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Abstract: The challenge that wildlife managers face in effectively conserving cheetahs is two-fold. In recent years, much focus has been given to improving successful captive breeding of cheetahs, while little emphasis has been given to the re-introduction of cheetahs. Our efforts to breed cheetahs in captivity have been only partially successful. Still, the captive cheetah population is not yet self-sustaining and is much less successful than breeding programs for Indian lions or Siberian tigers. Moreover, in order to realize our goal of cheetah survival and recovery in the wild, we must ensure that captive-bred cheetahs can be successfully re-introduced and that adequate habitat exists for this purpose. Thus, our land management philosophy must evolve from that of a "sanctuary" approach to one which investigates opportunities for cooperative multiple-use land management. Namibia, with perhaps the world's only viable cheetah population, appears to offer the greatest potential for the cheetah's conservation.

# DEVELOPING EFFECTIVE CHEETAH CONSERVATION AND RECOVERY PLANS : NAMIBIA AS A CASE STUDY

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## INTRODUCTION

A strong ecological argument can be made for cheetah conservation on both ecological and philosophical grounds. The cheetah plays an important role as a top predator, ensuring the health of prey populations by selectively pruning the weak and old. On a more philosophical level, it can be argued that preserving the fastest animal on earth is an ethical obligation our generation owes to future generations. In addition, unlike lions, cheetahs are not dangerous to humans, and thus, management plans can be developed to encompass cheetah populations and humans. In fact, humans have been living with cheetahs for 5000 years (*CNN*, 11/8/93), and can be traced back to Sumerians and dynastic Egyptians. Known as "hunting leopards", cheetahs have served as hunting companions since 3000 BC. Kubla Khan reportedly kept 1000 cheetahs in his court (*CNN*, 11/8/93). The opportunity costs of losing such a spectacular species due to negligent management are exorbitant on an ecological, cultural and ethical level.

The challenge facing wildlife managers in effectively conserving cheetahs is two-fold. In recent years, much focus has been given to improving successful captive breeding of cheetahs, while little emphasis has been given to the reintroduction of cheetahs. Our efforts to breed cheetahs in captivity have been only partially successful. Since 1956, the following institutions have had breeding successes: the Whipsnade Zoological Park, U.K; the de Wildt Breeding Center, South Africa; the San Diego Wild Animal Park, California; Wildlife Safari, Oregon; the Fossil Rim Wildlife Center, Texas; and the Columbus Zoo, Ohio (Caro, 1994). Still, the captive cheetah population is not yet self-sustaining and is much less successful than breeding programs for Indian lions or Siberian tigers. Only 14.9 percent of imported

individuals reproduced successfully between 1956 and 1986, and infant mortality claimed 33 percent of 1046 cubs born between 1978 and 1988 (Caro, 1994).

Moreover, in order to realize our goal of cheetah survival and recovery in the wild, we must ensure that captive-bred cheetahs can be successfully reintroduced and that there exists adequate habitat for this purpose. While recognizing that habitat loss is the primary threat to the future survival of cheetahs, we must accept that human population pressures may prohibit the creation of additional preserves. Thus, our land management philosophy must evolve from that of a "sanctuary" approach to one which investigates opportunities for cooperative multiple-use land management. Because the cheetah is not dangerous to humans and is adversely affected by other predators, it makes an excellent candidate for this new type of conservation, provided local communities are fully educated and involved in such land management decisions. Namibia, with perhaps the world's only viable cheetah population, appears to offer the greatest potential for the cheetah's conservation.

## DISCUSSION

### I. NATURAL HISTORY OF CHEETAHS

Effective management plans for cheetahs must address their physiology, reproductive history, and social behavior as well as their ecological niche within their habitats. Cheetahs are incredibly specialized animals, morphologically adapted for high speed hunting. With their slight build, light bones, and long, thin legs, cheetahs have evolved to outpace their prey with incredible speeds of up to 112

kilometers (or 70 miles) per hour. In fact, a cheetah beats a Ferrari GTO off the line, needing less than three seconds to reach fifty miles-per-hour, instead of four seconds required by the car (Lumpkin, 1993). This speed is made possible by a deep chest for greater oxygen intake and the detachment of the cheetah's shoulder blade from its collar bone, enabling the animal to achieve much longer strides (Caro, 1994).

Cheetahs have both a larger litter size and more frequent reproduction than other felids. Up to eight cubs can be born in a single litter, and females are estrous every twelve days. On the other hand, cheetahs have the highest cub mortality of non-hunted felids, approaching 96 percent as a result of predation. In addition, cheetahs have a relatively short life expectancy of only 6.9 years in the wild and 11.7 years in captivity. As a result, cheetahs have been characterized as having a "live fast, die young" reproductive strategy (Caro, 1994).

While the cheetah is quite morphologically specialized, its diet is remarkable diverse. They are known to prey on animals ranging from mole rats to buffalo calves, rarely taking animals exceeding their own body weight of 100 pounds. In the Serengeti ecosystem, cheetahs have demonstrated a definitive preference for Thompson's gazelles, which compose 90 percent of their kills (Caro, 1994).

The cheetah is a diurnal hunter that relies on sight to capture prey. Its chase covers several hundred yards and culminates with a deadly stranglehold to suffocate its prey. Because cheetahs lack an evaporative cooling mechanism, however, they must either catch or abandon their prey after 300 yards to avoid dangerous overheating (Lumpkin, 1993). Due in part to its relatively smaller size and its exhaustion following a successful attack, cheetahs are often deprived of their prey by

predators. Hyenas may take up to 13 percent of cheetah kills (Caro, 1994). In addition, because cheetahs hunt using a visually spectacular hunting technique during the light of day, they may attract predators (Eaton, 1978). Cheetahs also risk predation on their cubs, which accompany their mothers to the hunts at eight weeks of age, while they are pursuing their prey.

Cheetahs have a social structure unique from all other mammals. While it was originally thought that cheetahs were solitary felids, like leopards, it has been found that cheetahs are in fact semi-social (Eaton, 1978). That is, while females are solitary except when raising cubs to the age of 13 to 20 months, males often form pairs or trios. Studies in the Serengeti plains ecosystem show that approximately 40 percent of cheetah males are solitary, 40 percent live in pairs, and 20 percent live in trios (Caro & Laurenson, 1989). One hypothesis suggests that the limited sociality of cheetahs results from their being exclusively carnivorous, and not opportunistic scavengers (Caro, 1994).

Cheetahs also exhibit territoriality. Females have overlapping home ranges of approximately 800 square kilometers in the Serengeti plains. These ranges are too large to be defended by males, so it is in the interest of males to form coalitions to defend "hot spots," where female territories overlap (Caro & Laurenson, 1989). In fact, males who do not form coalitions are unlikely to hold a territory, whereas half of male pairs and trios successfully defend territories. These territories may change ownership but their boundaries appear to remain constant over time, although they are not occupied year-round (Caro & Collins, 1986). The intense competition for territories triggers fighting between males which results in only half of males who reach adolescence surviving to old age (Caro & Laurenson, 1989).

## II. DENSITY AND DISTRIBUTION OF CHEETAHS

If our goal as land managers is not only to conserve existing cheetah habitats, but to attempt to recover cheetahs throughout their former range, we must understand the historical and current ranges and densities of cheetahs.

Cheetahs have survived for over eighteen million years throughout many ecosystems ranging from woodlands to semidesert across Africa, the Middle East and Asia (Caro, 1994), including at least two species in western North America (Lumpkin, 1993). Because North American cheetahs are ancestral to Eurasian cheetahs, it is believed that the former crossed the Bering Land Bridge into Siberia during the Pleistocene (Lumpkin, 1993). Stephen J. O'Brien, of the National Cancer Institute, has found that, based upon genetic analysis, the cheetah population crashed approximately 10,000 years ago, creating a "genetic bottleneck" by severely reducing genetic diversity within the species (Pennisi, 1993). In fact, it is possible that only one female and her cubs survived to rebuild the population (Lumpkin, 1993). At the time of Christ, the population had regrown, and cheetahs were widely distributed throughout Africa and Southwest Asia. By the turn of the century, there were approximately 100,000 cheetahs in Africa (Braun, 1994).

Currently, cheetahs demonstrate low population numbers despite a relatively wide distribution throughout Africa. Although relic populations may remain in Iran and northwest Afghanistan, cheetahs have been virtually eliminated from the rest of Asia and India. In 1975, Myers estimated the population of cheetahs in 28 sub-Saharan African countries as between 7,300 and 22,950 (Caro, 1994). A current census is ongoing, but estimates vary from 5,000 to 25,000, with a probable estimate

among 9,000 to 12,000 (*CNN*, 11/8/93). Compared to other carnivores, cheetahs have lower population densities. For example, the Serengeti plains support only 200-250 cheetahs compared to 2000 lions, 3000 hyenas, and 1000 leopards (Eaton, 1978).

## III. THREATS TO CHEETAH SURVIVAL

One of the most well-publicized and controversial threats to cheetahs concerns its genetic homozygosity. Cheetahs' reduced genetic variability has been dated back to a population bottleneck at the end of the Pleistocene era, around 10,000 years ago (Pennisi, 1993). This lack of genetic diversity is unusual because, unlike other species which demonstrate similar genetic homozygosity, it is not believed to be caused by humans or by being confined to an island (Caro, 1994).

Some scientists have argued that the cheetah's lack of genetic diversity may predispose it to high levels of juvenile mortality. It appears, however, that predation, and not genetics, is a more important factor. In fact, other scientists argue that juvenile mortality resulting from lack of genetic variability is no higher in cheetahs than in other species (Caro, 1994). High infant mortality and low levels of breeding in captivity may be due to improper nutrition and susceptibility to disease in captivity instead of to genetic homozygosity (Cohn, 1986).

It has also been theorized that the cheetah's low genetic variability may increase the species' risk to disease. Cheetahs demonstrate a 90-99 percent reduction in measurable allelic variation, including a genetically monomorphic major histocompatibility complex, which plays a critical role in the cell-mediated

destruction of infected cells (O'Brien, 1993 and 1994). For example, when feline infectious peritonitis killed 60 percent of the cheetahs at Wildlife Safari, Oregon, in 1983, some assumed that the cheetahs had lacked the genetic "tools" to fight off the disease (which is rarely fatal in more than 10 percent of domestic cats). T.M. Caro argues that if genetics were entirely responsible for the animals' susceptibility to the disease, 100 percent of the populations should have died (Caro & Laurenson, 1994). In fact, it can be argued that certain aspects of cheetah behavior may mitigate the risks posed by its genetically compromised immune system. Because cheetahs live at relatively low population density levels, are somewhat asocial, feed on fresh kills, and live in dry climates, the species is less likely to be infected with disease or to pass it on to other animals (Caro, 1994).

Evolutionary biologists also point to the cheetah's genetic homozygosity and highly-selected morphological features as evidence that the species suffers from "over-specialization" (Cohn, 1986). This could mean that cheetahs may be less capable of adapting to changing environmental conditions such as fragmentation of habitat and the introduction of exotic species. This argument can be countered, however, by noting cheetahs' "wide ecological and geographic distribution and broad prey base suggest a wide tolerance for varying ecological conditions" (Caro, 1994).

Finally, the genetic similarity among cheetah provokes the fear that inbreeding will result in birth defects, stillbirths and infertility (*NYT*, 11/10/92). In fact, geneticists like Stephen O'Brien believe that since the genetic bottleneck occurred so long ago, injurious genes would have appeared soon thereafter and would be selected out by now (Cohn, 1986). Still, nearly 70 percent of cheetah sperm is abnormal, indicating that cheetahs suffer from infertility due to inbreeding (Lumpkin, 1993).

The greatest threat facing cheetahs, however, is not genetic but due to loss of habitat. Increasing human populations have encroached on savannah grasslands and reduced cheetah habitat available for cheetahs (Eaton, 1978). While current population estimates have not been completed, it is known that in areas where cheetahs were numerous in the 1970's major environmental changes have occurred. For example, wildlife fences have been built in Botswana, farmers have (legally) killed many cheetahs in Namibia and Zimbabwe, and agriculture has spread rapidly in Kenya and Zimbabwe (Caro, 1994). In addition, the Sahel, where large mammals were still common until WWII, droughts and agricultural pressures have virtually eliminated viable populations of cheetahs (Le Houerou & Gillet, 1986). The prey base for cheetahs, gazelles and other hoofed animals, is also drastically diminishing due to conversion of habitat and hunting (Lumpkin, 1993).

Another significant threat to cheetahs is from other predators. While competition for food is unlikely to impact cheetahs, given their diversity of diet, the theft of kills by lions and hyenas is a serious problem. Cheetahs are easily driven away by predators drawn to a its kill by the panic of a gazelle herd or by the circling of vultures (Lumpkin, 1993). In addition, as mentioned before, predation on cubs is key factor in high juvenile mortality. George Schaller noted that the impact of predators on cheetahs may explain how the cheetah population is kept "depressed and seemingly stable at a low level" (Caro, 1994). In fact, it has been shown that larger populations of cheetahs thrive in the absence of lions and hyenas (Caro & Laurenson, 1994).

Cheetahs also continue to be threatened by direct exploitation by humans. This is certainly a large factor in curbing populations in Namibia and Zimbabwe. Before

the cheetah was internationally protected by being listed on Appendix I of the Convention for International Trade in Endangered Species (CITES), the "cat fur boom" of the late 1960s had driven demand for 3000-5000 cheetah skins in the United States and Europe each year (Fitzgerald, 1986). In 1992, quotas were established limiting the export of trophies and live animals to: 150 from Namibia, 50 from Zimbabwe, and five from Botswana. In addition, limited trophy hunting is permitted in Zimbabwe, and hunting permits are issued for "nuisance" cheetah in Zimbabwe. In Namibia, farmers are permitted to shoot cheetah which take their livestock (Caro, 1994).

Finally, a more recent concern involving human impact has developed. Most cheetah are easily "spooked" by human presence and will leave an area, often without humans even knowing a cheetah had been there. Because the cheetah hunts during the day, it is a favorite photographic subject for tourists. As tourism has increased in areas like the Serengeti, concerns have been raised that indiscreet tour drivers have frightened cheetahs away from their kills. Conversely, some tour operators argue that their presence may benefit the cheetah by discouraging hyenas from stealing the kill or killing her cubs.

## IV. CONSERVATION CHALLENGES: EMPHASIZING ECOLOGICAL VS. GENETIC APPROACHES

Because the greatest threat facing cheetahs is loss of habitat, land managers must both look for opportunities to reduce human encroachment as well as to create buffer zones around existing protected areas. Since cheetahs are not dangerous to humans, it is possible to utilize multiple-use range management which

encompasses the needs of pastoralist tribes such as the Maasai while providing habitat for the cheetah (Burney, 1982). Existing sanctuaries create artificially high densities of predators which result in theft of cheetah kills and high cub mortality. In fact, only one-third of Africa's parks and reserves contains cheetahs. It is clear that we must look beyond the "sanctuary strategy" to conserve cheetahs (Eaton, 1978). T.M. Caro has suggested that managers look for opportunities to open up migration routes to wet season pastures which are currently blocked by farms & ranches (such as near Tarangire National Park in Tanzania) (Caro, 1994). In fact, connecting existing parks with dispersal corridors to prevent insularization may be reasonably inexpensive, viable options in some cases (Burkey, 1994).

An essential component of effective cheetah conservation is providing community education. Farmers in South Africa and Namibia can be shown methods to change livestock management practices. For example, Daniel and Laurie Marker-Kraus have found that cheetah can often be deterred from taking livestock if a donkey is placed among the herd. In addition, the Krauses provide halfway houses for cheetahs that have been trapped on farmers' land in order to release them elsewhere (Braun, 1994).

It seems reasonable that if the cheetah is to be considered part of our "world heritage," there ought to be international funds allocated to compensate farmers for livestock losses incurred by cheetahs. One suggestion has been to use the World Heritage Trust as a model for a funding source (Eaton, 1978). I would also argue that because such compensation increases the likelihood that endangered species (such as the cheetah) are more effectively conserved as part of a global effort to preserve biodiversity, developing countries ought to petition for grants from the Global

Environment Facility (GEF). This is an institution administered jointly by the World Bank, United Nations Environment Programme and the United Nations Development Programme which was established, in part, to assist poorer countries in preserving biodiversity. The GEF was made permanent and replenished with $2 billion in March of 1993 (French, 1994).

Other important educational efforts must be made to encourage cooperative living with cheetahs on pastoralist land located in non-preserved areas (Caro, 1994). It is important to remember that wildlife exists today in large part because these pastoralists historically lived in harmony with it. Educational efforts to encourage a greater tolerance of cheetahs and to address economic, sociological and biological concerns may help to create a peaceful coexistence between local communities and cheetahs.

Although tourism can provide much needed conservation funds, it is critical that tour operators be educated about minimal impact tourism. It has been observed that a van using a slow circling approach and not directly facing the animal is much less disturbing to the cheetah. It is also important to stifle vocalizations and prevent passengers from exiting vans. Provided minimal impact tourism guidelines are strictly followed, it may well be advantageous to wildlife if tourist vehicles are more evenly distributed throughout protected areas in order to discourage poaching (Burney, 1982).

A greater emphasis should be place upon the reintroduction of cheetahs in contrast to captive breeding programs, particularly since the eventual reintroduction of cheetahs ought to be the goal of these programs to begin with (Caro, 1994).

Reintroduction of cheetahs has proved quite successful in areas where lions and spotted hyenas are not present. For example, within one year, a population of six cheetahs introduced into Pilansberg National Park, Botphuthatswana, South Africa, increased to seventeen. In the Suikerbosrand Nature Reserve, five introduced males and three females rose to twenty-four animals in two years (Caro, 1994). On the other hand, resident cheetahs may kill animals introduced into areas where cheetahs are already present, as appeared to be the case when one of three males was seriously injured after introduction into the Timbavati Nature Reserve (Caro, 1994).

The likelihood for success in future reintroductions seems elevated because of several important ecological characteristics of cheetahs: they can tolerate a broad range of environments, they have a variable diet, they are able to move into new areas, and are able to successfully hunt even after being raised in captivity (Caro, 1994).

Enforcement of conservation laws and park boundaries is critical to guard against poaching, particularly of cheetah prey. Funding and staffing in most national parks is inadequate. Currently, much of the revenue generated by tourism leaves the country via overseas tourism operators, and few local community members are employed by these operators. If more jobs and a greater portion of the revenue received from tourism benefited the local communities who are most impacted by the presence of wildlife near their homes, the community would be much more likely to help to enforce the park boundaries and alert wardens of poaching activity.

Additional research must be undertaken to determine how the distribution and density of cheetahs has changed throughout Africa and Asia since Myers' 1975 study.

Scientists are still unsure of estimated subpopulations within different habitats, what threats face each of these subpopulations, or how many individuals constitute an effective population size (Caro, 1994).

Lastly, while emphasis should be directed toward the reintroduction of cheetahs, it remains worthwhile for existing captive breeding institutions to improve their efforts to breed cheetahs successfully. The Species Survival Plan developed by the Association of Zoological Parks and Aquariums (AAZPA) in 1983 established a National Cancer Institute cheetah blood serum storage bank which, in conjunction with an "International Cheetah Studbook" developed by Laurie Marker-Kraus should enable captive breeding facilities to prevent related animals from breeding. This is a serious problem facing cheetahs, as 35.3 percent of the 201 cubs born between 1987-1991 were between related parents (Caro, 1994). Another suggestion has been to breed East African cheetahs with those from South African in an effort to create more genetic diversity within the species. An improved understanding of cheetah behavior indicates that cheetahs ought to be provided with large enclosures in natural surroundings, including an elevated area for the animals to watch over their territory (Caro, 1994).

## V. NAMIBIA: A CASE STUDY

Namibia is one of the most sparsely populated countries in the world, with only 1.7 million inhabitants in a country the size of Texas and Mississippi combined (824,000 square kilometers). Population pressures will be increasing, however, since its population growth is estimated at 2.8-3.2 percent/year (WB, 1992).

Agriculture is the nation's largest employer, supporting either directly or indirectly some 70 percent of the population. Stock farming accounts for 65 percent of the sector's output and beef is its major product. Up to 90 percent of the total annual beef output of 77,000 tons is exported, most to South Africa. The tax base in Namibia, however, is based in large part on revenues from diamond and uranium, which are sensitive to fluctuation in market price (WB, 1992). Thus, given the government's extremely limited resources, conservation programs initiated and funded by NGO's are more likely to be successful.

Over half the country is classified as semi-arid or as desert, and only about half of the land area is suitable for farmland. Seventy-three percent of the usable land is farmed as 6,337 large-scale commercial holdings by 4,500 owners, with an average farm size of more than 7000 hectares (WB, 1992). It is on these lands where the greatest promise for cheetah conservation lies. In contrast, 900,000 people occupy communal area farms on the remaining 27 percent of usable land. Although unequal access to land is one of the root causes of structural inequality in Namibia, the government is committed not to expropriate, and current legislaiton prohibits the break-up of existing farms. Even if the large farms were to be broken up into smaller ones, in order to relocate a large number of farmers there would be considerable short-run costs in terms of reduced output as well as ecological damage due to more intense range utilization (WB, 1992). For these reasons, I believe that the existing land tenure system will continue, and that conservation programs should be designed around this system.

Effective cheetah management in Namibia is critical because it is considered to have the world's only sustainable and genetically viable cheetah population

(approximately 2000-3000 animals) (Braun, 1994). It is estimated that the cheetah population has been halved in the past ten years, including 6700 taken from Namibia between 1980 and 1991.

Namibia is also unusual in that approximately 95 percent of Namibian cheetahs live outside protected areas on farmlands (Braun, 1994). Although the woodlands habitat is considered less ideal for cheetahs than the savannah in terms of hunting efficiency, it appears than the "king cheetah" may have adapted to the habitat by evolving horizontal lines along its back which may help to disguise the animal from predation by leopards (*Toronto Star*, 6/13/93).

Currently, Namibian cheetahs are protected but can be hunted or killed if livestock is threatened (Braun, 1994). In fact, it has been suggested that without compensation for livestock losses, "live-caught cheetahs sold to animal exporters in Namibia for a higher price than for skins may be the ranchers' only reason not to kill them" (Bartmann, 1989). Because of the cheetah's strong preference for gazelles, a livestock compensation program could be economically feasible. For instance, in the United States, there is a state-run program in Minnesota to compensate ranchers for livestock losses to wolves. The program paid $43,000 to farmers for losses in 1989 (Heck, 1992), a figure certain to be much higher than would be required for losses due to cheetahs.

In addition, principles developed in the Kaokoveld region adjacent to Etosha National Park can be applied to communal farmlands to provide buffer zones and to conserve endangered wildlife, which could lead to the development of tourism for those communities. In the Kaokoveld, government anti-poaching units were

replaced by community-appointed game guards to monitor wildlife, report poaching and lead officials to poachers. Since their appointment, these guards have virtually halted illegal hunting in their preserves. Elephant populations have increased from 250 to 350; rhinoceroses from 60 to 100; and springbok from 1000 to 7000 (Mbanefo, 1992). Based upon this program's success, it seems apparent that a community-based approach to wildlife conservation is more effective than a "top down" government approach, should government or private funds become available.

Private efforts by Laurie Marker-Kraus and Dan Kraus on behalf of the Cheetah Conservation Fund also appear to be having an impact. Simply educating farmers about the ecologically perilous position of cheetahs in Africa has helped to soften attitudes towards sharing rangeland with cheetahs. The Krauses hold rancher meetings to show that cheetahs are not responsible for most of the livestock losses. They encourage ranchers to get large, aggressive guard dogs which can scare cheetahs away from livestock, or pen a loud donkey with young calves. The Krauses have set also up "halfway houses" to provide refuge for cheetahs that have been trapped until they can be re-released, whereas, in the past, farmers simply shot cheetahs on sight (NPR, 1993).

## CONCLUSION

In conclusion, I believe the outlook for cheetahs in Namibia is optimistic for several reasons. Namibia is the first government to incorporate the concepts of sustainable utilization and protection of the environment and wildlife into its constitution (*CNN*, 11/8/93). From an ecological point of view, since other predators have been virtually eliminated from farmlands, these areas are ideal for cheetah

reintroduction.

In addition, because cheetahs rarely return to their kills, they are less susceptible to poisoning from a disgruntled farmer. Finally, ongoing efforts to educate farmers about alternative livestock management and the endangered status of cheetahs appear to be having some success. Community-based efforts both by the Krauses and in the Kaokoveld region demonstrate the effectiveness of approaching endangered species conservation at the local level in Namibia.

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