

David McCabe - 1579/E - Wildlife Ecology Elective Essay

*Dangers to the Lion Population of the Ngorongoro Crater
and steps being taken to Ensure their Survival.*



King of the Jungle

The lion, *Panthera leo*, is one of the most instantly recognizable animals on Earth. The second largest member of family *Felidae* is known for the large, shaggy mane

possessed by the adult male, and its ferocity as a carnivore has led to the lion being dubbed 'King of the Jungle.'

However, the multiple threats of habitat destruction, pollution and hunting, all caused by mankind, have begun to threaten the very existence of the lion throughout the world. The lion's status is now considered 'vulnerable.' And although there is no immediate threat of extinction, this huge feline is becoming more and more endangered every day.

National Parks and Conservation Areas

Amidst concerns regarding the loss of biodiversity of the planet and fears that many animals including the lion may soon become extinct, there have been many national parks and wildlife reserves established in the last century. These are protected areas, therefore the aforementioned dangers are minimised, if not completely eliminated. Unfortunately, there are other threats to wildlife which are not so easily eradicated, even within conservation zones. Problems like inbreeding and disease amongst lion populations may not seem as glaringly obvious as complete habitat destruction, but they are nonetheless quite worrying. One particular protected area where such problems are apparent is in the Ngorongoro Crater of Tanzania.

The Ngorongoro Crater, Tanzania

A caldera is a crater which is formed when a volcano falls in on itself rather than erupting. Resembling a somewhat 'hollowed-out' mountain, the Ngorongoro Crater is one such caldera. In fact, the area of the crater floor is approximately three hundred square kilometres, making the Ngorongoro Crater the largest unbroken volcanic caldera in the world today (*Wikipedia 2009*).

The crater itself is the focal point of the Ngorongoro Conservation Area, a protected expanse of land spanning over more than eight thousand square kilometres. Located in the north of Tanzania, this area borders the Serengeti National Park, a vast expanse of land approximately fifteen thousand square kilometres in area (*NCA 2009*).

The floor of the caldera has become an ideal, if somewhat isolated, habitat for African wildlife. Baboons and other monkeys reside in the dense forests. Flamingos

can be seen in their millions on Lake Makat, a soda lake, and huge herds of ungulates including buffalo, wildebeest and zebra roam the plains. These herbivores are of course preyed upon by dominant carnivores, the main ones being leopards, hyaenas and a population of approximately sixty lions (*TTB 2009*).

However, it is probably the small population of the extremely rare black rhinoceros residing within the crater that has led to the particular interest taken by conservationists in preserving Ngorongoro as extensively as possible. Norman Myers coined the term “biodiversity hotspot,” meaning a “region which exhibits high species richness and endemism.” The International Union for the Conservation of Nature (IUCN) has since declared twenty-five hotspots worldwide. One of these is the Eastern Arc Mountains and coastal forests of Tanzania and Kenya (*Smith, Smith 2006*), and a small part of this particular area is indeed the Ngorongoro Crater. By conserving a huge area with high biodiversity, many plants and animals benefit. Similarly, in order to protect the black rhino, its complete habitat must be conserved. In so doing, the whole crater community benefits, including the lion population.

Reasons for the Conservation of Biodiversity

Why conserve biodiversity at all? The first argument is quite selfish yet logical. A huge amount of products used by humans, including the majority of our foodstuffs and many medicines, are derived from natural sources. According to Edward Wilson, the services provided to man free of charge by nature, such as pollination and the cleansing of water, amount to thirty trillion dollars every year! There may in the future be ways of utilising organisms which today are seemingly useless, and for this reason it is important to do everything in our power to keep the plants and animals around us extant.

There is also a purely ethical viewpoint that humans are simply one of the many organisms present on Earth today, and we have no right to destroy other forms of life, when we can instead find ways to co-exist with them. We have developed the intelligence to dominate the world like no other species before us, so surely we can use this intelligence to protect those around us rather than simply looking after our own material wants.

Conservation of the Ngorongoro Crater

The land now known as the Ngorongoro Conservation Area first became a wildlife sanctuary in the late 1920s in an effort to curb extensive hunting in the area. It was in 1959 that it became the first conservation area, defined as “an area providing protection status for wildlife while simultaneously allowing human habitation,” in Tanzania, and in fact remains the only one in the country to this day. Under the jurisdiction of the Ngorongoro Conservation Area Authority (NCAA) and using several management plans, measures were put in place to utilise and develop the natural resources of the area and to encourage tourism, while at the same time conserving the wildlife and ensuring there were no infringements on the needs of the Maasai people living in the area (*UNEP 2009*). In 1976, cultivation was banned as it was deemed to decrease the suitability of the habitat for wildlife.

The Tanzanian government and the IUCN proposed a development project in 1985 which laid out the requirements for ensuring the long-term conservation of the area. Taking into account the needs of both the animals and the Maasai, and with increased funds from the NCAA, new, more permanent policies were put in place. Prospective settlements were examined in order to ensure they did not infringe upon annual migration routes of ungulate herds. Many organisations including the World Wildlife Federation and the Tanzanian police became involved in poaching control, with vehicles and radio being purchased for this cause.

Problems for Lions within the Crater

Despite numerous conservation policies and measures put in place, there still remain unavoidable problems for the lion population in the Ngorongoro Crater. For one, it is an extremely small area for a collection of huge carnivores to viably exist. In 1981, Shaffer presented the idea of a minimum viable population, MVP (*Primack 2002*). This is the smallest possible population size of a certain species which has a 99% chance of surviving for another thousand years despite any possible environmental trends and random natural disasters, no matter how unpredictable they may seem. By studying the habitats and population dynamics of large carnivores such as lions, an MVP of approximately a thousand has been calculated. Computations made using

data from the study of the home ranges of lion prides have estimated a minimum dynamic area, MDA, of around ten thousand square kilometres to support such an MVP.

As previously stated, the lions in the Ngorongoro Crater number less than a hundred, and the area of the crater floor is only three hundred square kilometres. From these facts, it appears that these lions have no chance of survival at all. However, the crater is not completely closed off from the surrounding conservation area. There is an extremely steep slope over two thousand metres high but this is not impossible to navigate, merely very difficult. Should a lion manage to leave the crater, it would enter the rest of the Ngorongoro Conservation Area and adjoining Serengeti National Park, with a combined area of over twenty thousand square kilometres, and over three thousand other lions (*Serengeti 2009*). Despite its apparent isolation, lions and other animals can migrate into or out of the Ngorongoro Crater should the need arise, and they have done so in the past. The fact of the matter is that this behaviour is seldom seen. Lions are reluctant to leave the crater, as there are plentiful supplies of food and water within it all year round. The only food immediately outside is the livestock of the Maasai who would not hesitate to kill a lion should it be seen as a threat to their cattle. New lions rarely venture into the crater from outside, as they tend to avoid overlapping territories with established prides.

Inbreeding

The main problem of this isolation for the lions within the crater is that their population is being denied new blood. They have therefore been inbreeding for many generations. Lion numbers have been in decline in the area because of their loss of genetic variability. In fact, in the last twenty years, crater lions have lost ten percent of their diversity, whereas in the close by population of Serengeti lions where close inbreeding is extremely rare, there has been no apparent loss of genetic variation in the same time frame. Due to their long-term isolation, these lions may have gone through several “population bottlenecks,” where a certain event or catastrophe causes the number of individuals to greatly decrease (*Primack 2002*). In a sufficiently small population such as the lions in the Ngorongoro Crater, such a bottleneck can have drastic effects, causing rare alleles to be lost entirely and thus reducing the fitness of the population as a whole. For example, two organized hunting trips in the early

1920s resulted in the deaths of fifteen adult lions on the crater floor. In such a small population, this is a huge proportion of individuals to be killed, and the chances of at least one important allele being lost forever are immense. This almost definitely led to the designation of the crater as a wildlife sanctuary towards the end of the same decade. There was, however, a much more destructive event in the 1960s which almost eliminated lions from the Ngorongoro Crater completely.

The lion population in the crater numbered approximately seventy until 1962 when there was an extremely heavy outbreak of rain. Normally, this would not be a problem for the lions, but the rains lasted six months, making the conditions ideal for an outbreak of a certain type of biting fly known as *Stomoxys calcitrans* (Packer 1991). The bites of these parasitic insects caused all of the lions to develop severe and painful skin infections. Most were so badly affected that they became unable to hunt their prey. By the time the rains eased up and the flies departed, the Ngorongoro Crater lion population had been reduced to nine females and one male. This would have been the end of the population were it not for the immigration of seven further males to the crater over the next three years.

Although the arrival of new blood may have saved the population, fifteen individuals is a very small number of lions from which to begin all over again. All of the lions alive today within the crater walls are descended from these fifteen original lions. This is known as the 'founder effect.' With a very small set of alleles to begin with, after this bottleneck, the negative effects of inbreeding on these lions has become all too clear. When compared once again with the Serengeti lions, those living in the crater display much higher levels of sperm abnormalities such as bicephalic sperm and entirely non-functional sperm. They therefore have lower reproductive rates and when cubs are born, there is a higher level of mortality.

If the lions continue having to inbreed, these problems will only get worse. Every catastrophe has the potential to wipe out further alleles until eventually there will not be enough founding members remaining to start building a viable population again. So what can be done to help? Using modern technology, the case is being made for cloning and storage of embryos. Conservation areas do not, however, allow for their animals to be interfered with in any way. Also, cloning individuals who are already inbred would probably not be advantageous in the long run. There are also those of the opinion that cloning and artificial insemination are too much like 'playing God.' Are the offspring of such practices able to behave as nature intended or do they

simply resemble the organism from which they were cloned? These are seen as steps on the way towards domestication, which is a far cry from conserving a population as they exist naturally in the wild.

One viable solution may be the human-assisted introduction of a small number of lions from another area. This can be difficult for several reasons. Male lions, if introduced to a different area, will either be driven out or killed by the pride, or manage to take over, killing any cubs in the process. Neither outcome is desirable, so it is nearly always females who are moved from one place to another. Even still, she may not fit in with the social dynamics of the group and may be killed herself. Either way, it is a risky move to make, but has been known to work on a few occasions.

Success at Lake Kariba

One such success story took place in an area near Lake Kariba in Zimbabwe (*Hoare 2001*). The lion population there had been immensely decimated by poaching. Common practices included the usual snares and also the poisoning of carrion which, when eventually ingested by lions, had fatal effects. Safari hunting was also legal in the area up until the start of the 1990s. Eventually, these factors led to lions being totally absent from a habitat where they had previously been very abundant, and measures were put in place in an effort to change this. The most important first step to take before introducing wildlife into a new area is to remove the factors which forced them out in the first place. Hunting was banned in Lake Kariba and efforts were increased to halt poaching in the area. When the region was deemed once again a suitable habitat for lions, conservationists set about trying to rebuild the population.

Two female lions and their cubs in nearby Omay communal land had already been under observation for several months using radio tracking, and it was decided to transfer one female and her cubs to the Lake Kariba region. The lioness and her three offspring were tranquilized in January 1997 and placed in a secure structure called a 'boma' in the Kariba area. This temporary captivity allowed the lions to become used to their new surroundings, thus preventing them from wanting to return to their original home upon release into the wild. In April of the same year, the four lions were released and settled very easily. The operation was deemed a complete success when the adult female came into oestrus, attracting five new adult males to the area. They have since managed to start a viable population of lions near Lake Kariba, and

form the basis of the resident pride in the region today. It was stated that this exercise would have been impossible without the “network of dedicated field observers,” and really showed that with the right attitude, there are positive steps we ourselves can take to ensure the survival of animals in our midst.

Potential Solutions to Inbreeding at Ngorongoro

Would reintroduction necessarily work in the Ngorongoro region? One complicating factor would be the presence of Maasai cattle herders and warriors. The lions in the crater today know not to venture out and approach the grazing herds of cows, but should new lions be introduced, they could easily make the mistake of treating Maasai herds as simple targets, getting themselves killed by a spear in the process. It is one thing to place a ban on hunting, but the NCAA places the interests of the local people on a par with the interests of the wild animals. It is therefore out of the question to even ask the Maasai not to kill animals who threaten their very livelihood.

There are ways, however, to minimise the numbers of lion attacks, as seen in a project carried out in the Laikipia District of Kenya (*Ogada 2003*). Researchers suggested to the local ranch owners and cattle herders that they should allow their animals to graze freely during the day, under close supervision. So long as the supervisors are clearly visible to lions, the predators are unwilling to approach the herd. Then when night falls, all livestock should be enclosed in a secure barn or a boma similar to those used in reintroduction programmes. With the presence of a guard dog outside or with frequent sightings of humans nearby, again lions are reluctant to approach. Due to the Laikipia District study, these husbandry techniques have been proven to reduce the numbers of livestock fatalities caused by lions. This therefore reduces the rate of lion depredation caused by local people as retribution. While it is impossible to stop retributive killings entirely, it is important to try to reduce lion attacks on cows, sheep and goats, thus benefiting the locals and the lions at the same time.

Disease

Disease amongst lions, as with all animals, is not uncommon, yet the effects and spread of disease are somewhat amplified by the fact that the crater lions live in a

relatively small and enclosed area (*Primack 2002*). The ratio of the caldera perimeter to the surface area of the caldera floor is quite large, which yields a proportionally large chance of disease being transmitted into the population via an outside source, such as nearby domesticated animals. There is also the fact that in smaller spaces, any given individual is more likely to come into contact with a disease-carrying individual due to a high population density, thus facilitating the spread of that particular disease. Finally, in a small area such as the Ngorongoro Crater, potential sources of infection including faeces and dead animals are never far away. In large populations, disease can almost be seen as a good thing in the long-term, as it allows natural selection to take its course, thus strengthening the group as a whole. Unfortunately, as mentioned already, the crater's population of lions is so small that valuable alleles are nearly guaranteed to be wiped out with every outbreak of disease.

Canine Distemper Virus

One disease which had dramatic effects on both the crater lions and the lions of the Serengeti was canine distemper virus (CDV) during an outbreak in 1994 (*Cleaveland 2000*). This virus is transmissible in the air, making it very fast-spreading. It can cause an infection in the central nervous system which, if persistent, generally proves fatal when untreated, especially in young pups or cubs. Lions somehow contracted a strain of CDV from dogs, even though they are only related at order level, being both members of *Order Carnivora*. This is a great example of how preserved zones are never truly protected. With more than thirty thousand domesticated dogs in the area, there was no way a barrier of any sort could be put up to prevent the spread of an airborne disease to the lions within the boundaries of the Serengeti National Park or the Ngorongoro Conservation Area. The effects of the disease on the two populations of lions were similar. Approximately one quarter of the three thousand Serengeti lions perished, while one third of those in the crater died. This slightly higher proportional death rate would have been due to the aforementioned combination of a high population density and high inbreeding. However similar the effects, the implications on the two respective populations were very different. The lions of the Serengeti recovered extremely quickly, as their population was sufficiently large to cope with the loss of a quarter of its members. The Ngorongoro lions, on the other hand, were forced through another bottleneck. Although not as serious as that caused by

Stomoxys calcitrans, the bottleneck after the CDV outbreak led to further loss of genetic variability and acted as another huge setback in the struggle of these lions to survive.

Potential Solutions to Disease at Ngorongoro

Thankfully, many steps are being taken to eradicate disease as much as possible in protected wildlife. Any plant, animal or soil entering these places must be inspected first, and is placed in quarantine if necessary. In theory, there are efforts being made to minimise contact with humans, but with tourism being a huge aspect of the Ngorongoro Crater, this is very difficult to put into practice. Domesticated animals, especially those closely related to endangered species, are kept away from the crater as much as possible, although when it comes to airborne viruses like CDV, this may not be enough.

There are other steps which could be taken and would be very effective, but they go against the policies of the NCAA (and most conservation authorities for that matter). Firstly, veterinarians could be brought in to treat animals showing signs of illness, and remove any individual carrying a contagious disease which could eventually threaten the whole population. This, though, would be seen as an unnatural process. Even if a population is threatened, it is preferred to let nature take its course and to allow the fittest to survive. Therefore treatment of wild animals is not put into practice. Secondly, the space available to the lions could be enlarged, to increase the dynamic area available to them to one which can support a viable population. This would also bring the lions into contact with others of the same species, and the new blood would eventually help to solve the problem of inbreeding. The only way to do this would be to make some sort of path through the walls of the caldera, making the crater floor more easily accessible. This would be difficult, expensive and time consuming, but more importantly, the move would be opposed by most conservationists, as no matter what the benefits would be to the lion population, it would not be worth it to destroy the true wonder of the world that is the Ngorongoro Crater.

Further Problems

Further problems exist within the crater which threaten all of the wildlife residing there, including lions. Unfortunately, many of these problems are due to human neglect or constraints on management techniques (*UNEP 2009*). Five percent of the land is ruined by the tracks of vehicles which carry tourists on safaris. In the last five years, the NCAA has cut the crater's opening hours to the public by half, in an attempt to allow the terrain to improve.

Poaching is still a problem, as the funds available are not high enough to buy the number of vehicles necessary or to employ enough park rangers. This problem can only be solved if monetary donations are given to organisations like the NCAA, IUCN and WWF by governments and the general public.

Despite their good intentions, those working in the conservation area have neglected several pipelines and dams which were put in place in the 1960s to improve water quality. With a small amount of time, effort and money, this situation can easily be put right.

A harder problem to solve is the spread of an invasive species of grass which cannot be eaten by most of the ungulates within the crater. Any problem for these herbivores is in turn a problem for the lions, which prey on them directly. It is therefore important to carry on with the quarantining process to prevent further invasive species from decreasing the quality of life in the crater.

The final problem is perhaps the most controversial of all. The local Maasai derive all of their food from their own livestock, eating their meat and drinking their milk and blood. In times when cattle stocks have been dangerously low, the Maasai have resorted to cultivation of the land in order to survive. Although this is strictly banned, exceptions have been made in certain cases. The problem is that the land is not suited to farming, which has a negative impact on water, vegetation and ultimately, wildlife.

A Doomed Population?

This brings up the argument that conservation is simply an idea of the rich. How can anyone be told that they are not allowed to farm in order to survive, just to protect an

animal that is perceived as 'charismatic' by Westerners? When human lives are at stake, surely to those at risk conservation is an optional extra, a luxury they would rather do without?

As one can see, there are countless problems facing the lion population of the Ngorongoro Crater. There exist potential solutions to every one of these problems, yet every answer given brings up further questions and difficulties of its own. The fact is that conservation zones are generally established after it has already become apparent that one or more species is at risk of extinction. Although the NCAA has managed to stem the tide of problems like hunting and, to a certain extent, disease, the damage done to this population may already be too immense to reverse. The unwillingness of conservationists to interfere with the course of nature, coupled with the lack of funds from local governments makes it very difficult to take the huge steps necessary to ensure the survival of these wonderful creatures.

Brilliant work is being done by many organisations and dedicated individuals to help not just the lions, but all of the flora and fauna of the Ngorongoro Crater, and hopefully it will not prove to be too little too late. While these lions have been given a chance, the next setback they face will always have the potential to be the factor which finally renders their population extinct. There is still a long struggle ahead.

References

Cleaveland S, Appel MGJ, Chalmers WSK, et al.

Serological and demographic evidence for domestic dogs as a source of canine distemper virus infection for Serengeti wildlife.

Veterinary Microbiology 72 (3-4) 217-227. Mar 15 2000.

Hoare RE, Williamson J.

Assisted re-establishment of a resident pride of lions from a largely itinerant population.

South African Journal of Wildlife Research 31 (3-4) 179-182. Oct 2001.

Ogada MO, Woodroffe R, Oguge NO, et al.

Limiting depredation by African carnivores: the role of livestock husbandry.

Conservation Biology 17 (6) 1521-1530. Dec 2003.

Packer C, Pusey AE, Rowley H.

Case study of a bottleneck: lions of the Ngorongoro Crater.

Conservation Biology 5 (2) 219-230. Jun 1991.

Primack RB.

Essentials of Conservation Biology, 3rd edition.

© *Sinauer Associates, Inc.* 2002.

Smith TM, Smith RL.

Elements of Ecology, 6th edition.

© *Pearson Education, Inc., publishing as Benjamin Cummings.* 2006.

<http://ngorongoro-crater-africa-org> (NCA 2009)

<http://www.serengeti.org> (Serengeti 2009)

<http://www.tanzania-web.com/parks/ngorongogo.htm> (TTB 2009)

www.unep-wcmc.org/protected_areas/data/wh/ngorongogo.html (UNEP 2009)

www.wikipedia.org (Wikipedia 2009)

David McCabe.

May 1st 2009.