with sufficient advance notice. He did not have export permits on hand, but if a purchaser insisted, documentation could be obtained from the Department of Wildlife Conservation, although he was usually told that the consignment in question must be the last. Presumably this accounted for some of the difference in price between an undocumented skin or otherwise, viz. in the case of a leopard E. $1,000 and 1,500 (U.S. $500 and 750 at January 1973 rates). The permit to possess and export a skin, whether leopard or cheetah, cost E. $125, and customs dues were E. $50-75 depending on the size and quality. A curio dealer in a shop on the main street told a similar story, when showing his stock of about 40 cheetah and at least 100 leopard skins (he claimed to have as many again in store at home). Only one skin in ten looked as if it came from a sub-adult animal, which suggests there is no undue differentiation in the hunting pressures on age groups.

In 1972, an attempt was being made to control the skin trade and to stop illegal traffic, beginning with the registration of skins in possession of traders, whether legally obtained or not. All such traders in Addis Ababa were supposed to belong to two cooperatives, one with 14 and the other with 20 members. After some cut-off to be fixed, skins would become obtainable only through the Department of Wildlife Conservation or similar official channel. Whether this policy will be continued and effectively completed by the new government is still uncertain, nor is it known whether the departmental budget has been maintained at E. $1 million, as it was at that time, although this sum was hardly commensurate with needs despite considerably exceeding the equivalent expenditure in several other African countries—with much less to show for it.

An estimate of cheetah numbers in Ethiopia is made almost impossible by the size of the country and paucity of information. Potential habitat covers 500,000 km^2 and populations seem to be encouraging in some areas, negligible in others. Some indications can be obtained through the skin trade, e.g. difficulty in obtaining skins in one locality as compared with another, and something is known of the varying degree of competition from human communities and of numbers of wild prey available in different sectors. Assuming—which is a pretty massive assumption—that cheetah numbers have been little depleted in the Omo region and the south-west, there may still be as many

as 1,000 left in Ethiopia. The number could equally well be lower, though it is hard to believe that it can be less than 500. The trend, as usual, points clearly to continuing decline in numbers, habitat and prey. By 1980, the total could well be down to a few hundred.

Somalia

More than any other country in Africa south of the Sahara, Somalia exemplifies the prolonged deterioration of the environment through man's destructive activities (Hemming 1966). It shows what may well overtake other pastoral countries, notably those of the southern Sahara fringe, within a decade or so. Degradation has progressively accelerated in the last thirty years, though the processes probably originated over a century ago. The main modification has been to the vegetation cover and may have been triggered off by climatic change, although aggravated by human activities in recent times. It has been of at least as much consequence during the past 10 years in reducing the numbers of cheetah as the fur trade or the demand for live cubs. In the future, however, man-made pressures, principally on the cheetah's natural prey, will almost certainly predominate in determining whether the cheetah survives until the end of the century.

Among areas of relevance to cheetah, the lower reaches of the Juba and Shebeli Rivers in the south offered unusually good refuge to wildlife only a few years back. But the river banks are now being rapidly settled as obviously favourable sites and wildlife thereby reduced out of all proportion to the areas directly affected. The grasslands of the interior to the north east of the Webe Shebeli and the town of Belet Uen still hold a few small herds of beisa oryx, though they are hunted by tribesmen with spears or bows and arrows. A few kudu of both species occur in the south and also range much further northwards to the Nogal Valley and about 10°N. In the Nogal plains, a number of Speke's gazelle still survive (Simonetta, pers. comm., 1971). The great herds of Soemmering's gazelle in the south are gone, leaving only scattered remnants. In the coastal steppes, Speke's gazelle are still widespread, though in most places they have declined drastically. In 1960 considerable herds could be seen within 15 km of Mogadishu, but since 1968 only scattered individuals are to be found nearer than 100 km, although some recovery has been reported well to the north of Mogadishu (Funaioli, pers. comm., 1973). Only to the north of Warshiek, up the coast from Mogadishu, can some fair wildlife numbers still be seen, notably, warthog, gerenuk, ostrich and guineafowl. This area could well suit both cheetah and leopard, if some were left to exploit its potentialities.

The cheetah has probably been rare though widespread over most of Somalia since the end of last century. Travellers and hunters seldom encountered them, except in the savannahs from Afmadu, west of the Juba, south and west to the sea, and in the sparse bush region bordering the cultivated areas west of Bur Akaba-Baidoa Lugh, possibly also extending beyond the Juba River. There may also have been fair numbers in the Nogal Valley and the north between Gardo and the sea. Since World War II, all these populations have been hit hard by the fur trade, the capture of cubs for export and the disappearance of their natural prey. An average of around 500 skins a year were officially being exported as long ago as the early 1950s (Funaioli & Simonetta 1966). Totals generally remained above 400 until 1960, before a rapid drop to 164 in 1963. Regrettably, recent figures are not available, though fresh skins could still be readily obtained in Mogadishu in 1968. The trade in live cheetahs reached the official figure of 71 in 1959, thereafter tailing off to 10 or 12 in

the early 1960s.* There was another upsurge of activity in the mid 1960s, at which stage a more destructive mode of operations was probably accounting for more animals than the skin trade (skins then seemed to be coming mostly from Ethiopia, though some were still said to be derived from the region around Ough-Dolo, on the Juba very near the Ethiopian border).

Although the international trade in cheetah cubs and cheetah skins has now been reduced if not eliminated by the government, the third threat to the cheetah, the decline of its food sources, is increasingly affecting its prospects of survival. Normal prey species have disappeared over wide areas and little information is available on the status of the small mammals which often benefit temporarily from a degraded savannah environment, i.e. from the short grass intermittently available, although hares and bush rabbits do seem to have flourished during recent years. Cheetah in the Kalahari can subsist in large measure off lagomorphs, though whether Somali cheetah will be able to adopt their hunting behaviour in this way after having been so dependent on antelope food remains to be seen. The main large carnivore in Somali is now the hyena, and its numbers are reported to be increasing in some areas though more frequent sighting may simply be due to them paying more attention to domestic livestock weakened by the poor grazing. Whatever the reason, hyenas would also be likely to take increasingly to scavenging of cheetah kills, and thus to cause cub mortality (see Chapter II).

To sum up, one can still rely on finding cheetah in the south-central region of semi-desert habitats, notably around Hiran Medug, but they have disappeared from the coastal zone except close to the Kenya border, having been present in acceptable numbers around Mijirtinia north of Mogadishu only ten years ago. An 'order of magnitude' estimate for the cheetah population would therefore be between a minimum of 150 and a maximum of 500, and 300 is adopted as a fair figure. The prognosis can be more accurately assessed as a steady decline to virtual extinction within ten years, unless the government imposes stringent protective measures. Control of illegal hunting may not be enough, since the cheetah's survival is intimately tied up with how the country's livestock industry is developed.

Territory of Afars and Issas

The Territory of Afars and Issas, formerly French Somaliland, centres on the Red Sea port of Djibouti, long the main trade outlet for wild animal products from Ethiopia and northern Somalia. Now that the Suez Canal is reopened, Djibouti could become an even more significant centre for such trade than in the past.

During the 1960s, Djibouti was a notorious funnel for spotted cat skins on their way to world markets. Hundreds of skins, many of them illegally obtained, were sent each year to Europe and North America, drawn from not only Ethiopia and Somalia but also Sudan, Kenya and further afield. The trade has declined a good deal since 1971, thanks in part to a ban imposed by the President on all killing of wildlife within the Territory. His efforts have not yet, however, brought the skin trade to a standstill, since skins from an extensive hinterland of several neighbouring countries continue to appear on the market.

* One protagonist of this trade was reputedly exporting 'only' twenty cubs per month during the late 1960s. When account is taken of unavoidable mortality in the capture process (even when the most efficient and humane methods are used), this would account for a large share of cheetah recruitment potential over considerable tracts (see section below, on Afars and Issas, for rough calculations of offtake impact). The custom of keeping cheetah as pets—reputedly 30 in Mogadishu alone as of late 1973—should be terminated by specific regulations.

I made enquiries in early 1973 to discover the present extent of the trade. This entailed making contact with over twenty of the merchants formerly involved, both in the main market square and in the shanty communities outside the town. No sign of activity was found, except for the three street hawkers in the centre of Djibouti who had seven cheetah and four leopard skins between them. No overseas dealers had visited Djibouti since mid-1971. There were disturbing reports, however, that airline pilots and members of the 16,000-strong French community are still involved in dealings from which they can expect to make a good profit on return to Paris.

I gathered from the street hawkers that one week's turnover for all of them would amount to about ten skins, usually half cheetah and half leopard. I was quoted around U.S. $50 for a cheetah skin, and U.S. $200 for a leopard skin. One local opinion is that the trade has dwindled not so much because of restrictions in Djibouti—the skins were on display on the pavement in the main square—as because of stricter protectionist measures and checks at customs posts for goods coming in from Ethiopia. Djibouti makes much of its income on dues levied on Ethiopian trade, with the result that some attempt was being made by the Ethiopians to develop the neighbouring port of Assab in Eritrea, which in turn encourages the authorities in Djibouti to extend their dues to a wider range of Ethiopian imports. At the time of my enquiries, the cub as well as the fur trade seemed to be managed by a taxi driver, supported by street hawkers, based in one of the main hotels. They showed me four four-month-old cheetah cubs in the Arab quarter, one blind from a kick by a goat, and all semi-emaciated but showing no signs of rickets. They were due for despatch that evening to Paris by plane, travelling in a simple freight crate, and the consignee acts as a distributor to zoos, safari parks and pet owners through much of Western Europe. Ten cubs had been sent to him in the previous four weeks and the price delivered in Paris in U.S. $280, subject to discount on large or regular orders.

The taxi man and his friends claimed that they could easily supply 10 cubs a year. Assuming this sort of figure is in fact achieved, the implications appear to be as follows. On the optimistic basis that the mother cheetah escapes alive, that an average litter size is five, that a new litter replaces the captured one within one year, that for every cub delivered in Paris one falls by the wayside, and that cheetah density in this semi-desert region approximates that of the Kalahari, the annual offtake of 100 live cubs could in theory be sustained by an area of under 10,000 km^2, which is relatively small by the standards of the great tracts of country potentially suitable for cheetah in this region. But when one adds in the various other factors working against the survival of the species, such as increase of domestic stock populations, decline of wild prey communities, and perhaps 250 cheetah skins in the Djibouti trade alone, the live-capture business could seriously affect cheetah stocks over a very substantial area.

(f) THE EQUATORIAL RAINFOREST REGION (see Fig. 1 and Table 6)

This region, covering an area appreciably larger than Western Europe, is taken to include Zaïre, Congo, Gabon and Equatorial Guinea. Only the southern sector of Zaïre is believed to support any significant number of cheetah. The number was never large, but the species was more widespread in the 1950s than now. No sightings have been reported from the Virunga or

TABLE 6 THE EQUATORIAL RAINFOREST REGION

Country (with area in square kilometres)	*Land-Use Trends*	*Cheetah Range*	*Protected Areas*	*Estimate of Cheetah Numbers*	*Remarks*
Zaïre (2, 345, 000)	Only one third is rainforest; some localized pressure for agricultural expansion.	Parts of Shaba, Kasai & Kwango Provinces	Kundelungu and Upemba Parks contain a few cheetah	300, range 100-500; could decline below 100 by 1980	Habitat undergoing some agricultural modification

Congo, Gabon and Equatorial Guinea are not known to contain cheetah.

Summary for Equatorial Rainforest Region: 300 cheetah, range 100-500; could decline below 100 by 1980.

Garamba parks since 1960. The plateau areas of Kundelungu Park (1, 200 km^2) in Shaba (ex-Katanga) still support a few and to the north, between Mitwapa and Lake Mweru, occasional individuals have been sighted in recent years, though they may well have wandered out of the park. Spasmodic sightings are noted in western Shaba near the Angola border, around Sandoa, as well as in the northern part of the province. In the Upemba Park (9, 500 km^2) cheetah have sometimes been found on the Kibara plateau. The people living along the Lufira Valley in this region have recently been moved and poaching has declined. The areas bordering both the Upemba and Kundelungu parks are

Fig. 4 Cheetah Distribution Throughout Sub-Saharan Africa

A few cheetah may survive outside the areas indicated, but not in sufficient numbers to have any significant effect on the over-all status of the species.

affected by the use of poison by herdsmen as a defence against lions and, although scavenging is generally considered uncharacteristic of cheetah, the poisoning campaigns are reported to be accounting for a moderate number. Finally eastern Kasai and also Kwango provinces are said to have a few cheetah, but no estimate of the extent of their range is available.

The cheetah population of Zaïre is usually put at between 100 and 200 by local wildlife officials and ecologists (though without the use of any very precise method of evaluation). Such a small total, in widely dispersed areas, could easily be partly accounted for by transients from Angola and Zambia, i.e. some of the populations in Zaïre may not be constant or stable. Although the figures proposed seem unduly low, there is, however, no reason for believing that the total could reach anywhere near 1,000, unless the Zaïre cheetah is exceptionally self-effacing. For this report, a slightly higher figure of 300 is adopted, although it will probably diminish as human communities find it necessary to expand their cultivations further into the savannah.

Summary of Cheetah Status in Sub-Saharan Africa

The overall position, based on the country by country reports in this Chapter, is summarised in Fig. 4 and Table 7.

The 'working estimates' produce a total of somewhat under 14,000 cheetah for Africa south of the Sahara. As emphasized throughout the Chapter, the figure represents no more than an attempt to arrive at an 'order of magnitude': the actual total could conceivably be over 20,000 or already well below 10,000.

However imprecise this appraisal of cheetah status at the present time, it seems certain that rural development in Africa will express itself primarily through occupation of hitherto lightly settled areas. The more fertile zones having been taken up to the extent possible under prevailing agricultural practices, the next most suitable target for occupation are the savannah grasslands. A 10% increase in rural population could easily reduce the cheetah's effective range by 30%; by 1980, the more favourable of its present habitats could be cut by half and its total population reduced to around 7,000 or less.

After 1980, unless much more effective measures than any yet devised are implemented, the elimination of the cheetah outside protected areas will proceed even faster. Some areas, such as those of the Sahel (as opposed, for example, to the floodplains of the miombo zone) are unlikely to be denied to the cheetah by outright human occupancy, but the signs are that their condition may deteriorate to the point where they can no longer provide the cheetah with sufficient living space, prey resources or life-support systems in general.

Although only the arid environments of north-eastern Africa look like undergoing the extreme biotic impoverishment of the Sahel (parts of Somalia have reached that stage already), most of the savannah forming the remainder of the cheetah's range will probably be occupied by human populations. Because of its ecological and ethological attributes, the cheetah will have less capacity to adapt to the process than the lion and far less than the leopard. This pessimistic forecast is realistic within present trends: only if demographic and developmental processes take a new turn, allowing less extensive disruption of Africa's wildland environments, could the cheetah's prospects improve in substantial measure. Changes in present patterns do not seem likely, so that any assurance of a future for the cheetah must lie in the conservation measures discussed in the next two Chapters.

TABLE 7 SUMMARY OF CHEETAH TOTALS IN SUB-SAHARAN AFRICA

Region	*Estimate of Cheetah Numbers in 1974 (with range)*	*Anticipated Cheetah Numbers in 1980* (unless stringent conservation measures are implemented)	*Likely Causes of Decline 1974-1980*
East Africa (Kenya, Uganda, Tanzania)	3000-plus (1600-4650)	1800 or less	Habitat disruption for agricultural purposes; conflict with ranching communities.
Miombo Woodland Zone (Angola, Zambia, Mozambique, Malawi)	1500-plus (800-3300)	1000 or less	Habitat disruption. Poaching.
Southern Africa (Botswana, Rhodesia, S.W. Africa, S. Africa)	4600 (2850-7300)	3000	Conflict with ranching communities; captive animal and fur trade.
West Africa (Mauritania, Mali, Upper Volta, Niger, Tchad, Cameroun)	1700 (800-2600)	500 or less	Environmental degradation; decline of prey; poaching.
North-Eastern Africa (Sudan, Ethiopia, Somalia)	2500 (1150-4500)	1000 or less	Biotic impoverishment in Ethiopia and Somalia; poaching & fur trade in Ethiopia & Djibouti; decline of prey in Ethiopia, Somalia & parts of Sudan.
Equatorial Rainforest Region (Zaïre)	300 (100-500)	100 or less	Habitat modification for agricultural purposes.
	13,600, say 14,000 (7300-22,950, say 23,000)	7400 or less	

CHAPTER IV

The Cheetah's Status: Basic Factors and Issues

This Chapter reviews the causes of the cheetah's decline to its present status; the factors that will decide whether it will survive in modern Africa; and the relevance of existing conservation measures.

(a) FACTORS IN THE CHEETAH'S STATUS OF 'THREATENED AND DETERIORATING'

The Cheetah as a non-numerous species in pristine Africa

As indicated in Chapter II, the cheetah has probably never anywhere had a population density to match those of the other large cats. One to 50 km^2 is about the maximum for cheetah in savannah and one to 100 km^2 may be more like the average. In arid environments, which are perhaps closer to optimal conditions for cheetah in terms of population stability, the density drops to one to 150-300 km^2.

These estimates of cheetah density in still reasonably undisturbed environments suggest that a century or so ago, before disruptive and competitive land-use patterns were imposed on the landscape, cheetah totals may not have exceeded 100,000 for Africa south of the Sahara. This figure could well have been matched by lion numbers as recently as 1960, and is certainly surpassed by present-day leopard numbers (Myers 1974b). As often stressed in this report, all such estimates have only an 'order of magnitude' validity and are simply to assist in setting perspectives for the conservation considerations.

The conclusion that the cheetah has probably always been rare compared with other large carnivores and predators, both regionally and continent-wide, should modify our evaluation of the cheetah's present status: its 'low' density is in itself no sufficient reason for regarding it as 'endangered'; the real issue is that its numbers are declining, and seem likely to continue to decline even faster until only remnants will be left.

Sensitivity to environmental disturbances

The threat to the cheetah is aggravated by its unusual sensitivity to modification of the physiobiotic environment: an increase in competition from other carnivores, a shift in the make up of its prey, a spread of bush growth, can equally well serve to induce significant instability in cheetah population. Moreover, no absolute change in such determinant factors is required to throw the population 'off balance'; even a quite marginal perturbation can be enough.

The Serengeti eco-unit at present supports about 250 cheetah (Schaller 1972); even were the number closer to the total for lions (2,000) or leopard (1,000 plus), the cheetah population would still be by far the least secure, by reason of its ecologically and ethologically derived inability to resist environmental fluctuations. Thus when that part of the eco-unit which lies outside the national park comes under human pressures, the cheetah is bound to suffer more than other predators.

Man's modification of rangeland habitats

It is just this vulnerability to changes that explains why extensive tracts of wildland Africa have been virtually cleared of cheetah in a relatively short space of time. For example, in the more intensively farmed sectors of the Rift Valley in Kenya gazelle, zebra and other larger herbivores were squeezed out in a twenty-year period during the 1950s and 1960s, leaving the cheetah with much reduced prey resources. For a time, cheetahs persisted, by living off small prey or livestock, but in due course became mere transients. Now in the 1970s the conflict between ranching interests and cheetah is no longer being resolved to the latter's detriment solely by a steady increase of these pressures, but is being accelerated by use of the trap and the gun. It needs only a few years to extirpate the cheetah entirely from great blocs of savannah ranchland. In the Laikipia ranches of Kenya it looks as if the process will take nearer five years than the previous twenty. A similar timescale applies to the lowveld areas of Rhodesia as compared with the highveld or to the ranchlands of S.W. Africa as compared with those of South Africa. These cases are far from exact parallels, of course, but the same abbreviated time-limits are basically involved.

The pressures of modernized ranching are matched by those which arise when subsistence pastoralism is being upgraded. Thus the Masai in Kenya seem capable of disposing of wild predators little more slowly than do intensive farming communities elsewhere. The tendency for acceleration of such processes can also be seen in the environmental impoverishment of the Sahel zone as compared with that of Somalia and the Ogaden of Ethiopia. The Horn of Africa has deteriorated in productivity over a period of at least fifty years, the wild herbivores reduced to poor vestiges of their former proliferation, the cheetah likewise. In the Sahel, on the other hand, degradation has run its course largely within the past 15 years, reaching its climax only during the past 5 years. The consequence for cheetah is much the same, though the threat has arisen with far greater speed and compounded impact. A similar process must be anticipated in other marginal ecotopes, such as southern Sudan and Botswana, except that the forces of biotic devastation may gather with yet more rapidity. The implications are that conservation measures for the cheetah must devised on the assumption that, in terms of room for manoeuvre a 10-year time-horizon may offer less opportunity for taking adequate measures than a 5-year period in the recent past, so quickly are future options closing.

The international fur trade

This trade is undoubtedly another factor in the cheetah's decline. As mentioned in Chapter III, the main centres for funnelling cheetah skins onto world markets are situated in Ethiopia/Djibouti and South Africa, the skins in both cases coming partly or mostly from other countries and perhaps nearly always having been obtained illegally in the first place.

The dimensions of the trade are difficult to assess. Dealers in Africa, Europe and N. America have been understandably reluctant to assist the survey with details of the number of skins handled per year. A very rough indication is given from figures of imports into U.S.A. at the height of the spotted-fur boom in North America: 1,283 cheetah skins in 1968, and 1,885 in 1969. If European imports accounted for rather more than as many again, the totals would approach 3,000 and 5,000 for the years in question. The North American market has subsided markedly following legislation in U.S.A., but the European demand has continued to grow. Unfortunately, a feature of the trade, which has also continued, seems to be disdain for the law at all stages of the transactions involved, witness the enormous number of illicit skins found in the possession of a New York furrier in 1971 and 1972, including 1,867 cheetah skins.

If, on the basis of the figures quoted, it is assumed that 5,000 cheetah skins have been marketed each year for the past five years, and if the 'working estimate' of cheetah stocks arrived at in Chapter III is accepted, namely a total of about 14,000, and if the crop of cheetah cubs surviving to adulthood each year is put at 5,000, representing the annual increment to which any 'harvest' must be related, and if, finally, cheetah populations in Africa are being reduced by roughly 1,000 each year through loss of habitat, then the figures, crude though they may be but perhaps near enough to the mark for present purposes, suggest that—(i) the fur trade is not the dominant factor contributing to the decline in cheetah numbers year by year but (ii) the cheetah would be in far better straits if dealings in cheetah skins ceased. It might no doubt be argued that if numbers of cheetah are eliminated each year anyway, in the wake of various development trends, their skins might as well be used. But the past record of the trade inspires little confidence that legal limits would be observed or that any market outlet would not be abused but scrupulously coordinated with specific cheetah populations.

(b) THE FACTORS DETERMINING THE CHEETAH'S FUTURE IN AFRICA

The cheetah must have somewhere to live and something to eat. Both requirements are likely to be in ever shorter supply in the years ahead, in the light of existing demographic and development trends as reviewed, for example, in Allen (1965), Economic Commission for Africa (1972), Hance (1972) and Ominde and Ejiogu (1972). While the statistics are familiar to many observers of Africa's wildlife scene, they do not receive the currency they deserve. Still less is the legitimacy of expectations for socioeconomic advancement properly appreciated: while there may be some justification for regulating population growth of Africa's human numbers, there is no parallel case for restricting aspirations to the enhanced standards of living which can often cause greater pressure on undisturbed natural environments than sheer growth of human numbers. No factor impinges so directly or significantly on the cheetah's prospects than the evolving status of human communities in Africa. Conservation of the cheetah can only derive political and cultural support to the extent that wildlife conservation clearly recognizes the issues.

The socioeconomic factor

The average income in Africa is still equivalent to only about U.S. $100 per year. While a figure of this sort is only a rough approximation of standards of living (taking little account of subsistence agriculture and other activities outside the market economy), it points up the fact that African aspirations for better living are legitimate by any criterion. The U.N. list of the world's poorest 25 nations includes 16 in Africa and the widening gap between the 'have' and 'have-nots' may soon be matched by another gap, between Africa and the rest of the developing world. This is becoming increasingly a gap in values, in social organisation, in contrasting life styles, in perceptions of the world in which people live, above all a gap in communication. In the main, the opportunity for modifying these trends and processes lies in trade and aid patterns between Africa and the more highly industrialized world, since a modicum of modernization would permit expanded employment in urban areas, thus taking the pressure off rural territories. But this perspective lies outside the terms of reference of the survey.

The implications of this socioeconomic situation for cheetah conservation derive from the dependence of the species on fairly undisturbed rangelands. The pressure on that kind of asset, stemming from the aspirations of increasing numbers of people, vary from country to country. Thus, Zambia, with only 4.3 million people in a country nearly as big as France and West Germany combined, with 25% of its populace urbanised as opposed to the tropical Africa average of under 10%, and with a considerable potential for industrialisation, will probably be able to keep one third of its national territory under one form or another of protected wildland status into the medium-if not long-term future (though the cheetah is largely confined to the one-seventh of the country comprising floodplains and dambos, which as we have seen is chosen by people looking to new land to cultivate in preference to miombo woodland). By contrast, in Kenya there is already mounting pressure on major wildlife areas. Since Kenya contains some of the finest wildlife congregations in Africa, supported by a chain of parks and reserves, a brief analysis of its prospects will serve to illustrate what may over take much of wildland Africa in the near future—and the constraints which conservationists must take into account when planning long-term protective measures for the cheetah.

The Kenya experience

Kenya's population totalled almost 13 million in early 1974, with a growth rate of 3.5% per annum. The proportion of young people is so large that a full decade would be needed to bring about a reduction in that growth rate (Likimani & Russell 1971) even with a tenfold increase in family planning, which at present reaches less than 5% of women of childbearing age. The best that can be hoped for during the period 1972-77 is a reduction of anticipated births by about 7 or 8% (International Labour Office, 1972).

The amount of good agricultural land per person in the rural population is now little over 0.7 hectares. In many of the main population areas, the average holding per family (average size, 9 persons) is under 1.8 hectares, whereas in Narok District, in Masailand, the figure is almost ten times the national average. This District is, in fact, credited with a million hectares of high-potential land, thus being much the same in size as Kikuyuland where people subsist on less than half a hectare per head; other areas of high-potential, under-developed land are to be found in Samburu, Lamu and Tana River Districts—like Narok including some of the best wildlife areas in Kenya, although Narok is perhaps exceptional in containing some of the finest concentrations in the whole of Africa despite the fact that only a fraction of the district has been classified as reserve. The proposed land-use plan for the Narok District anticipates integrating some of the wildlife resources with other rangeland activities, but in extensive areas cropping them to extinction. Even this limited degree of conservation may not be feasible unless it proves technically as well as socially possible to make agriculture much more intensive as well as extensive.

Technological inputs are, of course, already exerting an impact on Kenya agriculture. High-yielding grains are becoming moderately widespread, but the most revolutionary breakthrough has been to extend the ecological boundaries within which cereal crops can be grown. Katumani maize, a quick maturing strain adapted to a short wet season can be successfully cultivated with a seasonal fall of only 125-175 mm, whereas 600 m *annual* rainfall was once considered the lower limit for maize growing. This means that huge tracts are now available to land-hungry emigrants from over-populated zones of high rainfall. Several savannah areas, containing much of the country's best wildlife outside parks and reserves, already reveal the trend, with a population growth at least twice the national average: for example, in the environs of the Tsavo Park, with its great stocks of wild herbivores, the growth

rate from immigration has ranged from 10 to 35% per year (Wisner & Mbithi 1972).

Parallel with this agricultural development, the official plan is, by upgrading the livestock industry, to promote beef production in 12 million hectares of rangeland or getting on for a quarter of the entire country. This will involve the kind of ranching developments in arid areas which are often adverse to wildlife interests. Thus experience to date indicates that ranchers in Masailand, whether as a group or individually, attach little value to what they regard as stock-killing predators and herbivores which compete for the grazing, however much such a simplistic attitude to these other elements of the rangeland ecosystem may be open to question. The probability is, therefore, that greater expanses of savannah, which have hitherto afforded habitat to cheetah, will come under disruptive development.

(c) CURRENT CONSERVATION MEASURES

In face of the pervasive problems outlined in the previous sub-sections, existing measures for the conservation of cheetah seem somewhat inadequate. They have to a great extent been based on legislation and the creation of reserves.

(i) Legislation

Almost all countries of sub-Saharan Africa extend complete protection to the cheetah. The exceptions, South Africa and S.W. Africa, are considering new legislation which would give cheetah increased if not total protection. Two international Conventions support complete protection: the 1968 African Convention on Conservation of Nature and Natural Resources is binding only on ratifying countries in Africa, while the 1973 Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora extends to all ratifying countries anywhere and, as breaches of the law in Africa are frequently encouraged by trading demands from outside, should in theory, when brought into force, ensure greater protection for the cheetah. The qualifying phrase 'in theory' recognizes the regrettable fact that disregard for the law has hitherto been a feature of many of the centres of trade in cheetah and cheetah products.

Other breaches of the law arise from conflicts between livestock interests and cheetah requirements. Sometimes these are genuine conflicts, sometimes fabricated, but the fact remains that in Kenya, Rhodesia, S.W. Africa and South Africa, ranchers have taken to trapping or shooting cheetah much more often than in the past, although the practice is entirely against the law in the first and in partial disregard of the law in the last three of these countries. This is excused by self-interest, whether or not the excuse is justified.

Inability to enforce the law and inadequacies of penalties imposed for its contravention are other aspects of protective legislation, to which reference has been made in this report. African governments often lack the resources necessary for enforcement, but even wealthy countries have been notoriously unsuccessful in preventing citizens from marauding alligators, polar bears or birds of prey in contravention of law. Moreover, it must be recognized that Conventions will be of no avail unless persons in breach of the law are penalized appropriately: this does not imply any recommendation for higher penalties for the herdsman who eliminates a predator, but for those who stand to gain big profits from dishonest and illegal dealings in protected

species, the penalty should never be less than twice the local market value of the product concerned, instead of half the value as all too often at present. Other measures known to be effective but too seldom applied are confiscation of guns, vehicles and other tools of the trade used in capture, handling or processing, and the debarment from further trading of anyone caught dealing in illegally taken animals and their products. A more difficult problem is how to ensure that an admirable recommendation such as that made by the International Fur Trade Federation to all its members, calling on them to suspend dealings in cheetah skins during a three year moratorium from September 1971, would be properly observed. Instead it was widely disregarded or even specifically rejected by at least one affiliated organization in southern Africa, and this does seem to point to the need for specific legal backing in such cases which would at least be enforceable however difficult in practice to enforce.

The case of the rancher suffering livestock losses is different. He is not concerned with exploitation of the cheetah's skin, unless the fur trade offers such attractive terms as to induce him to see cheetah depredations where none have occurred. In general he does not expect to profit when he shoots or traps a cheetah, but merely to offset losses, although, even for genuine losses, he should be initially more ready to accept them as part of the price of ranching in wildland Africa, and should no more look for compensation than when he encounters other recurring natural setbacks such as a failure of the rains. Only when losses continue, is there a strong case for offsetting them by some sort of compensatory contribution from those who benefit from the cheetah's survival (see Chapter V). In its absence, the rancher is bound to be tempted to take the law into his own hands.

(ii) The creation of Reserves

Africa now contains over 170 parks and reserves which are included in the United Nations List (there are of course quite a number of others which are not). Their total area exceeds 640, 000 km^2 or well over twice that of Great Britain. Insofar as these protected areas cannot claim to be a representative sample of typical African ecosystems, they probably favour cheetah in that they are heavily biased towards the type of savannah that supports spectacular herbivore congregations. Moreover, some of the parks and reserves are among the largest in the world, with seven of over 20, 000 km^2 and another eleven over 10, 000 km^2, the largest being the 52, 800 km^2 Central Kalahari Game Reserve in Botswana and the 49, 000 km^2 Ouadi Rimé/Ouadi/Achim Fauna Reserve in Tchad. One of the unlisted areas, the strictly controlled Selous Hunting Reserve in Tanzania, is very nearly 40, 000 km^2. Not all of these protected areas have the staff and budget to ensure that the protection is really effective, but there are reasonable prospects that some sub-standard parks and reserves may be upgraded and new ones added. The whole network is often quoted as offering the 'final refuges' where adequate populations of endangered species including cheetah can be safeguarded.

This could constitute a dangerous strategy. Parks as viable self-sustaining oases in developing Africa could prove poor bets for the long term (Myers 1972). Many of them are more interrelated or open-ended than those of North American and Europe, and so more prone to environmental disturbances outside their boundaries and sometimes far from those boundaries. Tsavo Park in Kenya, for example, will not survive in its present form unless its hydrological balance can be safeguarded from siltation caused by agricultural malpractices in arable areas 200 km to the west (Myers 1973). Indeed, many

of these protected areas should be looked upon as heartlands within much larger ecosystems where land-use is or should be complementary. But although there has been much talk of strengthening parks and reserves by surrounding them with buffer zones, controlled areas and the like, next to nothing has materialized in the way of regional planning to that end.

Within the near future, if not already, most parks in savannah zones may become susceptible to all manner of disruptive pressures from outside. As virtual 'islands', they will, for instance, be vulnerable to disease. The effects of a pandemic even on a 21,000 km^2 park such as Tsavo (perhaps affecting the cheetah's prey species, like the rinderpest outbreak of the 1890s), could be critical. The Nairobi Park, which for ten years or more has successfully supported one of the highest densities of cheetah (between 5 and 15 adult cheetah, plus cubs in 114 km^2) cannot for this reason be regarded as an effective sanctuary, since it is only part of a much larger ecosystem of at least 450 km^2 and seasonally more than twice that size.

Kruger Park in South Africa holds around 250 cheetah. Their numbers are alleged to be declining (though the leopard is increasing) in response to rapid bush encroachment in recent years, changes in prey availability and carnivore competition. These environmental factors probably cannot be adequately counterbalanced by park management since they stem in part from the diversion of water supplies for ranching and irrigation far beyond the boundaries. A count of the existing cheetah population is, therefore, not nearly so significant for the survival of the species as knowledge of overall trends, of what range of factors need to be monitored and of changes in the environment indicated by the data acquired. If, as is not unlikely, desiccation and bush growth continue, carrying capacity for cheetah could decline markedly.

These examples suggest that the 'safe sanctuary' strategy for safeguarding cheetah should take account of the vulnerability of protected areas and recognize that much is not known, perhaps not even suspected, about the relevant ecosystem dynamics. One recent idea is that these complex natural systems may be subject to long-term fluctuations of shallow amplitude, possibly reflecting climatic trends or pendulum-like readjustment to a more balanced situation after past perturbations. Thus tentative evidence suggests that such cycles may affect elephants over periods of centuries (Parker, Watson & Bell 1972). If the cheetah, sensitive as it is to shifting conditions in its life-support systems, were similarly affected, its present 'low' densities could reflect a cyclical ebb in its fortunes. If indeed its decline may be explained in this way and does not necessarily imply early extinction, a conservation strategy over-dependent on maintaining fragmented populations in parks and reserves could weight the scales against its chances of survival. Existing protected areas, even assuming that their stability remains assured, would protect no more than 3,000 cheetah: for a species which appears to be especially vulnerable when reduced to isolated populations, this could be a most critical situation.

This is not to rule out the possibility of designating certain areas as of outstanding importance for conserving cheetah. One such would be the section of the Kalahari astride the South Africa/Botswana border, where already one park and one reserve provide almost 35,000 km^2 of arid-zone environments with many favourable habitats for cheetah. Its cheetah population is probably well below 500, but still the largest in any protected area in Africa. Botswana's Central Kalahari Game Reserve (53,000 km^2) should contain a fair number of cheetah, but how many is not known. A similar role could eventually be played by the Ouadi Rimé-Ouadi Achim Reserve in Tchad (49,000 km^2), but at

present the degree of protection it receives makes it incapable of supporting substantial numbers of the cheetah's favoured prey species (notably gazelle).

Several localities in the central Sahara also deserve investigation of their potential for protecting cheetah. Reports frequently suggest that cheetah are seen more often than might be supposed around the Hoggar massif and eastwards to Djanet in Algeria. Similar reports are made of western Libya and even southern Tunisia while cheetah reputedly survive in better than relict status in northern and north-western Mauritania. Since these areas lie outside the terms of reference of the survey, they have not been investigated in any detail.

But it at least seems possible that reserves in these remote areas would not only protect the cheetah with its associated prey species but also be less likely than those of the Sahel to the south to be subject to persistent over-use by nomadic pastoralists.

CHAPTER V

Framework for a New Approach to Long-Term Conservation of the Cheetah

The forecast in this report that less than 10,000 cheetah could survive in Africa south of the Sahara by 1980, and that the decline could become even more critical thereafter, makes it hardly necessary to emphasize the urgency of appropriate conservation measures. The cheetah does not lend itself to the standard methodology for safeguarding endangered species. By contrast, the Bengal tiger, which for the time being is in worse straits, is well adapted to respond to a 'sanctuary strategy'. A 500 km^2 block of suitable jungle habitat can support at least five times as many tigers as would a similar-sized piece of savannah cheetah. There are grounds for believing that a relict population of a few score tigers stands better chance of being genetically viable than the same number of cheetah. The cost per animal of providing effective protection for cheetah would certainly be much higher than for tiger, with less assurance that the investment will pay.

A more hopeful strategy seems to lie in some method of integrating cheetah conservation with multiple-use land planning of savannah.* This will present problems for land-use design beyond the scope of present policies which generally see wildlife as a tourist attraction tied to parks and reserves, or as a resource for cropping. The cheetah's worth must be evaluated within a framework of socioeconomic constraints and politico-legal institutions. Those who derive benefit from assurance of its continued existence should be prepared to bear the costs of predator conservation in developing Africa—costs in terms of their pocketbooks and philosophies alike.

THE SOCIOECONOMIC ANGLE

The cheetah must be seen as one of a series of goods and services competing in the marketplace. However much this pragmatic approach seems alien to the notion that wildlife has its own intrinsic value beyond the scope of justification in monetary terms, the nature of the environments within which the cheetah must maintain its late twentieth-century niche demands that a cash evaluation must be worked out: these environments are not only the physiobiotic entities to which the cheetah and all other creatures including man himself belong, but also constitute the socioeconomic setting for the evolution of human communities.

This implies a marked dichotomy in any analysis of the present situation. While conservation interests may feel that wildlife protection should 'rise above' mere economic arguments, a different perspective is held by the man whose hand is on the lever at a local level, whether he be peasant, pastoralist, rancher or developer. While these agents of decision may not sense any antagonism toward wildlife, may indeed approve of it in general terms, their

* Some evidence of the potential of this approach has recently come from Iran. Fifteen years of regulation of livestock numbers to permit a recovery of wild herbivores, in conjunction with stringent controls to eliminate illegal hunting, have led to a marked come-back for the cheetah (Harrington, pers. comm., 1973)

actions reflect their real priorities. Except for those for whom wildlife is a principle interest, they may in effect discount its needs by virtue of the whole range of their daily actions and their composite response to wildland Africa, which is to modify it. Without conscious knowledge and without malice, they implicitly deny the right of wildlife to exist. Wildlife for its part has had little opportunity to present its counter-claims, since its values have not been expressed through the language of the marketplace* or other institutional mechanisms by which society regulates its affairs—property rights, legal dispensations and the like. Conservation should respond to the implicit lack of consideration for wildlife values by taking these constraints into explicit account when formulating policies.

RANGELAND TRADE-OFFS

A further implication of the divergence of attitudes is that any attempt at integration of the needs of cheetah conservation with man's other needs in rangeland Africa will have to take cognizance of the cheetah's shortcomings as a 'good and service'. As a start, methods should be investigated to minimise the negative impact of the cheetah on livestock interests. An obvious possibility lies in the trade-offs involved for the rancher *at the margin*, i.e. the incremental benefits per unit costs arising from predator control through elimination of offending animals. Thereafter, objectives should be evaluated within the framework of predator management, viewing predators as a resource in which society at large has an interest. The spectrum of benefits and costs—ecological, economic, cultural, aesthetic, etc.—consequent upon the cheetah's continued existence should be weighed, and where appropriate weighted, within a social cost/benefit framework.

The problem of how to balance cheetah conservation against competitive demands on rangeland resources lies in an exceptionally complex field, which cannot be covered here except in a very preliminary way. Presumably the ultimate strategy which would emerge from any evaluation would depend to some degree on a 'grant economy' resolution of the problem (Boudling & Pfaff 1970; Cowan 1973), but before considering this aspect more closely, the size of the problem may perhaps be clarified by taking a look at some of the dilemmas pertaining to common property resources.

THE CONSERVATION OF THREATENED SPECIES AS A PROBLEM IN COMMON PROPERTY MANAGEMENT

Endangered species could usefully be looked at as common property resources. Hitherto when their conservation has been planned, the emphasis has generally been on bio-ecological factors: show how a species is in trouble from over-exploitation, shrinking habitat or other threat to its life-support system, then hand over the problem to society in the expectation that people will do the sensible thing. This could be where conservation has directed too much attention to a single sector of the problems involved and the need now is to broaden the focus to include economic, social, legal, cultural and political inputs.

* The cheetah's main economic contribution is a major tourist attraction. It is however one attraction among many, and were it to disappear the consequences for tourism would be marginal.

The unnecessary extinction of a species represents a loss to human welfare, with consequences that are generally considered at present to be incalculable. Partly because the loss could not up till now be quantified in terms comparable with other human activities, conservation has usually been limited to amending the situation within the framework of present institutions. Measures taken have included attempts to rescue the remnant of an endangered species (Hunter's hartebeest) or to safeguard a crucial sector of its habitat (white rhinoceros), easement dispensations, artificial breeding programmes and the like.

The cheetah has been shown in this report to be eminently worthy of safeguarding as a common property resource. It does not as a rule belong to any identifiable private persons or bodies. In some sense, property rights over it are vested in the rancher on whose land it may or may not be committing depredations; in other senses they adhere to the country within which the ranch is situated. In some senses, too, the species belongs to the whole of Africa as part of its natural heritage, and even to the human race as part of its patrimony. Insofar as various levels thus possess 'rights' in the species, responsibility for safeguarding them must be allocated accordingly, and—herein lies the crux—protective systems must be made operational at multiple levels also.

The survey indicated that factors adverse to the cheetah's survival stem not only from growing populations with growing aspirations, but also from more demand by industrialized countries for goods of the kinds which lead to pressures on the cheetah's life-support systems. As an instance of this, the rising world demand for beef makes ranchers even less willing to share the rangelands with wild predators. What this amounts to is that the cheetah is no longer primarily menaced by direct threats such as being slaughtered for its fur, but more by the indirect results of the life-style of wealthier countries. People who may therefore live very far from Africa share responsibility for the cheetah's survival and should be required to share the price of permitting it to have a future. Many such people would probably prefer to see the external responsibility somehow built in to the conservation process and, being keen that the cheetah remains in existence, would be quite ready, instead of receiving them free, to pay for the 'goods and services' which it represents.

The haphazard wildlife protection of the past is less likely to work in the future. The impact of human activities spreads as marketplace forces generate greater momentum. This is not to say that the former strategy did not achieve wonders.

But the methods of the 1960s may no longer be able to moderate pervasive impacts during the 1970s, let alone the 1980s: the scene in 1980 may resemble 1960 less than 1960 resembled 1900. Rather then struggle to compensate for deficiencies within present institutional frameworks, the conservationist might be inclined towards the restructuring of the social systems involved, that is of all regulatory mechanisms by which common property resources are safeguarded and utilized. Such adaptations are difficult enough at national level, but at international level they enter an area where the appropriate legal, economic and political practices have as yet received no general acceptance. A further complication lies in the socioeconomic and cultural divergences between countries where no doubt the majority of those with an overriding interest in the study and conservation of wild flora and fauna live, and the countries, in which a rare species such as the cheetah lives but faces diminishing prospects. These latter countries may well be trying to safeguard their cheetah, but are scarcely in a position to subsidise the rest of the world by

accepting sole responsibility for the cost. The urgency of this problem cannot be over-stressed; the situation is not waiting on a solution, since a solution is already being imposed—albeit by default rather than by design.

Before concluding with a suggestion for the kind of international institution which might help to solve the problem, it seems desirable to digress briefly to touch on the educational aspect. The need for education in this context might be reduced by a solution of the economic issues, but would certainly not be obviated.

The ecological significance of predators, their role in ecosystem stability and so forth, is poorly understood, even where the cultural and aesthetic value of the great cats is appreciated. It is the first of these aspects which needs emphasis. In education campaigns in Africa, which should be directed primarily at people who undergo losses by virtue of the predators' existence (the Wildlife Clubs in Kenya, by contrast, are mainly composed of members of intensive farming communities who have had to bear few costs as a result of wildlife conservation), it is essential to move beyond the notion that wildlife has its own self-evident rationale, derived from a mixture of mystique and talk of mankind's heritage. Otherwise the response of the yeoman rancher in Masailand, exhorted to protect the cheetah, may well be that he sees no direct financial benefit from the cheetah and only knows about its depredations. Some Africans are aware that American ranchers are not yet persuaded of the value of coyotes and cougars or Europeans of that of the wolf. These situations may not be precise parallels, but from an African viewpoint they suggest double standards.

In short educational campaigns serve an excellent purpose provided they are not detached from considerations of everyday life and relate to constraints on development as seen locally as well as by outsiders.

INSTITUTIONAL INPUTS: A WORLD HERITAGE TRUST FOR THREATENED SPECIES?

When the costs and benefits represented by the cheetah have been identified, and as far as possible quantified, the costs perceived within an African context may well prove the larger. The aim must be to adjust the adverse ratio through some form of compensatory mechanism entailing disbursement of funds by communities which at present place greatest premium upon the cheetah's survival.

To some extent a precedent is available in the World Heritage Trust, which aims at giving financial assistance under UNESCO auspices for the protection of cultural and natural monuments of unique value.* The basic principles could be equally valid in a Trust for Endangered Species. During the decade since UNESCO rescued the Abu Simbel temples on the lines now envisaged for the operation of the World Heritage Trust, the species to which the temples

* An institutional device of this sort is of limited efficacy to the extent that in effect it is trying to establish islands before the tide comes in. Rather it should be seeking ways of adapting to the tide or better still adapting the tide itself by modifying the whole system of management of unique resources. Otherwise it may find itself facing annual disbursements on an ever increasing scale to counteract the competitive demands of development processes.

were dedicated, the Nile crocodile, has fallen into ever-worsening straits. The provisions of a Trust for endangered species might sometimes overlap with those of the existing Trust for natural sites, but this would not apply to the cheetah or the crocodile in that neither species maintains adequate numbers in any of the world famous parks of reserves.

The main purpose of a Trust of the sort proposed would be to offer security to a species which is under threat for reasons of fundamental deficiencies in society. The cheetah is not primarily endangered because particular people kill particular specimens. Rather it is moving towards extinction because of the way the world at large wishes to live. This represents a significant change in the concept of 'species endangerment', which in turn implies that there must be a fresh approach to the problem. A reappraisal of conservation strategy is all the more appropriate insofar as future trends seem likely to precipitate further changes: few natural environments in Africa will remain undisturbed, and the cheetah may eventually face as much pressure on its habitat as the tiger now encounters in Asia.

The present position thus represents a turning-point in methods of dealing with endangered species in Africa. The conservation of the cheetah could be a measure of how far man is able and ready to reach some degree of accord with his natural environment—and 'man' means the inhabitants not only of Africa but of the world.

SOME SPECIFIC RECOMMENDATIONS

1. Arising out of Chapter II on Ecology and Ethology, further research should be urgently undertaken to extend knowledge of the cheetah's life-support systems, covering habitat preferences and requirements, prey species, carnivore competition and all other factors which relate to stability of cheetah populations under different conditions.

2. Arising out of Chapter III reviewing cheetah status region by region:

   (a) absolute protection should be extended to the cheetah as a threatened species throughout Africa, in conformity with the provisions of the African Convention and the Washington Convention;
   (b) this implies that the cheetah should be safeguarded from all forms of commercial exploitation whether through the fur trade or the live-export trade;
   (c) it also implies that institutional means should be investigated for integrating the needs of cheetah conservation with other land-use objectives, notably upgraded pastoralism and commercial ranching, with their legitimate interests;
   (d) in order not only to stabilize present cheetah populations but also to stimulate their recovery to a level which accords with the carrying capacity of habitats available, measures should be taken to rebuild the prey populations where they have been unduly depleted, notably in the Sahel and the Horn of Africa; and
   (e) for the purpose of restoring wildlife resources in such regions, development strategies which tend to emphasize single-purpose interventions—such as wells and other water installations—should be rigorously re-appraised to ensure that they accord with the holistic perspectives in this sensitive environment.

3. Arising out of Chapter IV on the basic factors and issues affecting the cheetah's status:-

   (a) cheetah conservation efforts must recognize the significance of the upsurge in human numbers and human aspirations in Africa and its implications for cheetah habitat; and any conservation programme for the species must accept that its survival is only part of the complex problems at issue; and
   (b) in consideration of the precarious status of the cheetah, the fur trade inside and outside Africa should recognize its responsibility to do everything possible to terminate past disregard for conservation legislation.

4. Arising out of Chapter V on the long-term conservation of the cheetah:-

   (a) greater consideration should be given to the socio-cultural and legal problems involved in maintaining the cheetah as a common property resource, which forms part of Africa's natural heritage and mankind's patrimony;
   (b) urgent attention should be directed to the possibility of conserving cheetah in rangeland Africa outside parks and reserves, having regard to the limitations of protected areas as 'ultimate sanctuaries' for ensuring the cheetah survival; and
   (c) an institutional framework should, therefore, be devised to allow people outside Africa to take an active interest in safeguarding the cheetah; for example, a structure on the lines of the World Heritage Trust might be developed to give protection not only to threatened biotopes of exceptional value but also to endangered species in that category, such as the cheetah.

References

ADAMSON, J. 1969. *The Spotted Sphinx*. Collins, London.

—— 1971. *Pippa's Challenge*. Collins, London.

ALLEN, W. A. 1965. *The African Husbandman*. Oliver and Boyd, Edinburgh.

ANNA, M. 1973. *Etude du Léopard et du Guépard dans l'Afrique au Sud du Sahara: leur situation actuelle dans la République du Tchad*. Directorate of National Parks and Game Reserves in Tchad. 4 pp. mimeo.

ANSELL, W. F. A. 1960. *Mammals of Northern Rhodesia*. Government Printer, Northern Rhodesia.

BAKER, R. 1973. The Need for Long-Term Strategies in Areas of Pastoral Nomadism. In *Proceedings of Symposium on Drought in Africa*. Centre for African Studies, School of Oriental and African Studies, London University, July 19-20, 1973.

BELL, R. H. V. and GRIMSDELL, J. J. R. 1973. The Persecuted Black Lechwe of Zambia. *Oryx 12* (1): 77-92.

BERRYMAN, J. H. 1972. The Principals of Predator Control. *J. Wildl. Mgmnt.* 36 (2): 395-400.

BOLTON, M. 1973. Notes on the current status and distribution of some large mammals in Ethiopia (excluding Eritrea). *Mammalia* 37 (4): 563-586.

BOULDING, K. E. and PFAFF, M. P. 1970. *The Grants Economy and The Development Gap*. Paper presented the Meeting of the International Economic Association, Bled, Yugoslavia, August 29, 1970. 40 pp., mimeo.

BROWN, L. H. 1965. *Africa, a Natural History*. Random House, New York.

—— 1969. Ethiopia's Wildlife Conservation Programme. *Biol. Cons.* 1: (4) 332-334.

BROWN, G. H. H. 1970. The Conservation Situation in Ethiopia. *Biol. Cons.* 2 (4): 293-298.

BRUCE, P. 1971. *Game Digest of the Cheetah Acinonyx jubatus (Schreber)*. Dept. of Zoology, University of Pretoria. 24 pp., mimeo.

CAIN, S. A. 1972. *Report by Advisory Committee on Predator Control*. U.S. Department of the Interior, Washington, D.C.

CAMPBELL, A. C. 1973. The National Park and Reserve System in Botswana. *Biol. Cons.* 5 (1): 7-14.

—— and CHILD, G. 1971. The Impact of Man on The Environment of Botswana. *Botswana Notes and Records* 3: 91-110.

CHILD, G. and LE RICHE, J. D. 1969. Recent Springbok Treks in Southwestern Botswana. *Mammalia* 33: 499-504.

CLOUDSLEY-THOMPSON, J. L. 1971. Recent Expansion of the Sahara. *Intern. J. Environmental Studies* 2: 35-39.

—— 1973. Developments in the Sudan Parks. *Oryx 12* (1): 49-52.

CORFIELD, T. F. and HAMILTON, P. H. 1971. *The Conservation and Management of Wildlife in Central Africa*. Report of the Cambridge Central Africa Project 1669-70, I.U.C.N., Morges.

COWAN, I. McT. 1973. Vanishing Species: Habitat Change and Reconciling Conflict. In *Conservation for Development* Proc. of I.U.C.N.'s 12th Technical Meeting, Banff, Canada: 321-334. I.U.C.N. New Series No. 28, Morges.

DORST, J. and DANDELOT, P. 1970. *A Field Guide to the Larger Mammals of Africa*. Collins, London.

EATON, R. L. 1970. Group Interactions, Spacing and Territoriality in Cheetah. *Z. Tierpsych.* 27 (4): 481-91.

EATON, R. L. 1974. *The Cheetah*. Van Nostrand, New York.

ECONOMIC COMMISSION FOR AFRICA, 1972. *Report of the African Population Conference, Accra, Ghana, 9-18 December, 1971*. Addis Ababa.

ESTES, R. D. 1967. Predators and Scavengers. *Natural History* 76 (3): 38-47.

EWER, R. 1973. The Carnivores. Weidenfeld and Nicholson, London.

F.A.O. 1969. *Wildlife Management in Parks and Reserves of Mali*. F.A.O. Report No. TA2698, F.A.O. Rome.

FLORIO, P. and SPINELLI, L. 1967. Successful Breeding of a Cheetah in a Private Zoo. *Int. Zoo Yearbook* 7: 150-152.

FUNAIOLI, U. and SIMONETTA, A. A. M. 1966. The Mammalia Fauna of the Somalia Republic: Status and Conservation Problems. *Monitore Zoologico Italiano*, Supplement to Vol. 74.

GRAFF, G. DE 1971. The Impact of Development on Wild Areas (including National Parks) and on such Areas Across International Boundaries. In *Proceedings of Symposium on Nature Conservation as a Form of Land Use*: 67-70. Southern African Regional Commission for the Conservation and Utilisation of the Soil, Pretoria.

GRAHAM, A. D. and PARKER, I. S. C. 1965. *East African Wildlife Society Cheetah Survey: Report by Wildlife Services*. 42 pp., mimeo.

GROVE, A. T. 1973. Land Use and Drought in Africa. In *Proc. of a Symposium on Drought in Africa*. Centre for African Studies, School of Oriental and African Studies, London University, 19-20 July, 1973.

GUSTAVSON: C. R., GARCIA, J., HANKINS, W. G. & RUSINIAK, K. W. 1974. Coyote Predation Control by Aversive Conditioning. *Science* 184: 581-583.

HANCE, W. A. 1970. *Population, Migration and Urbanisation in Africa*. Columbia University Press, New York.

HAPPOLD, D. C. D. 1973. The distribution of large mammals in West Africa. *Mammalia* 37 (1): 88-93.

HEMMING, C. F. 1966. The Vegetation of the Northern Region of The Somalia Republic. *Proc. Linn. Soc. Lond.* 177 (2): 173-252.

HERDMAN, R. 1972a. Cheetah Breeding Programme. In R. L. Eaton (ed.) *The World's Cats*. Vol. 1. Ecology and Conservation: 255-263. World Wildlife Safari, Winston, Oregon.

—— 1972b. A Brief Discussion on Reproductive and Maternal Behaviour in the Cheetah (*Acinonyx jubatus*). A.A.Z.P.A. Conference, Portland, Oregon, 29th September—6th October, 1972. 16 pp.

—— 1972c. Captive Cheetah Reproduction. *Zoonooz* (Publication of the San Diego Zoo) 45 (10): 4-12.

HORNOCKER, M. G. 1972. Predator Ecology and Management—What Now? *J. Wildl. Mgmnt.* 36 (2): 401-404.

HUNTLEY, B. J. 1973. *Outlines of Wildlife Conservation in Angola*. Serviços de Veterinaria, Luanda, Angola, 35 pp., mimeo.

INTERNATIONAL LABOUR OFFICE, 1972. *Employment, Incomes and Equality: A Strategy for Increasing Productive Employment in Kenya*. I.L.O., Geneva.

JARMAN, T. R. W. and BUTLER, K. E. 1971. Livestock Management and Production in the Kalahari. *Botswana Notes and Records*, Special Edition No. 1: 132-139.

JONES, D. M. 1973. Destruction in Niger. *Oryx* 12 (2): 227-33.

KLEIMAN D. G. and EISENBERG, J. F. 1973. Comparisons of Canid and Felid Social Systems from an Evolutionary Perspective. *Anim. Beh.*

KRUUK, H. 1972. *The Spotted Hyena*. University of Chicago Press, Chicago.

LABUSCHAGNE, W. 1974. *Ecology and Ethology of the Cheetah in Kruger and Kalahari Gemsbok National Parks, South Africa.* Unpub. Ph.D. Thesis, University of Pretoria.

LAMB, H.H. 1972. *Climate: Past, Present and Future*, Methuen, London.

LAMPREY, H. F. 1964. Estimation of the Large Mammal Densities, Biomass and Energy Exchange in the Tarangire Game Reserve and the Masai Steppe in Tanganyika. *E.Afr. Wildl.J.* 2: 1046.

LEOPOLD, A.S. 1964. Predator and Rodent Control in the United States. *Trans.N. Amer. Wildl.Con.* 29: 27-49.

LIKIMANI, J. C. and RUSSELL, J. J. 1971. *Kenya: A Country Profile*. The Population Council, New York.

MANTON, V. J. A. 1970. Breeding Cheetah at Whipsnade Park. *Int. Zoo Yearbook* 10: 85-86.

——. 1971. A Further Report on Breeding Cheetah at Whipsnade Park. *Int. Zoo Yearbook* 11: 125-126.

McCABE, R. A. and KOZICKY, E. L. 1972. A Position on Predator Management. *J. Wildl. Mgmnt.* 36 (2) 382-394.

McLAUGHLIN, R. 1970. *Aspects of the Biology of the Cheetah Acinonyx jubatus (Schreber) in Nairobi National Park.* M.Sc. Thesis, unpub. University of Nairobi.

METZKE, G. E. 1971. *Settlement Reorganisation for the Production of African Wildlife in Miombo Forestlands: A Spatial Analysis.* M.Sc. Thesis, University of California, Berkeley.

MITCHELL, B. L., SHENTON, J. B. and UYS, J. C. M. 1965. Predation on Large Mammals in the Kafue National Park, Zambia. *Zool. Afr.* 1 (2): 297-318.

MOORE, J. E. 1971. Rural Population Carrying Capacity of the Districts of Tanzania. *Research Paper No. 18.* University of Dar es Salaam, Tanzania.

MYERS, N. 1972. National Parks in Savannah Africa. *Science* 178: 1255-1263.

—— 1973. Tsavo National Park, Kenya, and its Elephants: an Interim Appraisal. *Biol. Cons.* 5 (2): 123-132.

—— 1975a. *Cheetah, Hyenas and Gazelles: Some Aspects of Interdependent Relationships, with Implications for Conservation* (in prep.).

—— 1975b. *The Leopard in Africa: Report of a Survey Throughout Africa South of the Sahara.* I.U.C.N., Morges (in press).

OMINDE, S. H. and EJIOGU, C. N. 1972. *Population Growth and Economic Development in Africa.* Heinemann, London.

OWEN-SMITH, G. L. 1971. *The Kaokoveld: An Ecological Basis for Future Development Planning.* Ministry of Agriculture, Windhoek, S.W. Africa.

PARRIS, R. 1970. Important Role of the Kalahari Pans. *African Wildl.* 24: 234-237.

—— 1971. The Ecology and Behaviour of Wildlife in the Kalahari. *Botswana Notes and Records.* Special Edition No. 1: 96-107.

PIENAAR, U. DE. V. 1963. The Large Mammals of the Kruger National Park—Their Distribution and Present-day Status. *Koedoe* 6: 1-38.

—— 1969. Predator-Prey Relations amongst the Larger Mammals of the Kruger National Park. *Koedoe* 12: 108-176.

POCHE, R. 1973. Niger's Vanishing Parc du 'W'. *Oryx* 12 (2): 216-22.

RAWLINS, C. G. C. 1972. Cheetah *Acinonyx jubatus* in Captivity. *Int. Zoo Yearb.* 12: 119.

REPUBLIC OF THE SUDAN, 1971. *National Report of the Democratic Republic of the Sudan to the United Nations Conference on the Human Environment.* National Council for Research, Khartoum.

REPUBLIC OF ZAMBIA, 1971. *National Report on the Human Environment: An Assessment Prepared for the United Nations Conference in Stockholm.* Government Printer Lusaka.

RICHTER, W. VON. 1969. *Survey of the Wild Animal Hide and Skin Industy.* Report to the Government of Botswana, FAO TA 2637. F.A.O., Rome.

—— 1972. Remarks on Present Distribution and Abundance of Some South African Carnivores. *J. Sn. Afr. Wildl. Assoc.* 2 (1): 9-16.

ROWLAND, P. J. 1971. Coordination of Control of the Movements of Wildlife Products Across International Boundaries. In *Proceedings of Symposium on Nature Conservation as a Form of Land Use:* 83-84. Southern African Regional Commission for the Conservation and Utilisation of the Soil, Pretoria.

SCHALLER, G. B. 1972. *The Serengeti Lion.* University of Chicago Press, Chicago.

SHORTRIDGE, G. C. 1934. *The Mammals of South West Africa.* Heinemann, London.

SMITHERS, R. H. N. 1966. *The Mammals of Rhodesia, Zambia and Malawi.* Collins, London.

—— 1968. Carnivora, Felidae. In *Preliminary Identification Manual for African Mammals.* Smithsonian Institution, Washington, D.C.

—— 1971. *The Mammals of Botswana.* Trustees, National Museums, Rhodesia, Salisbury.

SPINELLI, P. and SPINELLI, L. 1968. Second Successful Breeding of Cheetahs in a Private Zoo. *Int. Zoo Yearbook* 8: 76-78.

STEVENSON-HAMILTON, J. 1947. *Wildlife in South Africa.* Cassells, London.

STEWART, D. R. M. and STEWART, J. 1963. The Distribution of Some Large Mammals in Kenya. *J. E. Afr. Nat. Hist. Soc.* 24 (3): 1-51.

STRANG, R. M. 1973. Bush Encroachment and Veld Management in South-Central Africa: The Need for Reappraisal. *Biol. Cons.* 5 (2): 96-104.

SWIFT, J. 1972. Pastoral Nomadism as a Form of Land Use: The Tuareg of the Adrar des Iforas. In *Proc. Int. Afr. Inst. Sym. on Pastoralism in Tropical Africa: Traditional Societies and Their Development.*. Oxford University Press (in press).

—— 1973. Disaster and a Sahelian Nomad Economy. *Symposium on Drought in Africa.* Centre for African Studies, School of Oriental and African Studies, London University, July 19-20, 1973.

SWYNNERTON, G. H. and HAYMAN, R. W. 1950. A Checklist of the Land Mammals of the Tanganyika Territory and the Zanzibar Protectorate. *J. E. Afr. Nat. Hist. Soc.* 20 (617): 274-392.

THOMSON, B. P. 1971. The Current Significance of Livestock Production in the Kalahari. *Botswana Notes and Records*, Special Edition No. 1: 122-131.

VAN DER WERKEN, H. 1968. Cheetahs in Captivity. *Zool. Gart.* 35 (3): 156-161.

WAGNER, F. H. 1972. *Coyotes and Sheep: Some Thoughts on Ecology, Economics and Ethics.* 44th. Honor Lecture, Faculty Association, Utah State University, Logan, Utah.

WICKENS, G. E. 1973. Overgrazing: A Social Problem in the Sudan. In *Proc. of a Symposium on Drought in Africa.* Center for African Studies, School of Oriental and African Studies, London University, 19-20 July, 1973

WILSON, V. J. 1969. The Larger Mammals of the Matopos National Park. *Arnoldia* 4 (13): 1-9.

WINSTANLEY, D. 1973. Drought in the Sahel Zone: Severity, Causes and Prospects. In *Proc. of a Symposium on Drought in Africa.* Centre for African Studies, School of Oriental and African Studies, London University, July 19-20, 1973.

WISNER, B. and MBITHI, P. M. 1972. *Drought in Eastern Kenya: Comparative Observations of Nutritional Status and Farmer Activity at 17 Sites.* Paper presented at 22nd. Int. Geog. Congr., Commission on Man and Environment, July 24-30, Calgary. 28 pp.

WROGEMANN, N. 1974. *The Cheetah: Its Natural History and Conservation.* Purnell's, Johannesburg (in press).

Appendix

SCIENTIFIC NAMES OF SPECIES MENTIONED IN TEXT.

Addax, *Addax nasomaculatus*.

African rabbit, *Pronolagus marjorita*.

Baboon, *Papio anubis*.

Barbary sheep, *Ammotragus lervia*.

Buffalo, *Syncerus caffer*.

Cheetah, *Acinonyx jubatus*.

Coyote, *Canis latrans*.

Crocodile, *Crocodylus niloticus*.

Dikdik, *Madoqua kirki*.

Dog, Wild, *Lyacon pictus*.

Duiker, grey, *Sylvicapra grimmia*.

Duiker, yellow-backed, *Cephalophus silvicultrix*.

Eagle, Martial, *Polemaetus bellicosus*.

Eland, *Taurotragus oryx*.

Gazelle, Dama, *Gazella dama*.

Gazelle, Dorcas, *Gazella dorcas*.

Gazelle, Grant's, *Gazella granti*.

Gazelle, Loder's or Slender-horned, *Gazella leptoceros*.

Gazelle, Red-fronted, *Gazella rufifrons*.

Gazelle, Thomson's, *Gazella thomsonii*.

Gerenuk, *Lithocranius walleri*.

Hare, *Lepus capensis, crawshayi, victoriae* and other spp.

Hare, Red rock, *Pronolagus crassicaudatus*.

Hartebeest, *Alcelaphus buselaphus* (including the subspecies -Bubal *major*, Coke's *cokii*, Jackson's *jacksoni* and Lelwel's *lelwel*) and Lichtenstein's *A. lichtensteinii*.

Hyena, Spotted, *Crocuta crocuta*.

Hyrax, *Procavia capensis*, also *Dendrohyrax brucei*.

Impala, *Aepyceros melampus*.

Jackal, black-backed, *Canis mesomelas*.

Jackal, golden, *Canis aureus*.

Jackal, side-striped, *Canis adustus*.

Klipspringer, *Oreotragus oreotragus*.

Kob, Buffon's, *Kobus kob*.

Kudu, greater, *Strepsiceros strepsiceros*.

Kudu, lesser, *Strepsiceros imberbis*.

Lechwe, *Kobus leche*.

Leopard, *Panthera pardus*.

Lion, *Panthera leo*.

Monkey, Patas, *Erythrocebus patas*.

Oribi, *Ourebia ourebi*.

Oryx, *Oryx gazella*.

Oryx, scimitar-horned, *Oryx tao*.

Ostrich, *Struthio camelus*.

Pangolin, giant, *Manis gigantea*.

Porcupine, *Hystrix africaeaustralis, stegmanni* and *geleata*

Ratel, *Mellivora capensis*.

Reedbuck, *Redunca redunca*.

Rhinoceros, Black, *Diceros bicornis*.

Rhinoceros, White, *Ceratotherium simum*.

Roan, *Hippotragus equinus*.

Sable, *Hippotragus niger*.

Serval, *Felis serval*.

Sitatunga, *Limnotragus spekei*.

Springhaas, Jumping Hare or Spring Hare, *Pedetes capensis*

Tiger, *Panthera tigris*.

Topi, *Damaliscus korrigum*.

Tsessebe, *Damaliscus lunata*.

Warthog, *Phacochoerus aethiopicus*.

Waterbuck, *Kobus defassa*.

Wildebeest, *Connochaetes taurinus*.

The International Union for Conservation of Nature and Natural Resources (IUCN) is an independent international body, formed in 1948, which has its headquarters in Morges, Switzerland. It is a Union of sovereign states, government agencies and non-governmental organizations concerned with the initiation and promotion of scientifically-based action that will ensure perpetuation of the living world--man's natural environment—and the natural resources on which all living things depend, not only for their intrinsic cultural or scientific values but also for the long-term economic and social welfare of mankind.

This objective can be achieved through active conservation programmes for the wise use of natural resources in areas where the flora and fauna are of particular importance and where the landscape is especially beautiful or striking, or of historical, cultural or scientific significance. IUCN believes that its aims can be achieved most effectively by international effort in co-operation with other international agencies, such as UNESCO and FAO.

The World Wildlife Fund (WWF) is an international charitable organization dedicated to saving the world's wildlife and wild places, carrying out the wide variety of programmes and actions that this entails. WWF was established in 1961 under Swiss law, with headquarters also in Morges.

Since 1961, IUCN has enjoyed a symbiotic relationship with its sister organisation, the World Wildlife Fund, with which it works closely throughout the world on projects of mutual interest. IUCN and WWF now jointly operate the various projects originated by, or submitted to them.

The projects cover a very wide range, from education, ecological studies and surveys, to the establishment and management of areas as national parks and reserves and emergency programmes for the safeguarding of animal and plant species threatened with extinction as well as support for certain key international conservation bodies.

WWF fund-raising and publicity activities are mainly carried out by National Appeals in a number of countries, and its international governing body is made up of prominent personalities in many fields.