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Ngorongoro Conservation Area: Spring of Life

Abstract
This paper will provide management suggestions for the Ngorongoro Conservation Area (NCA) General Management Plan of 1996, with much focus on the valuable resources shared by the Maasai and wildlife. It will also summarize the creation of the Ngorongoro Crater, provide a history of human existence in Ngorongoro, describe the wildlife of Ngorongoro, and discuss current management of the Conservation Area. But most importantly, it will provide options for a better future for wildlife and for the Maasai people.

Comments
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Executive Summary

The Ngorongoro Conservation Area (NCA) was established in 1959 after being excised from the newly created Serengeti National Park (SNP). The NCA was designated as a "conservation area" under the premise that it would serve as a multiple-land use area for both the resident and migratory wildlife and the native residents who had been evicted from the surrounding preserved areas of the SNP and the Maasai Mara National Reserve.

In order to maintain this balance between wildlife, man, and the accompanying livestock, the Ngorongoro Conservation Area Authority (NCAA) adopted a General Management Plan (GMP) in 1996 which set forth goals and expectations for projects and developments to be carried out in the subsequent ten years. Upon the ten year anniversary of this GMP, numerous promises have remained unfulfilled and alterations must be made to better accommodate the residents, both human and animal.

Conservation of the NCA's wildlife, which has for years been the primary concern of the NCAA, will only enjoy further success and improvement if the native Maasai residents are involved in tourism and research efforts. These people who are most affected by the management choices made for the NCA must be encouraged to actively participate in the NCAA's decision-making authority to ensure that pastoral concerns are also being heard when management options are being considered. Involvement in these activities will generate much needed revenue with respect to tourism endeavors and a feeling of empowerment in decision-making opportunities.

The current situation of the NCA Maasai is bleak, mostly stemming from the fact that their livestock populations, upon which they depend for subsistence, are suffering due to disease outbreaks and reduced access to resources such as water and pasture. Many of these adversities arise from conflicts with wildlife, namely wildebeest (*Connochaetes taurinus*) populations. Reduced access to pasture is further exacerbated due to bush encroachment from the highland region of the NCA, a problem that would traditionally be controlled through fire management. This practice, though, has long been prohibited by the NCAA and the acceptance of this technique in the 1996 GMP has not been implemented.

Wildlife can benefit from the improvement of the Maasai situation by their involvement in tourism efforts and species monitoring, as it will bring much needed funds to the people and will reduce resentment against wildlife for the restrictions imposed upon them in the name of conservation. Similarly, the native people can be integral players in research efforts for plants and animals to determine the needs of these species and the impacts that environmental changes can have on their populations. Also, as Maasai livestock developments improve conditions for these native people they will naturally phase out cultivation which is not a traditional practice of the Maasai, and will return to their primarily pastoralist existence which has been found to be more compatible with wildlife conservation.

Efforts to benefit the Maasai and wildlife should include Maasai education for involvement in tourist operations, the establishment of more cultural bomas and walking tours throughout the surrounding areas of the Crater, disease abatement and improved veterinary services, enhanced medical services, adequate control of immigration, improved water and pasture management practices, increased studies on threatened and isolated species with an emphasis on genetic diversity, and involvement of native Maasai in studies to identify rare species and to increase understanding of the NCA environment.

Cooperative efforts between the NCAA and the native Maasai will not only help improve the situation of the Maasai and their livestock, but it will also advance conservation efforts for the preservation of NCA wildlife which are of immense international importance. Acquiring this harmony among all of the entities of the NCA will ensure a long and successful future for the NCA and will allow many generations of tourists to experience the wonders of Ngorongoro.

Introduction

Now commonly referred to as the "Eighth Wonder of the World,"[1] Ngorongoro Crater and its surrounding conservation area are deemed of great importance by many different people, for a variety of diverse reasons. Depending on whom one speaks with, whether it be Western conservationists, African conservationists, local residents of surrounding towns, anthropologists, the Tanzanian government, or the resident Maasai, a grand list of attributes can be compiled including items such as outstanding wildlife density, the birth of human evolution, perennial water supply, rain catchments for surrounding regions, resources for subsistence, or maybe simply "home." Ngorongoro Conservation Area is unique among Tanzanian protected areas in that it allows the pastoralist Maasai tribes and their accompanying livestock to reside within its borders. This distinction can be inferred from its designation as a "conservation area" instead of a national park as seen throughout the rest of Tanzania. The "national park" label inherently implies that the only residents will be wildlife, and that any local people will be moved to the perimeter or other surrounding areas. A "conservation area" works to preserve not only wildlife, but anthropological sites and traditional people as well.

The amazing features of Ngorongoro Conservation Area, both wildlife and anthropogenic, have brought great accolades to this "Eighth Wonder of the World." In 1978 it was designated a World Heritage Site by the Untied Nations Educational, Scientific, and Cultural Organization (UNESCO). Three years later, in 1981, the Conservation Area was proclaimed a Biosphere Reserve by the same organization.[2] Though the site has been recognized for its cultural attributes, the management of the caldera and its surrounding area has not necessarily worked to preserve both wildlife and local Maasai residents. An area such as this requires a plan which recognizes and respects the harmony that can exist between pastoralists and wildlife, much as it had years before conservationists stepped foot on the land. Ngorongoro has a colorful human history involving the Maasai, other local African tribes, colonialists, and conservationists. Many visitors and students of wildlife do not know the human history of Ngorongoro caldera, yet further studies will reveal that much of the reason that such great wildlife remains in East Africa is because of the native Maasai.

The great challenge of this Conservation Area is to create a management plan that will properly benefit the people as well as the wildlife. As in most developing nations, the cost of conservation is felt most by the local people who either reside within or around park borders. The case of Ngorongoro is no different, making it imperative that management be changed for the better before actions are taken against the wildlife. Anger towards conservation efforts can easily be made apparent by poaching a park's most valuable species, in this case the Black rhino. It therefore serves both conservation and human interests to bring forth new ideas toward the management of this protected area. Such ideas can be used not only elsewhere in Africa, but also within other developing nations in which native people are forced to leave their homes in the name of conservation.

Ngorongoro's story is complicated even further by the fact that the caldera maintains a perennial spring that feeds a lake and swamp areas. Other springs can be found throughout the area that serve as important water sources for residents, wildlife, and livestock. The Crater highlands provide the natural resource of water catchments, as well as a different grazing environment than found on the Crater floor. These resources are valued for wildlife and Maasai livestock, especially during the dry seasons or periods of unusual drought. Wetlands are a rare commodity when seasonal dry periods leave behind dry grass and waterholes which are few and far between. Water is, of course, essential to life and rights to water use are not easily relinquished.

This paper will provide management suggestions for the Ngorongoro Conservation Area (NCA) General Management Plan (GMP) of 1996, with much focus on the valuable resources shared by the Maasai and wildlife. Such suggestions and ideas symbolize the new wave of conservation, where local people are considered and included in conservation efforts. Alienating people will only undermine conservation efforts in the future, making it vital that native residents are included and benefit from the use of their homes. This paper will summarize the creation of Ngorongoro Crater, provide a history of human existence in Ngorongoro, describe the wildlife of Ngorongoro, and discuss current management of the Conservation Area. But most importantly, it will provide options for a better future for wildlife and for the Maasai people. Information and

recommendations are based upon current literature and my recent experience during a visit to the Ngorongoro Conservation Area (NCA).

The Making of a Caldera

The NCA, which includes the well-known Ngorongoro caldera, is located on the continent of Africa, in the nation of Tanzania. The location is quite near the equator, with coordinates of 3°15'S, 35°30'E. A more visual description places the NCA on the western edge of the Great Rift Valley, and approximately 560km west of the Indian Ocean.[1] The conservation area is adjacent to the Serengeti National Park (SNP), and is halfway between Lake Victoria and Mount Kilimanjaro.[1] (Figure 1)

The exact latitudinal coordinates of the Ngorongoro caldera are 3°5' to 3°15'S and longitudinal coordinates are 35°25' to 35°40'E. Ngorongoro caldera is part of the greater Gregory Rift Valley and is the largest of the three included craters. The Gregory Rift Valley also contains two volcanoes, one of which is still active today. The Ngorongoro caldera formed from the now extinct Ngorongoro volcano as the rift valley began to shift millions of years ago. (Figure 2)

The Great Rift Valley formed on the African continent approximately 20 million years ago, and as the crack separated the earth that sank below the surface melted to become magma. In the region in which Ngorongoro Crater is situated, a great escarpment was formed by the sinking of land on the eastern side of the rift, now termed the Eyasi escarpment. As hot lava emerged from the ground along this rift it hardened and accumulated over time to form seven volcanoes.[1] The Ngorongoro volcano was formed five to seven million years ago, and is believed to have rivaled Mount Kilimanjaro in height.[3] As magma was forced to the surface, it hardened and filled the "vents" of Ngorongoro and most of the other surrounding volcanoes, in essence forcing the magma to move elsewhere along the Eyasi rift, thereby creating new volcanoes to the North. As the magma moved from underneath the volcano, the tops of Ngorongoro and the other volcanoes collapsed inwards, creating the calderas that are present today.[1] The formation of the caldera is believed to have occurred between one and two million years ago.[3] (Figure 3)

The wetlands that exist within Ngorongoro Crater, which are of great importance to the Maasai people and wildlife, are highly typical of areas of tectonic activity. Most of the water within the Crater either originates from natural springs within Ngorongoro, or as streams that enter the Crater from springs in neighboring calderas. Such tectonic activity creates stress between shifting plates which interacts with magma and groundwater, giving rise to the natural springs. While Ngorongoro caldera receives seasonal input of rain, its perennial water supply is due to the presence of such natural springs.[4] Other national parks outside of the rift valley cannot claim these resources, and their wildlife is reliant mainly upon relatively temporary waterholes.

The Crater itself, including its walls, covers approximately 310km^2, and the floor of the Crater, where most wildlife resides, is 250km^2. The walls of the caldera reach 600m, and exhibit an incline gentle enough to allow easy travel into and out of the Crater by the wildlife, the Maasai, and their livestock.[4] The caldera soils form in both basaltic and trachytic (alkaline) lavas. Parent materials in other regions of the Crater include some tuffs and scoria. Soils also form in alluvium deposited by streams and lacustrine sediments deposited by the central lake, Lake Makat.[3]

The greater NCA is roughly 8,300km^2, making the Crater only three percent of this area. (Figure 4) Within the NCA there are a vast number of resources other than the Crater itself including the Northern Highlands Forest Reserve (NHFR) which claims twenty percent of the NCA lands. There are more highlands which cover yet another twenty-seven percent and plains and bush in the remaining fifty percent of the NCA designated area.[1] The highlands outside of the Highlands Reserve are important to local people for lumber and natural substances used for traditional medicines. (Figure 5) In addition, the pastoralist Maasai are allowed to reside and graze in these areas outside of the Crater only, with very limited access to water sources within the Crater itself. As mentioned previously, it is these highland regions that supply a great deal of water resources to tourist activities and the surrounding local villages and towns.[2] The NCA therefore provides a great number of resources, leading to all of the controversies surrounding management of the area and the aforementioned assets.

The Wetlands of Ngorongoro

As previously mentioned, Ngorongoro caldera exhibits an extensive system of wetlands originating from natural springs brought forth by tectonic activity within the Great Rift Valley. It is important to discuss these wetlands because they are one of the main reasons that wildlife, both resident and migratory, as well as Maasai pastoralists, are drawn to this area. These wetlands and the surrounding grasslands within the Crater support the last great migration on earth, making them of utmost importance to conservationists and tourists as well. (Figure 6)

The Ngorongoro wetlands arise from a natural spring within the Crater, Ngoitokitok Spring, and two major streams that enter from the northeastern edge of the caldera. The first stream, Oljoro Nyuki, originates in the Olsiwra Highlands and is only an ephemeral source of water. The flow of this stream depends highly on the seasonal rains and evaporative fluctuations due to temperature and humidity. The Oljoro Nyuki stream feeds the Gorigor Marsh, located at the southern end of the Crater, which is also fed by the Ngoitokitok Spring at its eastern edge. The input of water from the natural spring allows this marsh to remain perennially wet, being only slightly affected when the contribution of its principal stream wanes.[4]

The second major stream that flows into Ngorongoro is the Munge Stream, originating from a spring in the nearby Olmoti Crater. Due to the fact that it is created by a natural spring, the Munge Stream is a perennial feature within the Ngorongoro Crater unlike the Oljoro Nyuki. The water of the Munge Stream supplies the Mandusi Swamp in the northwest region of the Crater, making this a perennial element as well. The Gorigor Marsh and the Mandusi Swamp are further fed by seasonal rain, and water levels fluctuate accordingly. The drainage system within Ngorongoro caldera is strictly internal, with both swamps draining into the central lake, Lake Makat/Magadi, whose water levels vary with evaporation rates and seasonal rain input.[4] (Figure 7)

Lake Makat receives some water input from the Seneto Springs on the western edge of the lake as well. Lastly, there are a few small streams that enter the Ngorongoro caldera through the southwestern wall and enter the Lerai Forest.[4] These streams are less influential to the overall wetland system within Ngorongoro Crater, but may be significant to wildlife that resides solely within the Lerai Forest ecosystem. Lerai is the

only forest ecosystem within the Crater and therefore supports a somewhat different compilation of wildlife. Forest is located only in this region of the Crater, as it is the only area that receives the moist winds of the Indian Ocean.[5]

Ngorongoro Vegetation

The borders of the NCA encompass a great variety of ecosystems including montane forest, swamp, marsh, dry forest, as well as long and short grasslands that are extensions of the Maasai Mara and Serengeti ecosystems. Such diverse ecosystems enable a large number of different wildlife species to reside within the conservation area in close proximity. This variation also allows for a succession of feeding by herbivores as the seasons change. For example, when grasslands are depleted and dry by the middle of the dry season, wetlands serve as the next preferred feeding location for the resident and migrant grazers.[1]

The vegetation suitable for grazing is similarly of importance to the Maasai livestock that either reside within, or pass through, the NCA. The borders of the NCA are open to resident and non-resident Maasai for grazing livestock; only the Crater Highlands Reserve and the Ngorongoro Crater are restricted from this particular land usage. Much like the native African wildlife, the Maasai livestock, small and large, have preferences for particular grasses. These preferences are generally the same or very similar to that of the wildlife. This likeness therefore presents one of the conflicts surrounding human use of the NCA; namely, competition for grazing resources by the wildlife that attracts tourists and domesticated subsistence animals.

The divergence between livestock and wild herbivores arises when preferences become more specific than simply the Serengeti grasslands. Cattle will graze all resident grasses that are not completely unpalatable. In addition, cattle will graze grasses down to the soil upon which they grow. Wild herbivores, conversely, will graze grasses of certain heights depending on the species of animal. It has been observed that the succession proceeds as follows: buffalo (*Syncerus caffer*) and elephant (*Loxodonta Africana*) feed upon rough grass and sedges; zebras (*Equus burchelli*) prefer the higher “softer” grasses; wildebeest (*Connochaetes taurinus*) graze the next level of grass that is more “tender” and of medium height; lastly, the gazelles (*Gazella* spp.) feed upon the lower level of

grasses with the tenderest leaves.[1] Thus, the migration which involves the zebra, wildebeest, and gazelles will show this succession as well with the zebras leading the pack.[5]

The vegetation of Ngorongoro is highly dependant upon where it is located with respect to variations in water inundation, salinity, and pH levels. The dominant ecosystem within the Crater is the tall and short grasslands. The dominance of short or tall grasslands depends on the underlying soil structure, including the porosity and the extent of compaction. The most palatable short grass species include *Sporobolus*, *Digitaria*, and *Cynodon*. Such short grasslands can be located surrounding Lake Makat in the lacustrine sediment and in the northwest corner of the greater NCA. Other species common to this short grass association are Cutleaf Medic (*Medicago laciniata*), Rhodes Grass (*Chloris gayana*), and *Aster hyssopifolius.* (Figure 8) The short grass environment is highly significant as a breeding ground for zebra, wildebeest, and gazelle during the wet growing season. These grasses die back quickly as the dry season progresses. The soil adjacent to Lake Makat is dry/saline alkali soils with pH ranging from 8.5-10.4 which is due to either the seasonally high watertable or runoff from higher grounds which are of base-rich colluvium.[3] Colluvium is soil moved downslope by gravity, whereas alluvium is deposited by water. The long grass environment emerges with distance from Lake Makat due to better drainage and possibly less trampling by herbivores. Long grass species in these areas include red oat grass (*Themeda triandra*), golden tipped *Chloris*, *Hyparrhenia*, *Aristida*, and tufted *Pennisetum*.[1] (Figure 9)

Plant species which grow in swamp conditions within the Crater must be tolerant of, or must require, frequent inundation with water of varying salinities. The Gorigor and Mandusi swamps are dominated by the water-loving sedges *Cyperus papyrus* and *Cyperus immensus*, as well as Lowveld Reed (*Phragmites mauritianus).* Other species found here include Smooth Flatsedge (*Cyperus laevigatus*), Rice Cutgrass (*Leersia hexandra*), Creeping Panicum (*Panicum repens*), and Brown Beetle Grass (*Diplachne fusca*).[3] (Figure 10) The swamps in Ngorongoro do not support woody vegetation due to thin soils and are instead dominated by longer grass species.

Around the swamps grow grasslands that consist of tall, coarse grasses due to the wet saline-alkali soil association. This system, which is comprised of alluvial sediments

and experiences a seasonally high watertable, can also be located around Lerai Forest.[3] The edges of the swamps are extremely valuable for grazing during the dry season when the more preferred grasslands have dried out.[1] Species in these locations include Rhodes Grass (*Chloris gayana*), Stargrass (*Cynodon plectostachyus*), Bermuda grass (*Cynodon dactylon*), and *Spilanthes mauritiana*.[3] (Figure 10) It is especially within this grass association that the grazing succession of buffalo, zebra, wildebeest, and gazelle can be observed.[1]

The Crater highlands are composed of tree associations with regions of grasslands akin to those of the Crater floor. Common tree species include *Acacia lahai, Croton* spp., *Cassipourea malosana, Albizia gummifera,* and *Nuxia congesta.* While the highlands can be considered a rain forest, it is termed "montane" because of its "higher altitude and lower and more variable temperature and rainfall."[1] The moisture provided by the rain and the blanketing fog encourages the growth of ferns, mosses, and lichens that are found within the canyons. There are also a great variety of shrubs and flowering plants that grow in these forests.[1]

It is within the grasslands of the Crater highlands, except for the reserve lands, that the Maasai are free to graze their livestock. In some places the invasive *Eleusine jaegeri* can be found to dominate, as it quickly occupies areas of disturbance. As a result, areas that have been overgrazed and consequently subject to erosion exhibit this species in abundance. *Eleusine jaegeri* is a sharp-edged grass that is highly unpalatable to wildlife and livestock alike.[1] This species damages the teeth of cattle and wildlife.[2] Infestations of *Eleusine* were previously controlled by selective burning by the Maasai, but burning has been prohibited within the borders of NCA. Due to this restriction, Maasai now move cattle before grasses are depleted so that this invasive plant will not out-compete palatable species.[2] Burning methods utilized by the Maasai were similarly beneficial because they encouraged new growth of palatable species before *Eleusine* was able to dominate the ecosystem.

The influence of humans in the Ngorongoro area is not recent, but has occurred in varying levels for millions of years. The Maasai are the most recent residents of Ngorongoro and are the most dominant tribe in the area. Excavations have unearthed amazing findings demonstrating that each tribe of people over the years had influenced

Ngorongoro in a different way. Most importantly, however, all of the various inhabitants were supported by the immense diversity of the area's vegetation and the abundant water sources that continue to flow to this day. The human history of the NCA will be further discussed in the following section.

Human History in Ngorongoro

The human history of Ngorongoro and its surrounding area is well known to anthropologists and laypeople alike, as it is deemed the birthplace of humankind. Human remains have been excavated in the nearby Oldupai and Laetoli gorges which date back approximately 3.5 million years. Little information is known about these early hominids, only what can be interpreted from their skeletal and cranial structures.[6]

The most ancient tribe known to the Ngorongoro area is the Hadzabe or Watindiga. This tribe still resides in the area along the border of the NCA and speaks their native click-language which is dissimilar to any other known language. The Hadzabe were, and still are, hunters and gatherers. They utilize bows and arrows for hunting purposes and gather roots, tubers, wild fruit, and honey. There is no estimated date of the origin of these people in the Ngorongoro area.[1]

Dating of cattle bones found within the Serengeti and Ngorongoro Crater estimates that pastoralists arrived approximately 10,000 years ago. These early herders are now known as the Stone Bowl People, as they left behind stone bowls which were constructed by hammering volcanic rock. It is believed that the bowls were used as mortars to grind food that had been gathered from the forests. There is also speculation that the Stone Bowl People may have dug the wells that are used today by both people and animals within the Ngorongoro area. These people are believed to have disappeared 1,000 years ago.[1]

Roughly 2,000 years ago the Iraqw people arrived in the Ngorongoro area speaking a language that originated in Ethiopia. These people were not only pastoralists, but cultivators that most likely grew millet. This was likely the first introduction of cultivation in the region. The Iraqw now reside on a plateau between the Ngorongoro Highlands and Lake Manyara.[1]

The most recent residents of Ngorongoro are the Datoga and the well- known Maasai tribes. The Datoga arrived at least 300 years ago and are strictly pastoralists. It is believed that they forced out any previous residents of the Crater. The Datoga were eventually driven out by the war-loving Maasai who arrived in the 1800s. The last battle between the Datoga and the Maasai was 150 years ago, leaving the Maasai as sole residents of Ngorongoro until present times.[1] The presence and impact of the Maasai is clearly demonstrated by the current alias of East Africa as "Maasailand."

The Maasai are semi-nomadic pastoralists which have recently begun to settle more permanently due to the formation of "villages" by the Tanzanian government.[7] The Maasai subsist on their livestock and forbid the taking of wildlife except in times of extreme hardship. The war-loving nature of the Maasai and their prohibition of wildlife utilization are deemed as some of the vital factors that have allowed such an abundance of wildlife to remain in East Africa. The Maasai have effectively restrained other wildlife-hunting tribes from encroaching on this region.[6] Currently, ninety-seven percent of the NCA population is Maasai.[7]

Early European explorers visited this area beginning about 100 years ago. Germans first colonized Africa and named the continent Deutsch Ost-Afrika.[1] The first white man to lay eyes upon Ngorongoro Crater was Dr. Oscar Baumann on March 18, 1892.[6] Baumann was on an expedition to discover the, as of yet, untouched areas of Africa. After discovery, hunters and explorers passed through the area, but there was no settlement for approximately twelve years.[1]

In 1904 two brothers, Adolf and Fredrich Siedentopf, began to cultivate on the Crater floor of Ngorongoro. The brothers built two houses, one at the North end of the Crater on the Munge River. The second home was constructed in Lerai Forest and the remains of these houses can still be seen today. The brothers brought with them 2,000 cattle which caused much conflict with the Maasai and Wanderobo tribes that were living within the Crater at that time. The Maasai believe that God gave them all of the cattle of the world and therefore will raid and steal cattle from other tribes or residents in their area.[6]

The Siedentoph brothers had considerable impact on the Crater, including a wagon trail that they constructed from a preexisting elephant trail. This became the first

road to the nearby town of Arusha and effectively made the Crater much more accessible to other visitors. Also, livestock husbandry introduced non-native species to the ecosystem, such as a species of clover that was planted by Adolf and Fredrich for pasture and continues to be a resident species within the Crater to this day. Fredrich was more of a hunter than a cultivator, and eventually attempted to establish an "East African Hunting Bureau" in Ngorongoro Crater. There was great interest in this area for rhino, black-maned lion, elephant, and buffalo. By 1912, the brothers had hunted the lion population to such extremes that the predators would not attempt to travel near their camps.[6]

In 1907 Adolf obtained a deed on his land with a twenty-five year lease from the government of Germany. Fredrich was unable to obtain a similar document because he did not have the funds to support such an ownership. All the while, the Maasai worked desperately to force out these "intruders" by setting wild bushfires near their land. After Adolf reserved his land right, however, the Maasai were forced to leave the same year by the German government, claiming that they had "stolen" land.[6]

In 1908 the German government began to realize the importance of the Crater for game preservation and tourism, yet they were too tied up in other business to force out the Siedentoph brothers. This task of expulsion proved to take many years due to Adolf's new lease on his land. After trying to purchase Adolf's land without success, the government enforced an old fencing clause that would force Adolf to enclose his property and his then 1,000 cattle, 2,500 sheep, 40 donkeys, and 12 horses. This expenditure would have been far too great for Adolf with inevitable damages by wildlife. Fredrich left Ngorongoro in 1914 to join the army and fight in WWI. This effectively ended any plans for a game hunting bureau in the Crater. Adolf left the Crater in 1916 due to battles with the British nearby. Adolf's wife returned for some time but was evicted by the British to Germany in 1920. She and Adolf moved to America soon after this eviction.[6]

After WWI the League of Nations declared Tanganyika a "trusteeship territory" of the British government. The British government allowed habitation in the Crater at the Siedentoph residences which led to subsequent hunting safaris by visiting friends of the residents. The British soon realized that Ngorongoro should be declared a national park and again imposed the fencing clause to evict current residents.[6]

Throughout the 1920's and 1930's preservationists made claims for the establishment of a national park, yet the government could not reclaim the land until twenty-five years after the lease. Residents were finally vacated by 1940 and the Game Ordinance of 1940 was enacted which designated the adjacent Serengeti as a national park. This decree was not very strict, and a new ordinance was declared in 1948 which was not effectively enforced until 1951 due to boundary conflicts.[6] In 1951 the Serengeti National Park (SNP) was proclaimed and included much of the NCA region.[1]

At first, the Maasai people were only restricted from specific areas, including the Ngorongoro area (1150km^2), Empakaai Crater (26km^2), and the western Serengeti region (3600km^2). Around 1957, however, conservationists declared conflict between Maasai resource management of felling trees and selective burning and conservation of the SNP.[6] The Serengeti Commission of Inquiry carried out by Professor Bernhard Grzimek and his son Michael agreed with the incompatibility of the Maasai lifestyle and conservation within the SNP. In 1959, the NCA was removed from the SNP and the Maasai were forced to vacate the park boundaries.[1] The SNP was no longer open to residence or seasonal grazing.

The Ngorongoro area was declared a Conservation Area in 1959 for the preservation of both wildlife and the native pastoralists. This area, in turn, became a much needed refuge for the Maasai who wished to continue their pastoralist lifestyle. Successful pastoralism is highly dependant upon unrestricted access to vast expanses of productive land unscathed by development. In Ngorongoro, and Africa in general, such flexibility is vital to pastoralist survival due to the patterns of seasonal rainfall. Access to water sources and nutritious grazing resources are two of the major determinants of traditional Maasai grazing patterns. These necessities and their surrounding conflicts will be discussed further in a later section of this paper.

In 1961, Tanzania became independent from the European colonialists once and for all, and the management of the NCA was given to a Conservator within the Tanzanian government. As previously mentioned, the NCA was declared a World Heritage Site in 1978 and an International Biosphere Reserve in 1981 as recognition for its efforts to conserve the ancient relationship between humans and wildlife in Africa.

The Ngorongoro Conservation Area is considered part of the greater Serengeti Ecological Unit because it includes the Serengeti's signature short grass plains.[2] As noted earlier, however, Ngorongoro exhibits a great complexity of ecosystems which have become exceedingly valuable to the wildlife and the resident Maasai. Competition for resources arises in the plains, the wetlands, and the highland forests making the balancing of these resources between animal and human a daunting task. This mission has been assigned to the Ngorongoro Conservation Area Authority (NCAA) who has for years been attempting to compile a workable management plan that is beneficial to the Maasai, the wildlife, and the tourism industry. No recommended plan was officially accepted until 1996, and its implementation has not been absolutely satisfactory. Similarly, there are holes in the plan that must be addressed to ensure the well-being of the wildlife and people.

The specifics of the General Management Plan (GMP) will be discussed near the end of this paper. It is essential to first look at the status of those who live within the NCA and rely upon its resources for survival, namely the wildlife and the Maasai people. An adequate management plan cannot be compiled or understood by readers without explanation of the current situation in the NCA, the patterns and importance of the last great migration, the conservation of endangered species, and the lifestyles and traditions of the resident Maasai.

The Wildlife of Ngorongoro

Ngorongoro is notorious for its wildlife both for diversity and density. The wildlife of Ngorongoro Crater has helped win the acclaim of "Eighth Wonder of the World," boasting the highest density of predators in the world and a viable population of the endangered Black rhino (*Diceros bicornis*). During a recent visit to Tanzania in June 2006 I was able to experience the Ngorongoro Crater and upon return I realize that there are really no words to describe this place other than "a wonder." Viewing the caldera on the rim and from within is breath-taking, awe-inspiring, and humbling. Yet, while this is the most frequented destination in the Conservation Area, the entirety of the NCA houses a vast number of resident and migratory animals.

As previously mentioned, Ngorongoro Crater exhibits the highest density of predators in the world including lion (*Panthera leo leo*), Spotted hyena (*Crocuta crocuta*), jackal (*Canis* sp.), cheetah (*Acinonyx jubatus*), and leopard (*Panthera pardus*). (Figure 11) The two main carnivores are the lion and hyena. The lion population currently fluctuates between 40 and 100 individuals[1], and is approximately 200 animals in the greater NCA.[2] In 1962 the lion population was at an all-time low of 15 individuals due to a plague of biting flies, however their numbers seem to have recovered.[6] Such a recovery from only 15 animals can lead to excessive inbreeding much like the African cheetah populations. Lions are able to move in and out of the caldera, however, so it is hopeful that immigrants have helped strengthen the gene pool.

Spotted hyenas number around 400, living in clans of 30-80 members on the floor of Ngorongoro Crater.[1] This population seems relatively stable, as estimates by Kruuk from 1964-1968 estimated spotted hyenas to number approximately 430 individuals.[8] The total population of spotted hyena within the NCA is estimated to be around 1000 animals.[2] The hyena is not only a predator, but also a scavenger, feeding on stolen or abandoned kills of lions, leopards, or cheetahs. Large clans of spotted hyena have been known to scare off a pride of lions, claiming the majority of food from their kill.[5] This ability to alternate between hunting techniques enhances survival and propagation of the hyena population, thereby allowing them to reach such high densities within the NCA.

The leopard population within the NCA is unknown, as these animals are very secretive and, if found, are hiding within the trees of forested areas within the Crater along Munge Stream. Jackal numbers are unknown due to lack of research on the three subspecies that inhabit the NCA, including the Golden jackal (*Canis aureus),* Side-Striped jackal (*Canis adustus*), and the Blackbacked jackal (*Canis mesomelas*).[2] The cheetah, which numbers approximately 100 within the NCA[2] is relatively hard to locate within the Crater due to competition with hyenas and lions.[1]

There is a great variety of herbivorous wildlife within the NCA, but for the purposes of the management plan the most important species are those which are most abundant. Such species include wildebeest (*Connochaetes taurinus*), Cape buffalo (*Syncerus caffer*), zebra (*Equus burchelli*), Grant's gazelle (*Gazella granti*), Thomson's gazelle (*Gazella thomsoni*), and the Black rhino. (Figure 12) All of the above mentioned

species compete for grazing space and water resources with the Maasai and their livestock except for the Black rhino which only resides at low densities within the Crater walls.

The plight of the rhino is well known among conservationists and lay-people alike, being poached solely for their valuable horns to be used in traditional Asian medicines and to be carved into Yemeni dagger handles. In 1965 the population of Black rhino in the caldera was numbered at 100 individuals; however poaching has reduced this number to 15 animals.[1] It is believed, though, that there may be a total of 30 Black rhino residing within the entire NCA with some living in the forests. This population is still seen to be biologically significant, although genetic diversity among these animals may be low.[2] Due to the fact that this is one of the last and largest populations within Tanzania, it is paramount that the conservation of the species be included in the General Management Plan (GMP). The protection of this species is so important with impending extirpation a real possibility that the NCAA has instituted a 24-hour ranger patrol for each rhino to ensure their protection against poaching. Similarly, if a ranger finds a tourist vehicle disturbing or thwarting the path of a Black rhino, they are liable to be fined for their offence.[1]

During my recent visit to Ngorongoro, I was lucky enough to see one of these rare creatures up-close. We had been searching all day for a rhino, seeing most of them off in the distance asleep on the ground. It was a windy day, and rhinos rely mostly on their olfactory senses, as their eyesight is quite poor. Therefore, during a windy day they are unable to make sense of the direction from which scents are coming and choose to lie low on the ground out of sight.[5] However, at the end of the day we were graced with the presence of a large male walking directly behind our vehicle to spray his territory. He was an astounding sight, exhibiting his almost startling strength and power while also portraying that oxymoronic ugly beauty that is known to rhinos. He seemed so prehistoric, yet so vitally important to his ecosystem today. The NCAA is working hard to keep this population safe as it rebounds from the damage of commercial poaching.

At the other end of the spectrum is the wildebeest, otherwise known as gnu, whose population numbers have skyrocketed in the recent past due to the elimination of a disease called Rinderpest. Wildebeest are resident and seasonal species within the NCA

with a great number immigrating in during the great migration. Estimates in 1988 set wildebeest numbers between 8,300 and 1,100,000 depending on the season.[2] Wet season numbers have increased from approximately 200,000 wildebeest in 1962 to a high of roughly 1,300,000 in the late 1970's to the current estimate of 1,100,000. As previously mentioned, this boom has been attributed to the near elimination of a disease known as Rinderpest which plagues cattle and can be transferred to wild herbivores such as wildebeest. Vaccination of cattle began in the 1950's and has reduced mortality in Maasai cattle as well as in wildebeest calves.[9]

The increase in wildebeest due to Rinderpest elimination has occurred throughout the entire Serengeti Ecological Unit (SEU). Between 1963 and 1974 the migratory wildebeest of the Serengeti increased by three-fold.[10] Such increases in numbers have affected the migration patterns of the wildebeest, thereby altering grazing patterns of the Maasai. For many years wildebeest and the other migratory species have utilized what has been termed the "'classic' annual migration cycle" in which the wildebeest utilize the plains during the wet season, December through June, and then move northwest beginning in May and June. During the dry season the migratory herds move north to Kenya and inhabit the Maasai Mara Reserve which borders Tanzania.[9]

New patterns of migration (Figure 13) with current wildebeest numbers find migratory animals further east and north in the Salei Plains and Angata Kheri plains much sooner in the wet season than normal. Some wildebeest actually move into Kenya directly, only passing through the NCA.[9] The expansion of the migratory wildebeest population into these new regions severely decreases the wet season grazing area of the Maasai livestock. Maasai do not share grazing area with the wildebeest during the wet season, which is also the wildebeest calving season, due to the transmission of Malignant Catarrhal Fever (MCF) which is highly prevalent in gnu calves. The implications of this disease on cattle and the Maasai will be discussed later in this paper.

Zebra populations, on the other hand, have remained relatively stable throughout the past 40 years, with an estimate of approximately 63,000 in the late 1980's.[2] Starting just prior to 1990 there was a slight decline in zebra population, however this change is non-significant.[11] Zebra populations tend to remain relatively stable due to

tolerance of low-quality forage, allowing them to remain in grazing areas longer than species which require high fiber grasses.[11]

Thomson's gazelle is the third migratory species (after wildebeest and zebra) which participates in the great migration. This species usually travels third in the pack utilizing the very short, low fiber, tender grasses.[11] Thomson's gazelle numbers were around 600,000 individuals in the early 1970's but have dropped to just over 300,000 in the late 1990's. There was a low of around 150,000 in the late 1980's, however populations have risen recently.[9] Non-migratory populations of Thomson's gazelle were approximately 5,800 in 1988.[2] The decline in Thomson's gazelles occurred about the same time as a slight decline in wildebeest numbers in the late 1970's. The year of 1974 demonstrated low availability of high quality forage causing Thomson's gazelle populations to decline during the wet and dry seasons, and wildebeest numbers to decline during the dry season of that same year.[11]

Grant's gazelles are purely resident species within the NCA and do not show any seasonal fluctuations. In the late 1980's population estimates produced numbers around 6,300 for Grant's gazelle in the entire NCA.[2] This species, similar to Thomson's gazelle and wildebeest, suffered during and after 1974 due to lack of quality forage.[11]

In 1988 Cape buffalo numbered approximately 3,500 in the NCA.[2] While wildebeest populations declined after 1974, buffalo numbers increased significantly. Within the caldera, the buffalo have become the dominant species during the wet season in terms of biomass (55%), whereas wildebeest have declined from 50-65% to 35-45%. This change has been attributed to the exemption of Maasai and their cattle from grazing within the Ngorongoro Crater. Maasai impact and range management in the Crater, including cattle grazing and fire, used to bring forth new short, tender grasses and more palatable species which were preferred by wildebeest and gazelle. The removal of these impacts has led to an increase in higher fiber vegetation that would usually be consumed by Maasai cattle, which is also preferred by the Cape buffalo.[11]

Buffalo have recently been seen in higher numbers in the Crater during the wet season. Buffalo are not migratory, thus there is presently no explanation for this change; however research is needed to solve this mystery. Before the 1970's buffalo were not usual residents within the Crater and it is believed that surrounding agricultural

communities have lashed back at the species after a great deal of crop destruction. The species has consequently moved from the highlands reserve to the Crater. This may have caused the current boom in buffalo populations as well as the eradication of Rinderpest as described previously.[11]

Elephant (*Loxodonta africana*) (Figure 14) populations were reported as approximately 300 individuals within the NCA during the 1980's [2], but have remained stable since 1963.[11] Families of females do not reside within the Crater, however some males may be found in forested or wetland areas of the caldera.[11] These males are able to move into and out of the Crater, and during my recent visit to Ngorongoro there were no personal sightings of any elephants within the Crater walls. The only truly forested region within the Crater is the Lerai Forest which would not be capable of supporting a permanent population of elephant, especially in large quantity.[11]

Indigenous people have attested to sightings of the very rare Giant forest hog (*Hylochoerus meinertzhageni*) within the Lerai Forest and in the highland regions of the NCA, as well as the claim by Maasai that their shields are made from Giant forest hog skins; however no sightings have been reported by officials or research teams.[2] If the presence of this species is truthful, it is even more essential to protect these valuable habitats, as this would be their only place of existence in Tanzania.[2]

There is an exceptional variety of additional herbivores that reside within the borders of the NCA, and the caldera specifically, however these populations are not as pertinent to the GMP as those mentioned above. Some of these species include giraffe (*Giraffa camelopardalis*), warthog (*Phacochoerus aethiopicus*), eland (*Taurotragus oryx*), bushbuck (*Tragelaphus scriptus*), waterbuck (*Kobus defassa*), oryx (*Oryx beisa*), and impala (*Aepyceros melampus*).[2]

Wildlife-Related Tourism

The wildlife described above has for many years drawn tourism to the Ngorongoro area, which has thus supplied much of the funding of the NCAA for employment, maintenance, and conservation projects. This ecotourism has been the backbone of the NCA thereby justifying a strong focus on wildlife conservation in this region. Little of this money has been directed towards social development for the

Maasai, even though they are directly impacted by the implications of tourism and wildlife management. Lack of compensation has brought bitterness and resentment towards the NCAA from the local Maasai.

As previously mentioned during discussion about the Siedentoph brothers, wildlife tourism in the Ngorongoro area began during the early 1900's and focused mostly on big game hunting. The region was known for its "big tuskers" and its black-maned lions. In 1934 the Crater was made more accessible for tourism by the construction of the first road leading directly to its location, as well as the erection of a hunting lodge on the rim of the caldera. After noticeable decline of wildlife populations, this area, along with the Serengeti, became protected as a national park in 1940. Ngorongoro was subsequently removed from the national park in 1959 and made into the conservation area that it is today.[7]

Tourism at Ngorongoro became quite popular in the early 1970's, however it has seen many fluctuations since that time. The largest decline was seen in 1977 when disputes between Kenya and Tanzania concerning tourism led to the closing of the border between the two nations.[2] The Serengeti National Park (SNP) in Tanzania and the Maasai Mara National Reserve meet at the Kenya-Tanzania border. Many tourists, including myself, travel across the border to access both regions during one visit. The closing of the border severely hampered tourism within the two countries during this period. The border between Kenya and Tanzania reopened in 1984 and tourism levels reached 1970 levels by 1988. As of 1993, tourism had doubled the 1970's high.[12]

The NCA is the most visited protected area in Tanzania, accepting more than 25% of tourists with respect to the total number of park visits.[2] Ngorongoro Conservation Area generates more revenue than both the SNP and the Kilimanjaro National Park together, which are the two most highly visited parks after the NCA. In 1994/95 the NCAA generated approximately 3.7 million US dollars, of which 80% was derived from tourism. In 1990, the SNP brought in one million US dollars and Kilimanjaro National Park made 1.9 million US dollars. The NCAA is required to pay 50% of their excess income after expenses to the Central Treasury of Tanzania.[13]

There are five lodges along the Ngorongoro Crater rim (756 beds) as well as a lodge at Ndutu Lake which borders the SNP.[12] As of 2005, there were 122 licensed

tour companies operating within the NCA, most of which concentrate on driving tours within the Crater itself.[7] During peak seasons between late June and August, the number of vehicles in the Crater may range between 80-140, many of which carry a small number of visitors.[12] Some visitors will take part in walking tours in different locations within the NCA, though these tours have only recently become popular.[7, 12]

Walking tours provide more employment opportunities for local residents than lodges and other driving tour companies. Employment at lodges requires schooling on the English language as well as training to work as maids, food handlers, or customer service representatives. Similarly, driving tour companies would require education pertaining to the English language, driving ability, and in-depth knowledge of wildlife that most guides learn through college attendance. Guide jobs are highly competitive and sought after throughout East Africa.[5] Local residents, however, are generally excellent wildlife trackers and know a great deal of information about the local environment, as they have lived in the midst of it for their entire lives. Correspondingly, most visitors are very interested in Maasai traditions and their ability to live amongst the wildlife.

During my visit to Africa, I was able to visit protected areas in both Kenya and Tanzania. It was quite noticeable that Kenya had a greater proportion of Maasai locals working within their lodges along with other natives to the area. Most of the Maasai workers were greeters or security guards for the tourists. Upon entry to Tanzania, however, there were no Maasai working at the lodges in which we stayed. While speaking to some of the workers in our Ngorongoro lodge, we found that many had come to work from distant towns such as Arusha. Workers were required to live near the lodge in camps and work seven days a week. After approximately three months they would receive a two week vacation in which they could travel home to their families, as family was not allowed to live within the camps. Workers mentioned that it was indeed a hard life, but it also was one of the best jobs in the area to support their families.

It seems, however, that employing local Maasai in lodges would be beneficial to both the Maasai and the lodges. Maasai already live within the NCA and would not need camp facilities to support themselves or their families. One critical difference between Kenya and Tanzania that would make employment of Maasai easier may possibly be the fact that the national language of Kenya is English. The national language of Tanzania is

Swahili, which would make English a third language for the Maasai. The Tanzanian Maasai people traditionally have their own Maa language, but are also fluent in Swahili. As schooling becomes more accessible and prevalent in Ngorongoro, it should be a high priority for the children to learn English so that they may have further opportunities to participate in tourism-based employment.

The benefits of tourism to Ngorongoro specifically, and to East Africa generally, are undeniable. Other than tourism, the only other significant industry in Tanzania is the mining of Tanzanite. It is well known, however, that most visitors to East Africa are seeking to experience the wildlife and the lifestyles of the native people. Much like other large industries, though, tourism has its share of negative impacts. Such impacts upon the native Maasai people will be discussed later in this paper, yet it is important at this time to discuss the negative impacts of tourism on Ngorongoro's wildlife populations.

With tourism on the rise in the NCA, lodges and other tourist facilities are using more and more of the natural resources in Ngorongoro to support their business. At present, water for the five lodges is pumped up from the caldera utilizing a much needed resource of the wildlife, especially during the dry season and the migration stop-over. Similarly, NCAA staff, as well as lodge staff, utilize these same resources all year. This constitutes a large impact upon the water resources of the area, and there are no studies that adequately address this resource in the Crater, or within the NCA as a whole. Hydrological studies concerning location of water points, average flow/quantity, salinity, pH, and purity should be conducted throughout the NCA. With reference to tourism, the average flow/quantity assessment compared with average usage would be most important to determine impact on this valuable resource.

As mentioned previously, depending upon the season the number of vehicles within the Crater may range between 80 and 140 at any given time. Most tour companies will enter the Crater around 7:00 AM and stay approximately five to six hours before heading back to camp or the lodge, as re-entry requires an additional fee. Visitors are required to vacate the Crater by 6:00 PM. There are currently no restrictions on the number of vehicles allowed in the caldera at one time, only rules that require tour vehicles to remain on the provided paths. From experience, it is quite easy to view wildlife from these paths due to their high densities in the Crater. Driving through the

long grass ecosystem before the migration has passed through is quite precarious, as it is difficult to notice animals hiding within the dense grassland. Similarly, species that utilize the microenvironments of the underlying soil may be highly disturbed by the creation of new ruts and pathways forged by large vehicles.

During peak season, however, such a density of vehicles may be intrusive to wildlife. For instance, while the animals seem very comfortable with Land Rovers and vans at very close proximity, these vehicles may obstruct a successful kill. Lions are known to hunt cooperatively, with each member placed specifically to ensure ambush when prey is driven in their direction by another pride member. It is quite difficult to see lions within the long grass system and excited tourists and drivers may not realize their intrusion until it is too late. Conversely, some tour drivers utilize their vehicle to prompt a kill, by scaring a zebra or wildebeest into the direction of the lion pride. I personally experienced this within Ngorongoro Crater during my visit, and it seemed as if not many other visitors were as outraged as I had been. Visitors therefore may place undo pressure on tour guides to travel in forbidden places or to interfere with the wildlife in unnecessary ways.

Tourist activities or placement of tourist lodges and camps may impede natural migration corridors employed by wildlife on a daily or seasonal basis. As of now, most migration corridors are open, though some paths into and out of the Crater may have been obstructed by the lodges placed along the Crater walls. Many of the seasonal corridors are located throughout the short grass plains of the NCA highlands, making it imperative that impact be kept minimal in these regions. Therefore, any tourism development planned for that area should focus solely on walking safaris to curtail interference, and further development of camps should be prohibited.

The Maasai of Ngorongoro

The Maasai are the most recent native residents of the NCA, and also the most numerous and well-known. (Figure 15) It is important, however, to address the human population as a whole in the NCA, of which the Maasai constitute approximately 95% of the total.[14] There have been a number of censuses conducted beginning in 1954 of the

Ngorongoro area, however methods may not have been trustworthy enough to produce reliable results. Similarly, the transhumant lifestyles of the Maasai pastoralists make it difficult to obtain accurate results depending on migration at that particular time of day or year with respect to water and forage availability. These censuses, nonetheless, are the only indications of relative numbers in the area and will be used to generate a general idea of growth rate over the past 50 years. Most censuses included current livestock numbers as well as human populations.

The first census was conducted between 1953 and 1954 (Grant), followed by those in 1974 (NCAA), 1977 (NCAA), 1980 (Arhem), 1987 (NCAA), 1988 (Tanzanian Government), 1993 (NCAA), and 1994 (NCAA). Many of these studies focused on aerial counts as well as some ground counts, which may have been helpful in determining numbers of residents that were herding livestock outside of the NCA at the time of census.[15] When determining livestock numbers through interviews, however, it is easy to obtain altered data due to the fact that the Maasai are hesitant to divulge true numbers, as stock ownership is their primary estimate of wealth in society.[14]

Using calculations from these surveys, the annual growth rate in the NCA is estimated to be in the area of 3.5% per year.[15] The Tanzanian national growth rate in 1988 was projected at 3.9% per annum.[9] Homewood and Rodgers placed the growth rate per year between 1954 and 1987 at around 2.3% in the NCA[2]; however it seems that recent growth rates are much higher. Using data from 1987 to the final census in 1994, growth rates in NCA are estimated to be approximately 8.7% per year.[15] Using a growth rate of 3.9% from the 1988 Tanzanian census, it was estimated that the human population in NCA would reach 34,000 individuals in 1994, however a 1994 survey found populations to be 42,508.[9, 14, 15] (Figure 16)

This 1994 estimate of 42,508 people did not include the staff of the tourist lodges within the NCA. This number can be further dissolved into more specific lifestyle and ethnic group designations. Of the 42,508 individuals, 41,980 live a primarily pastoralist existence, while the remaining 528 are non-pastoralists. Non-pastoralists fall within the categories of civil-servants, shop-keepers, teachers, etc. Among the pastoralist population, approximately 40,890 are of the Maasai ethnic group and the remaining 1,090 of the Datoga ethnic group.[14]

The cause of this population boom is unknown, though it is assumed that most of the explosion is due to an influx of people from outside of the NCA attempting to benefit from advances in livestock development and the lifting of the cultivation ban in the NCA in 1992.[2, 9, 15] Nevertheless, there is a great deal of people living within the NCA in a much specified region so as not to interfere with wildlife grazing and migration corridors. If human and livestock development is to benefit the people of Ngorongoro, it is essential to curb this, as of now, uncontrolled flood of outsiders. It is imperative that residency be established for those people now living permanently within the borders of the Conservation Area.

One of the greatest concerns over this population growth is the fact that livestock populations are not increasing at the same rate. The Maasai are primarily pastoralist people, living off of the resources derived from their stock with some reliance on purchased grains. Generally, Maasai men, especially warriors, sustain themselves on the milk and blood of their cattle. The women live mostly on milk, some blood, and grains. Every so often, during a ceremony or ritual a cattle will be sacrificed on a rotational basis between families living within one homestead, and the meat will be consumed.[2, 5, 6] Livestock are important not only for consumptive purposes, but also for trading at local markets. Livestock trading will buy beads, cloth, as well as grain to feed families.[2] Consequently, in order to maintain a sustainable lifestyle the Maasai are highly dependant upon the health, fertility, fecundity, and mortality of their livestock. Maasai herd both cattle and small stock (goats and lambs); however they are most reliant upon the cattle for survival. The Maasai people are not naturally cultivators, however they will participate in such activities as necessary.[5]

Generally, the Maasai will live in a boma or a homestead, which is a grouping of houses of multiple families enclosed by a protective “fence” of thorny acacia branches to deter predators from entry. This “fence” is also referred to as a boma. (Figure 17) Each male progresses through a ritual coming-of-age where he begins as a mere herder boy, then moves to warrior (Moran) (Figure 18), to elder, and finally to senior elder in his homestead.[2, 6] When he becomes a man after circumcision, his first wife is chosen by his father depending upon the wealth of the two families. Each man will have between two and five wives, each giving rise to approximately eight children. Each “household,”

otherwise known as each wife or *engaji* will have their own house within the same homestead (boma). There may be multiple male figures in a boma with their respective 2-5 wives. Each man has a designated entrance to the boma through which all of his livestock from each *engaji* will leave and enter.[5, 14] Livestock are herded outside of the boma in the morning and are returned at dusk to sleep inside the boma with the residents. The boma is a circular settlement with the homes along the walls. There is a central fenced-off region where small stock sleep and the rest of the area is left for the cattle to roam about and sleep. (Figure 19)

In the mornings before being taken out to graze or water, the livestock are milked by the women and then checked over by the men. General health is assessed, ticks removed, and natural remedies used to treat wounds and illnesses as needed. The Maasai are very vigilant of their stock, ensuring that they are not over-milked or that too much blood is drained from any one cow. Calves are allowed to milk first, thereby stimulating milk flow, and the Maasai women milk concurrently, making sure there is sufficient milk for the calf to satisfy itself.[2]

After milking and grooming, the stock will be taken out to graze. During the wet season stock will not need to travel very far in search of water or forage, and therefore young boys may take on this job in the family. However, during the dry season when longer distances must be covered, the warriors (Moran) will take over, as they are older, stronger, and more able defend against stock raiders.[2] The Maasai generally live a transhumant lifestyle, moving with their cattle with respect to good forage and water. In recent years, exclusion from surrounding areas and isolation in the NCA, as well as a greater need to supplement nutrition with cultivation, has caused the Maasai to become more settled. Now, within the NCA there is usually a permanent boma and a dry-season boma that is located more in the highland region where water is more available during drought. Mostly women and children will remain at the permanent boma with the small stock and the injured or old cattle while the men will travel long distances with the healthier stock to these secondary homesteads.[2, 14]

Settlement of the Maasai has also been supported and enforced by the Tanzanian government since the 1970's when these naturally transhumant people were forced to organize into "villages," which were comprised of a grouping of the bomas in a particular

area. Ecologically, settlement has fewer benefits than transhumance; however the creation of villages was geared more towards establishing political and administrative units. In this way, each unit could be provided with separate schools, health services, political representation, and livestock development projects. These units do not, though, correspond to traditional allegiances to sections or grazing rights amongst different Maasai homesteads.[2] Similarly, the growing need for cultivated diet supplements has led to increased settlement within this region.

Before discussing the current economic and health situation of the NCA Maasai due to rapidly increasing human populations and relatively stable livestock populations, it is essential to first consider the traditional living, grazing, and welfare environment of these people. The vital connection between the decreasing ability to sustain one's family and traditional water and grazing rights is that these traditional welfare systems, which previously would support needy families during hardship, are beginning to deteriorate within the Maasai population of the NCA as more families become destitute. This is, in turn, directly linked to conservation efforts with wildlife, as Maasai are generally restricted from large-scale cultivation and are further restricted from particular grazing and watering areas due to wildlife interactions. Consequently, pastoralists are forced to travel greater distances with livestock causing increased stress and physical activity, as well as increased incidence of tick-borne diseases in the forested areas in which other sources of forage and water are available. Such added stresses greatly influence livestock mortality and fecundity, thereby affecting Maasai well-being.

For centuries, the Maasai have lived within the realm of their traditional property rights, dictated by commonly held beliefs among all Maasai people. Although a few families may live within one homestead, they are generally familiar and friendly with surrounding bomas, as their family members commonly move between bomas due to marriage agreements or to take advantage of better grazing opportunities. However, certain areas of forage or water are restricted to that particular boma or to a particular family.[14] These traditional property rights may cause conflict with new water developments undertaken by the NCAA, or may be aggravated by increased compaction of bomas within smaller areas of the NCA to avoid wildlife confrontations.

The overarching belief of the Maasai is that all water, pasture, and livestock were made for, and subsequently belong to, the Maasai people. The Maasai traditionally practice a religion much like that of the Native Americans, in which God is manifest within nature.[5] They believe that their God has created all of their surrounding resources for their sole utilization. This has led, in the past, to cattle raiding by the Maasai, as well as the fierce war-loving nature of their people against intruders on their territory.[6] This same conviction, on the other hand, has also lead to a moral obligation to help other families in times of need, and is a very integral part of Maasai society.

Although the Maasai believe that all pastures belong to their people as a whole, certain communities will have "primary user rights" to "customary areas."[14] It is known, amongst the senior elders of each homestead, which area belongs to which community. There is a great deal of communication between homesteads through the elders, as they meet periodically to discuss general area information and grazing patterns. The holders of these "primary rights" are able to allow others to access their pasture, thereby giving them "secondary user rights," however the primary users are able to control the usage and behavior of secondary users. If standards of use are violated, the primary users are able to revoke their permission.

Each homestead retains a restricted pasture for their community only and does not allow any secondary users to gain access. This region is called the *olokeri* and abuts the boma. This area is used as forage for calves as well as sick and older livestock that are not able to travel long distances in search of water and pasture. It is imperative that this *olokeri* be retained for the specific village to reduce stress-induced mortality in weaker and more disease-susceptible animals. Unlike the *olokeri*, salt licks are owned by all of the Maasai and do not require "user rights" for access.[14] Salt licks are generally difficult to find, however this resource is readily available near Oldupai Gorge.

Water is a resource necessary for human and livestock survival, and while water availability in the NCA is higher than surrounding regions due to the presence of springs and rivers, restrictions and chemical compositions can make water a scarce resource for the NCA Maasai. The Maasai are restricted from utilizing most of the water in the Crater except for the central lake, Lake Magadi, which is open to use until 6:00PM each day.[5] As previously mentioned, this is a saline lake and the Maasai believe it has medicinal

powers to help their cattle. Like Lake Magadi, many of the springs within the NCA are saline and therefore unusable by the Maasai people for consumption. Consequently, the Maasai will generally utilize certain areas for livestock consumption, and others for human consumption.[16]

Again, all water is owned by the Maasai people, however standing water and flowing water are treated differently with respect to usage and "ownership." Standing water can be "owned" by a particular person, usually being the person who dug the well or discovered the spring. These sources are used by immediate family members and will generally be shared amongst male family members such as brothers and married sons. Within a certain region, in this case the NCA, it is broadly known who maintains "primary user rights" to a particular spring or well, and these rights are rarely violated. Flowing water such as streams and rivers, on the other hand, are commonly owned, yet those who maintain the source retain "primary user rights" for that area. Maintenance of flowing water sources may include repairs to redirecting pipes or livestock troughs. Similarly, if the NCAA undertakes a water development project and solicits the help of resident Maasai, it is those Maasai who manually participate in the development that retain these primary rights in the eyes of the Maasai society.[14]

Livestock ownership is slightly different from that of pasture and water rights in that it is co-owned by individual's fellow clan members. Clans within a boma are comprised of men of the same "age set," or those who were circumcised together. These clan members move through the different stages of life (warrior to senior elder) together, and maintain co-ownership of their respective livestock. The tie between clan members is strong and food-sharing is one of their binding forces. Warriors are not allowed to eat unless in the presence of another warrior. This extreme food-sharing ends when the warriors graduate to elder status. In most cases, however, the primary owner will solely utilize his livestock until there is a time of crisis or a family in need.[14]

A father will control an unmarried son's livestock until he takes his first wife, in which the son's livestock will then be distributed amongst his wives and given to his father-in-law. Until marriage, though, a father is able to sell, trade, or give away any of his son's livestock without consent. After marriage, a woman will receive cattle from her husband from which she is to breed and supply livestock for her children.[14]

Food-sharing is a very integral aspect of Maasai society and is supported by the belief that all of their resources are truly owned by all Maasai, not merely by one person. Livestock sharing is normally conducted between the men of two families, however such cattle are not used for meat consumption. The cattle are kept for a period of time by the borrowing family for reproductive purposes (impregnation of their cows), or for milk production. The cattle will be subsequently returned to the owner when the family is in a better state of being or wealth. Women are known to frequently share their grain with other women in the boma. At the market husbands will trade livestock for grain and divide the grain amongst their wives depending on their respective number of children. Women have been found to share on average 15% of their grain with other women. Similarly, women share approximately 10-30% of their milk. Sharing is done in good faith that goodwill will be repaid in the future.[14]

This system, however, is breaking down due to a general decrease in the livestock to human ratio. Malnourishment and undernourishment are seen in both rich and poor families, which is why the cultivation ban was lifted in 1992. Some grain storage is found within the NCA where the food is imported and sold to residents, yet this is insufficient and unreliable especially during the wet season when roads are generally impassable. Consequently, small-scale cultivation seemed the only answer to improve the well being of the Maasai.

Currently, 85% of NCA Maasai cultivate either maize or various root crops depending on their location. Maize is grown in the lowland grass ecosystem, whereas root crops are more productive in the highland regions.[14] Grain intake supplies approximately 65% of the caloric intake of the NCA Maasai, however cultivation fulfills only 50% of this needed intake.[2, 14] The remaining grain is purchased at markets by livestock trading in which mostly cows are sold (47%), followed by steers (27%), and finally bulls (20%). With declining livestock to human ratios, the sale of reproductively valuable cattle will threaten the security of the Maasai in the future.[2]

Studies conducted in the 1980s and 1990s on Maasai children have found that approximately 40-55% were malnourished or undernourished with respect to weight and height ratios. This means that over half of the children were 80-90% of their expected weight.[2, 9, 14] A study conducted by the District Medical Officer in 2001 during

measles vaccinations found 7% of children under five years of age were still less than 80% of their expected weight. Three percent of these children were 60% of their expected weight which is classified as severe malnutrition.[9] The same studies conducted in the 1980's found that 12% of adult males and 15% of adult females were malnourished.[2]

While small-scale cultivation will, and has, helped the NCA Maasai by allowing them to keep more of their cattle from being traded at market, it is obvious that such cultivation has not entirely solved the health problems faced by these people. The ban on cultivation was lifted in 1992, and studies conducted in 2001 still found malnourishment among the Maasai people. The NCAA has made restrictions on cultivation within the NCA to ensure that it will not interfere with wildlife conservation or become too widespread before action can be taken. Similarly, Maasai lifestyles do not foster a life of agriculture. The Maasai are still very dedicated to pastoralism, and if conflicts arise between cultivation and livestock, livestock always takes precedence.[14]

Currently, the overall area of cultivation within the NCA is not of sufficient size to sustain the present population. In order to provide a 2,000 calorie per day diet for all residents, with grain supplying 65% of their diet, the residents would need a combined area of 15,000 acres. There are, however, only 5,653 acres being utilized. Each person would require around 0.37 acres, yet current estimates find an average of 0.17 acres per person in the NCA.[14] While this is good for wildlife conservation and for the goals of the NCAA, it is not enough to ensure Maasai livelihood. Large plots are unfeasible for the Maasai, as they are hand-labored by the family and compete with livestock herding for labor.

Maasai may derive other sources of income through the collection and sale of natural resources such as firewood, charcoal, honey, and traditional medicines, yet the significance of this trade differs between families. Such activities may be controlled or prohibited in certain areas by the NCAA due to a concern of overexploitation, especially in the Northern Highlands Forest Reserve (NHFR). Milk may be sold by the women; however in 2001 this was only practiced by approximately 1% of Maasai women. Milk is usually sold in exchange for grain, as grain supplies more calories to their diet. The Maasai women are well-known for their beaded jewelry which is very popular amongst

tourists. Because most of the market for these products lies with the tourists, sale is generally controlled by the NCAA or other outside businessmen. Full profits may not, then, go directly to the women who create the commodity.[2]

Within the NCA, the Maasai currently live within a narrow belt that stretches from the southwest corner of the area to the northeast corner.[17] They have naturally settled in this region due to natural factors as well as NCAA restrictions. To the northwest are the short grass plains which are the grazing and breeding grounds of the migratory wildebeest. This region is little utilized by the Maasai during the wet season in order to reduce the transmission of Malignant Catarrhal Fever (MCF), a disease carried by wildebeest calves which is fatal to cattle. The impact of this disease will be further discussed in the section on livestock. To the southeast lie the escarpment, Ngorongoro Crater, and the NHFR. The Maasai are restricted from living within the Crater as well as in the NHFR, thereby creating the narrow strip in which the Maasai are able to reside. It is within these same regions that livestock are grazed and crops are cultivated. The southwest corner of the NCA is generally avoided due to cattle-raiding by the WaSukuma which has been highly problematic for the Maasai.[18] Looking at the proposed zonation map, the regions in which Maasai reside are letters B, C, and D.[17] (Figure 5)

Settlement of the Maasai into specific regions due to village creation, increased participation in cultivation, and resource availability has been seen as incompatible with wildlife conservation. Transhumant lifestyles are less likely to contribute to resource depletion, as livestock is moved frequently to new areas of abundant forage or water. This movement allows the regeneration of palatable species, whereas continuous grazing in a particular area allows for the influx of invasive and less palatable species such as *Eleusine jaegeri*. Unlike other herbivores, cattle will forage down to bare ground, thereby reducing the competitive ability of the natural palatable species. The increase in *Eleusine jaegeri* has caused some concern in the NCA, but it has not yet been directly linked to overgrazing by Maasai cattle. It does, however, seem quite prevalent in highly grazed regions occupied by livestock.[2]

Similarly, there is concern that settlement will create extra stress on natural water supplies. This is being combated by projects to redirect water to highly populated regions. Normally, when living a transhumant lifestyle, a boma would not remain in the

same place for multiple years. Families would move to new grazing areas when necessary and find new water sources, either perennial or ephemeral. Water development projects are also being conducted to ensure good drinking water for the Maasai people, as many natural springs are highly saline. Settlement has led to a great dependence on available water in the Ngorongoro region, as well as a need for good and reliable development of such sources. To date, there are no comprehensive studies estimating water abundance and water usage. With reliance by the Maasai, NCAA, lodge staff, tourists, and wildlife on these water sources, such a study is vital to the continued health of this system.

When the Maasai were forced out of the newly created Serengeti National Park (SNP) and relocated to the NCA, Tanzania undertook a program termed the Serengeti Compensation Scheme. Under this plan, water systems were constructed to ensure long-term use in this region by the Maasai, however upkeep has been lax. A total of 29 systems were created including ten reservoirs, nine gravity-fed pipelines, and ten pump-fed systems. During an inspection in 1988, a total of ten out of the 29 systems were in working order. This included two reservoirs, five gravity-fed pipelines, and three pump-fed systems. Of these ten systems, four are used to serve NCAA staff and tourist facilities, four serve wildlife and livestock, and two serve Maasai domestic consumption.[16] There have been further developments by the NCAA; however these systems suffer from the same maintenance problems. Upkeep is difficult due to corrosion, faulty parts, and damage by wildlife, yet it is essential to the well-being of the Maasai and their livestock.

Consumption of water was estimated as approximately five to ten liters per person a day, with the lower limit being more likely. In regions with convenient access to water the average may reach 20 liters, and the majority of this water is solely for drinking and cooking. In 1988 an estimate was made for water consumption in 2007 with an estimated population of 36,000 pastoralists, 5,000 NCAA staff, and 10% of the estimated livestock population (all incorporated a 2.5% growth rate from 1988 census numbers). Using these approximations, to supply the domestic needs and livestock needs there would need to be a source with a flow rate of 20.4 liters/second. This is half of the flow rate of the Lerai Springs on the Crater rim. This spring is used to supply tourist facilities and the NCAA

staff and is the most productive spring in the NCA. For example, the Lerai Springs produced 3.5 million liters/day in 1961, which was considered a dry year. Most other springs in the NCA have been recorded to generate between less than 45,000 liters/day and 450,000 liters/day. The Lerai Spring is also valuable for its low salinity and fluoride levels.[16]

It is important to note that in 1994, census numbers indicated a population that had already exceeded that of the 1988 estimate for 2007, implying a much greater demand more than ten years before such approximations. It is, therefore, essential that immigration be controlled and that water sources in disrepair are restored for human and livestock usage. Most controlled water sources are spring-fed and production varies throughout the seasons. The above mentioned reservoirs were formed at the head of permanent springs and are mostly used for livestock and domestic consumption. The Munge River is the only source which is not spring-fed, originating in the Olmoti Crater, and supplies approximately 10 million liters/day. There is a pipeline that redirects some of this water to the Maasai, as it is not highly saline.[16]

In essence, the NCA Maasai are currently living a more settled existence with limited access to resources due to wildlife interactions, restrictions by the NCAA, and limited development by the NCAA for their benefit. Though the cultivation ban was lifted in 1992, the Maasai continue to struggle near poverty with respect to their living standards. Lack of access to grain products and limitations on cultivation may be seen to be a key source of the problem, yet the root of the problem lies in the declining success of their livestock, namely cattle. Low production in cattle due to a great deal of variables leads to an increased dependence on grain products which are primarily purchased by selling cattle. This amplified trading and selling in turn leads to reduced stability and production in the herd. Adverse conditions and other variables that affect cattle must be taken under control before Maasai livelihood will be secured. Such impacts will be discussed further in the section on Ngorongoro livestock.

Tourism and the Ngorongoro Maasai

The general importance of Ngorongoro tourism has previously been discussed in the section *Wildlife-Related Tourism*, therefore it is not necessary to reiterate those facts.

It is important to note, though, that most visitors to the NCA are seeking wildlife-related adventures or are hoping to experience the history and anthropology of Oldupai Gorge. For many, learning of the Maasai culture and meeting with their people is of secondary importance. As a visitor in East Africa, I was one of the tourists who wished to travel to Africa to view as much wildlife as possible, to seek out the "Big Five." Luckily, however, I was able to visit a Maasai boma and speak with the Chief's son about their culture and lifestyle. Similarly, when speaking with our Tanzanian guide, whose family had left the Maasai homestead years ago in search of a more modern lifestyle, I realized that learning about the Maasai made my experience much more complete.

The Maasai have lived amongst the wildlife of East Africa for centuries and are startlingly secure and at ease with the closeness of such potentially dangerous animals. When speaking with the Maasai, one comes to realize that the animals and their people have some sort of understanding between them after all of their years of coexistence. The Maasai are able to walk through the open savannah during morning and dusk, otherwise known as prime hunting time, without soliciting unwanted attention from predators. Likewise, the Maasai are respectful of the wildlife, only taking action against problem animals that continue to threaten themselves or their livestock. If one does not visit a Maasai boma during their visit to East Africa, they can at least benefit from the sight of Maasai warriors herding livestock alongside wildebeest, gazelle, and a plethora of predators. While this sight is almost unimaginable, it is also truly reassuring and heartening that there continue to be humans that are able to live in harmony with nature. Hopefully many visitors will come away with a similar feeling, as it greatly enhanced my experience in East Africa.

It is essential, however, that the Maasai have direct involvement in wildlife-based tourism either through employment or the allotment of generated funds back to the people, namely the Maasai, who have endured many restrictions due to wildlife conservation. Harsh feelings between the NCAA and the Maasai have developed in the past due to restrictions on traditional range management (fire) and loss of grazing and water rights. The relationship between the Maasai and the NCAA improved significantly when the cultivation ban was lifted in 1992, yet the Maasai are also looking for increased involvement in conservation efforts and development strategies. The interests of the

Maasai are currently voiced by the Pastoral Council which was created in 1992 to advise the NCAA Board of Directors.[19]

As of 2005, the NCAA allocated TShs 550 million (Tanzanian Shillings) to the Pastoral Council for pastoralist development in the NCA. This figure is approximately 10% of the tourism-derived revenue of the NCAA, however pastoralists feel this allotment is insufficient.[7] Lack of commitment of the NCAA to development projects for the Maasai may also contribute to this discontent. If funds allotted are not utilized in a way which will produce maximum benefits, they will be seen as insufficient. NCAA staff that have greater knowledge of development projects and how to achieve successful improvements may be able to better utilize the funds that are provided to the Maasai, thereby demonstrating that such allotments are useful to the community.

As mentioned in the section on wildlife-related tourism, Maasai may benefit from employment in tourist lodges or camps in the NCA. The General Management Plan of 1996 and the NCAA staff claim that priority is given to Maasai who wish to work at these aforementioned facilities, yet levels of employment are far below that of tourist facilities in Kenya. Most Maasai in the NCA have only finished primary school, therefore they can only fill positions such as security guards or greeters. Security jobs are excellent sources of income for young Maasai men, as they do this on a regular basis with their livestock. Unfortunately, lodge owners have described the Maasai as “unreliable.” As previously mentioned, Maasai give priority to the livestock above all else, including work.[7] This reliability problem with the Maasai does not seem to be quite as problematic in Kenya, as their lodges support a significant number of Maasai workers. It is possible, then, that the priority that was promised to the Maasai is not actually being fulfilled. If priority is truly to be given, lodges must be willing to provide job training to interested Maasai individuals.

The largest problem for increasing employment will most likely arise from a language barrier, as most tourists are able to speak English. The Tanzanian Maasai are fluent in their Maa language and Swahili, making English a third language. Children that are sent to school are learning English as well; however adults may not be similarly educated. English would need to be taught by teachers at lodges or within the boma by fluent individuals, as usually one or two children from each family will be able to attend

primary school. (Figure 20) This tradition has been going on for some years, so there is a subset of adults who should be able to teach others. The desire for such fluency in tourism jobs should be emphasized to the Maasai so that they will put forth the necessary effort to learn the language.

Just as I visited a Maasai boma during my visit to East Africa, many other tourists find it exciting to experience the culture and lifestyle of the Maasai. In the mid-1990's three cultural bomas were constructed in the NCA for the benefit of both the Maasai and the tourists.[7] Such cultural bomas allow visitors to experience the lives of the Maasai, but it does not interfere with activities at their true homestead or degrade their culture. It is essential to separate tourist enterprises from their actual day-to-day activities so that the Maasai do not simply become performers between 7AM and 6PM. Maasai culture is truly fascinating, yet more importantly it is the backbone of their society. The Maasai are exceedingly proud of their culture and the fact that they have not modernized like so many other native groups. The preservation of this lifestyle is of highest priority, which is why they have not given up on their underproductive livestock, instead choosing to continue on in relative poverty and hunger.

Cultural bomas require an entrance fee and walking tours may be given by the Maasai who work within this tourist attraction. It has been found that cultural bomas are not benefiting the Maasai as they had hoped, as tour operators may "pocket" much of the entrance fees. All proceeds from the cultural boma are divided amongst the workers and the ward government which undertake projects within the villages.[7] Upon my visit to a Maasai boma in Kenya, entrance fees were paid directly to the Chief's son, with nothing passing through the hands of our tour guide. Similarly, after purchasing some native jewelry, it was explained that the money is divided amongst all of the families within the boma with a slightly larger percentage directed towards the specific families from whom we purchased our goods.

As mentioned above, the Maasai provide walking tours within the NCA which cover areas around the cultural bomas. This is an excellent enterprise for the Maasai warriors, as they are highly knowledgeable of the wildlife and how to track such animals. Likewise, tourists are thrilled by the idea of walking amongst such exotic wildlife and such an experience will truly be something to remember. The Maasai are very friendly,

helpful, and very willing to share information about their culture and interactions with wildlife. This, in turn, makes them excellent guides and companions during a safari.

The importance of sharing and helping others has permeated Maasai society, as can be seen with food-sharing, livestock-sharing, and the distribution of tourism-derived revenue amongst all members of the homestead. This aspect of their culture would make tourism enterprises profitable for everyone as long as there is a persistent inflow of visitors. Ngorongoro is the most visited protected area in Tanzania; therefore it does not seem that interest would be a problem. Driving safaris are the norm, yet more attention must be given to the cultural bomas and walking safaris for the good of the Maasai and the good of the Crater. These alternative safaris reduce vehicle stress within the Crater and instead focus attention on much forgotten regions throughout the rest of the NCA. Instead of visiting the Crater for two days, tourists may spend one day in the Crater and the next in the surrounding areas.

In order to make these endeavors profitable for the Maasai, it is essential that fees be paid directly to the Maasai that run the cultural boma without passing through the hands of middlemen. This would help reduce corruption and the sharing nature of the Maasai would hopefully ensure proper allocation to all employees. Help may be required to establish operations, whether by the NCAA or outside NGO's, yet further consultation should be minimal. Tourism projects would not only supply much needed revenue for the NCA Maasai, but it would also create a sense of empowerment and involvement that the Maasai have been seeking.

Lastly, the NCAA could employ Maasai warriors as rangers throughout the NCA. The Maasai have an excellent knowledge of the area and wildlife-tracking, as well as an unyielding willingness to protect their land. While poaching is less of a problem today than it was years ago, there is still significant need for able rangers. For example, there is constant surveillance of Black rhinos in the Crater to ensure their survival.[1] Rangers will always be needed, and Maasai warriors can be easily trained as companions to other rangers which can drive and carry weaponry. Increased surveillance may similarly reduce the incidence of livestock raiding, thereby benefiting the Maasai as well as the wildlife.

The Maasai do not by nature seek to harm wildlife as they understand the importance of wildlife to the NCAA and Tanzania in general. It is conceivable then that the Maasai may lash out against the wildlife to make their voices heard. The plight of the NCA Maasai has been discussed in the previous section and it is imperative that the NCAA make efforts to alleviate these hardships. This can be accomplished in part by including the Maasai in tourism-related endeavors, whether it is through employment at lodges or through the development and promotion of walking tours which will directly benefit the Maasai. Efforts by the NCAA to improve their current situation, including food security and livestock development, will not only increase survival and well-being, it will also illustrate to the Maasai that their presence is welcome and necessary instead of a burden. All of these efforts will improve relations between the NCAA and the Maasai, thus ensuring the continued health of the Ngorongoro system and fulfilling the principles of its National Heritage Site and Biosphere Reserve status.

The Maasai Livestock of Ngorongoro

Livestock is an integral part of Maasai livelihood, as they are traditionally pastoralist people who live a transhumant lifestyle. This lifestyle is highly compatible with wildlife conservation, as it does not impose overuse of any particular area, thus allowing regeneration. Transhumance is much like the migration of herbivores, in which species travel to where the resources are located at that time of year. Customarily, the Maasai would travel with their livestock to a region of good forage and accessible water and remain in this location until resources were beginning to be depleted. They would move on as needed to new areas with favorable conditions. The importance of this for livestock is ready access to forage and water without excessive strain or physical hardship on a day-to-day basis. The importance of this for the Maasai is sustained health and resilience of the livestock on which they depend for survival, as well as less conflict with wildlife. Wildlife also benefit from the lack of conflict, less obstruction of corridors, less overgrazing, and less transmission of diseases between herbivores.

This lifestyle has been severely altered by the exclusion of the Maasai and their livestock from national parks. Transhumance can no longer occur because pastoralists are forced to live within a confined area sandwiched between agriculture and the

conservation areas that exclude them. In Tanzania this area is the NCA, and the alteration has been as unfavorable for the livestock as it has been for the Maasai people. To many, livestock may be viewed as simply more competition for the wildlife to overcome; another hardship that African wildlife must endure in their fight for survival. The consumption of vegetation and water by livestock decreases the resources on which wildlife depends. Yet, if the NCAA is to protect the native Maasai as well as the wildlife of Ngorongoro, there must be efforts to improve the health and survival of their accompanying livestock.

The Maasai live primarily from livestock products, namely milk, blood, and occasionally meat. Grain may supplement this diet, and such additions have become more vital in recent years as livestock production has declined. While the Maasai are willing to participate in small-scale cultivation within the NCA to ensure their survival, they would much rather return to their previous life of primary dependence on livestock with occasional supplements of grain purchased at markets.[14] Cultivation is not a part of traditional Maasai culture, and their dependence upon it is solely out of necessity. Therefore, if the NCAA hopes to phase out cultivation from the NCA due to its incompatibility with wildlife conservation, it is vital that improvements in livestock health and productivity be made in the near future. These improvements will need to include increased access to water points, pasture, and veterinary services. Such actions can be undertaken through development projects by the NCAA in cooperation with the Maasai residents of the NCA.

While human populations are growing exponentially within the NCA, livestock numbers are not keeping up pace. Livestock kept in the NCA are generally Small East African zebu cattle (*Bos indicus*), red Maasai sheep (*Ovis aries*), and small East African goats (*Capra hircus*).[2] Populations of both cattle and small stock have continued to fluctuate, as can be seen by the census numbers between 1960 and 1994. As human populations continue to grow, livestock numbers have been documented to decline tremendously and then eventually return to just around 1960 census numbers. This indicates, then, a declining livestock to human ratio, thereby creating the adverse situation that the Maasai find themselves in today.

Cattle are by far the most important livestock species that the Maasai utilize, whether it is for milk, blood, meat, or trading purposes. Cattle are worth more money at market and produce more resources for Maasai survival. While small stock are included, the number of cattle is the main determinant of wealth in Maasai society, and such wealth may determine your input in village decisions, how many of your children are able to attend school, and when your children will get married. Also, cattle ownership will determine a family's access to food and their dependence on food-sharing by others in the boma.

In 1960, the cattle population was estimated at approximately 161,000 but had declined to 64,766 by 1970. The next nearly 20 years saw a restocking of cattle up to 137,398 by 1987, followed by another decline to 115,468 in the 1994 census.[2, 9, 14, 15] The reasons for these fluctuations are unknown, however some postulations have been made. The initial high in 1960 may be due to an influx of pastoralists from the bordering Kajiado District in Kenya due to drought conditions. The NCA highlands generally have abundant rain and therefore attract people from areas of less favorable conditions. In 1962, plentiful rain allowed these people to move back to their traditional homeland.[2] If this assumption is correct, it would help to explain the significant decline in livestock numbers between 1960 and 1970. The initial high in 1960 may also be due to the elimination of Rinderpest by vaccination in the NCA beginning in the 1950's.[9] (Figure 21)

The general increase in cattle numbers between 1970 and 1987 may be due to a variety of factors including lower incidence of disease due to cattle dips or simply higher reproductive rates due to increased health. Cattle increase, as well as human population increase, during this time may be due in part to the establishment of a ranching association in the NCA by the Maasai Livestock and Range Development Project (MLRDP). There were four total ranching associations in Tanzania which all began in the late 1960's and utilized $23,000,000 of USAID money. This endeavor did not flourish, however it is possible that surrounding pastoralists migrated in for these resources. Similarly, in the 1970's a beef ranch was established at Endulen within the NCA by the World Bank which involved pastoralist stock.[2] Such developments are of interest to the Maasai, especially when they are begun during times of hardship.

The decrease in cattle numbers up until the 1994 census may be due to a lack of veterinary services for the Maasai, most importantly dips to prevent the spread of tick-borne diseases. The impact of such diseases will be discussed later in this section, yet it is important to note here that the lack of disease-controlling resources will seriously affect livestock populations. The impact of disease, whether tick-borne or wildlife-transmitted (MCF), will reduce resources for Maasai survival and increase the sale of remaining livestock for grain goods. This will in turn adversely affect livestock population numbers.

Calving rates within the NCA were reported in 1991 to be between 53 and 69% (mean 61%) which falls within "normal" ranges compared to other pastoral populations.[2] In 1997, it was reported that eight Maasai families within the NCA expected a cow to produce a calf every 12.4 +/- 2.5 months. Studies of herds, however, found that time spans between births may range between 14 and 24 months depending on stress and adverse conditions such as drought.[18] While calving rates may be high during years of good rain and forage, calf mortality rates appear to be significant. Mortality within the first year may range between approximately 30% [2, 18] to near 70% [18] depending on drought and disease incidence. Cattle numbers remained stable between 1994 and 1995 due to dip availability and the subsequent lowering of calf mortality. Looking at herd structure, productive females constituted 42% of the herd which is relatively low for a subsistence population, yet calves were around 27% which is considered a high proportion.[14]

The relative health of cattle populations is questionable and may be affecting production. Milk is the main commodity that the Maasai take from their cattle, and a low percentage of cows in a herd will consequently adversely affect the health of the owners due to less milk production. Also, the cows that are available seem to be producing milk below the expected standard. As of 1997, a group of Maasai women in the NCA estimated average milk production at 2.8 +/- 1.7 liters per day from their best cow. Yet, during the dry season each cow may produce only 0.2 liters per day.[18] Studies in the NCA have demonstrated that Ngorongoro cattle production is far below their potential and are instead giving rise to production numbers much like those of cattle from significantly drier habitats.[18]

Goat milk may be supplemented for the consumption of children; however milk production is vital to Maasai survival. Decreased milk production may be attributable to high levels of stress and exertion required during daily treks to find pasture and water. The exclusion of Maasai and their livestock from good pasture in the short grass ecosystem due to disease transmittance, as well as restrictions due to conservation efforts, increase the travel time necessary to find sufficient resources for cattle and people. Studies have found an inverse correlation between milk production and travel time (energy expenditure). Similar studies have demonstrated a positive correlation between milk production and time spent feeding.[2] The fact that the NCA Maasai must travel longer and further to find resources due to settlement and restrictions increases travel stress on their cattle. This increase in travel time will generally mean that there is less time for the cattle to stand and graze. Commonly, the NCA Maasai will alternate grazing and watering days because it is not feasible for cattle to access both resources in one day.[2]

Herd structure is also impacted by livestock sales at markets in exchange for grain, beads, cloth, and metal. Most market trades of livestock are to buy grain, as livestock production is insufficient and grain is able to be stored for a long period of time. Generally, male cattle will be sold first, as their only use to subsistence is blood and impregnation of females. Therefore, there are generally more males than are truly necessary for subsistence needs. Also, males are larger and worth more at market with castrates selling for Tshs 16,020, bulls at Tshs 13,034, and cows at Tshs 11,040 in 1987.[18] These rates were taken from the Endulen market which is located within NCA borders. As herd production decreases more cows are being sold in exchange for grain, thus jeopardizing the health and structure of the population.[2, 14] This increase in cow sales is amplifying the production problem, but the Maasai are looking to satisfy their immediate needs. Small-scale cultivation will somewhat alleviate this problem, as they can grow some of the grains to reduce the need for trading. Milk production per family is also affected by livestock-sharing, as lactating cows will be lent to a friend until they are able to rebuild their herd. This will greatly increase stress on the lending family, possibly increasing reliance on purchased grain.

Small stock populations, namely sheep and goats, have experienced similar fluctuations in populations as have the Maasai cattle. Small stock populations were estimated at 100,689 in 1960 and fell to 41,866 by 1970. Populations rose dramatically to 244,831 in 1977 and decreased to 137,389 by 1987.[2, 9, 14, 15] As of 1994, there were an estimated 193,294 small stock within the NCA. (Figure 21) Fluctuations in small stock are more expected, as they reproduce faster, mature quicker, and are more prone to birthing twins.[2] In addition, rapid changes in population may occur due to alterations in trading preferences. If cattle populations are declining, stock owners may choose to trade small stock instead due to their abundance and population resilience. However, more small stock than cattle will need to be traded in order to purchase the same amount of supplies. Thus, it will cause great fluctuations in population.

Small stock is of less importance to the Maasai than cattle, yet this importance varies depending on the health of the cattle population. In times of cattle crisis, more goat milk will be utilized for consumption by children and more will be traded at market. It is for that reason that small stock populations are important to maintain at all times, almost as an insurance plan. As previously mentioned, goats and sheep are worth less at market, reported at Tshs 1,359 and Tshs 1,293 respectively in 1987 at the Endulen market in the NCA. There is also believed to be a large black market across the Kenyan border for Maasai livestock which may represent the largest number of sales for the NCA Maasai.[18]

As seen in the previous section concerning the Ngorongoro Maasai, the effects of livestock population trends since the 1960's has had a significant effect on Maasai health and livelihood. While there have been periods of dramatic increase and decrease, livestock populations are not growing at a rate that will sufficiently support a primarily pastoralist existence for the Maasai. The numbers can be looked at in a different way to demonstrate the situation in the NCA by using Livestock Units (LU). One LU equals one cattle or seven small stock. It has been estimated that in order to maintain subsistence, the herd must have 5LU/capita. In 1987 the NCA Maasai had livestock equivalents of 6.5LU/person, yet as of 1997 the ratio was down to 3.37LU/person.[14] These equivalents are below subsistence standards, even including small stock, thus indicating why the Maasai are so reliant on grain supplements to their diets.

It is imperative that changes be made within the NCA to improve livestock herds for the benefit of the Maasai and conservation. While most people would argue that livestock is simply competition for wild herbivores, alternative lifestyles such as increased cultivation or hunting would have a much more negative effect on wildlife conservation. Livestock does in fact compete for palatable grasses, yet interactions are reduced due to disease transmission. Consequently, Maasai livestock is forced into restricted regions where overgrazing leads to the growth of unpalatable grasses such as *Eleusine jaegeri*. This species is highly damaging to the teeth of cattle and would traditionally be selectively burnt by the Maasai to promote the new growth of palatable species.[2] Fire prohibition in the NCA has contributed to the growth of *Eleusine* as well as illegal burning to remedy this problem. If the Maasai are to graze within specific regions, actions must be taken to ensure that such areas are suitable for livestock grazing. Otherwise, intake will not be sufficient in amount or nutrition to promote a healthy livestock population.

Maasai livestock are restricted to dry season grazing in the highland regions which supports an abundance of ticks. (Figure 22) These ticks are not merely annoyances, but instead transmit a variety of diseases that have led to high mortality within livestock herds. The Maasai generally know about these diseases and are able to identify the clinical signs of each. Such tick-borne diseases include Anaplasmosis, Bovine Cerebral Theileriosis (*Ormilo*), and East Coast Fever (*Oltikana*). Each of these diseases is fatal to the cattle that contract the disease. Anaplasmosis is caused by the rickettsia *Anaplasma marginale*, and begins with fever and anemia. After death cattle are found to have an enlarged spleen and a swollen gallbladder with discolored bile. Bovine cerebral theileriosis (BCT) is believed to cause nervousness in affected cattle and is caused by the organism *Theileria taurotragi*. East Coast fever (ECF) is caused by the parasite *Theileria parva* and reveals clinical signs of weight loss, enlarged lymph nodes, corneal opacity, and frothing from the nose. Surveys of NCA Maasai indicated that the pastoralists considered ECF to be the most significant disease affecting cattle, as mortality can be up to 100%.[9]

Tick-borne diseases can be easily avoided by the development of cattle dips or the utilization of sprays to deter these insects. Severe declines in cattle populations can be

seen when insect repellants such as acaracides are not available. The stability of the cattle population in the NCA between 1994 and 1995 is highly attributable to the availability of acaracides. During this time there were approximately 12 dips running and were fully utilized by the Maasai. The NCAA will be able to maintain good relations with the Maasai if they are able to ensure ready access to these dips or equivalent alternatives.[14] The NCAA may also be able to employ Maasai at these stations after training on dipping techniques. While the death of these cattle may provide meat goods, it is less valuable than the continued production of milk and calves. Also, it may have been worth more at market to supply grain for the family.

Developments have occurred in the Ngorongoro District recently to abate such tick problems and their associated diseases. There is currently the Integrated Tick and Tick-Borne Disease Project in Arusha as well as a disease control method being developed through a VetAid Project in the Simanjiro District.[9] These advances will be necessary to reduce livestock mortality and ensure Maasai survival. Such efforts may be able to provide and ensure the availability of acaracides to the NCAA all year long or provide alternative ideas that would be more feasible for everyone involved.

Tick problems were traditionally controlled by avoidance due to a transhumant lifestyle, as well as range burning which would remove the brush that housed the pests. Range burning had been banned by the NCAA for years for fear that such fires would become uncontrolled and threaten the Northern Highlands Forest Reserve (NHFR).[2, 20] The 1996 General Management Plan, however, demonstrated an interest in developing a controlled program of range burning with the local people and their customary knowledge of these practices.[21, 22] Unfortunately, as of 2001 the proposed program has not yet been implemented.[9] A controlled burn program will not only help reduce pests, but it will also contribute to the regeneration of short grass plains grasses at the ecotone of the short grass zone and the forested highland region. Bush encroachment has been documented in this transition zone and is also attributed to a reduction in cattle grazing in this region due to interactions between livestock and wildebeest, and the subsequent transmission of Malignant Catarrhal Fever (MCF).[20]

While tick-borne diseases are generally preventable by the supply of adequate insect repellants, some diseases are equally as devastating but nearly impossible to

thwart. This is the case of Malignant Catarrhal Fever (MCF), which was rated among the NCA Maasai as the second most significant disease encountered in the NCA after ECF. MCF is caused by two sources: alcelaphine herpesvirus -1 (A1HV-1) and ovine herpesvirus-2 (OvHV-2) with natural hosts of the blue wildebeest (*Connochaetes taruinus*) and the black wildebeest (*Connochaetes gnou*), respectively. The disease is asymptomatic in the wildebeest; however it is usually fatal in affected cattle.[9]

Clinical signs of MCF include fever, inflammation of the mucous membranes in the respiratory and alimentary tracts, the conjunctiva, the eyes, and the skin. There may also be discharge from the nose and eyes, muscle tremors, anorexia, and circling. Twenty-two percent of respondents of a study conducted in Ngorongoro District, Tanzania (out of 81) noted an incubation period of between one and two months before symptoms appeared after interaction with wildebeest. These same respondents estimated survival for 4-5 days after clinical signs became apparent, yet there were some unusual cases in which cattle survived up to 30 days.[9]

Transmission occurs during interaction with wildebeest and it does not appear that direct contact is necessary. The virus is carried in the saliva and nasal secretions of wildebeest calves, allowing it to become airborne and communicable over short distances.[2, 9] Communication with Maasai has indicated that they believe the virus to be found in the placenta and afterbirth fluids of the wildebeest calves, as well as on their hair. For this reason, Maasai will avoid water contaminated with afterbirth and will avoid any location in which cattle may ingest wildebeest hair or smell afterbirth.[9] While these beliefs have been proven false by scientific studies, they have in fact helped to reduce incidence by avoidance of wildebeest during the times in which these factors are present. Transmission of the virus does not occur between cattle, only between the host species and cattle which is very significant for the survival of the remaining healthy individuals in the herd, and the resulting survival of the Maasai as well.[9]

Importantly, infection occurs most frequently during, and for some months following, the calving season of wildebeest. (Figure 23) The association between calving season and disease incidence is what has led the Maasai to believe that afterbirth carries the MCF virus. Studies have indicated that viral excretions through the nasal passage occur during the first 3-4 months of a wildebeest calf's life. Periods of transmission peak

at different times in different regions, however the season in Ngorongoro ranges between April and September.[9] More importantly, this coincides with the peak of the wet season during which the short grass plains are lush and highly valuable to wildlife and livestock for their high nutrient and mineral content. The consumption of grasses with high nutritional value is vital to proper lactation in both livestock and wildebeest.[2, 9, 18]

Unfortunately, the transmission of MCF from wildebeest to cattle during this time leads to the exclusion of cattle from valuable resources in the short grass plains. To avoid interactions, Maasai herd their cattle into the highland region which in turn increases the incidence of tick-borne diseases such as ECF which was discussed previously. Unlike the tick-borne diseases, MCF is not preventable, as there is no known vaccine against the virus as of yet. The Maasai may utilize traditional remedies; however they have found these practices to be ineffective.[9] Even if treatment was available, it is questionable whether such practices would be effective in view of the fact that cattle survival after appearance of clinical symptoms ranges between four and five days. Outward signs may indicate that the disease is too far along for treatment to be viable, and instead may incur large amounts of financial burden on families with no positive outcome. If possible, development of a vaccine would be most beneficial to the Maasai and their cattle.

As mentioned, due to the lack of preventative treatments Maasai are forced into the highland region for wet season grazing. Some people have purported this to be an advantageous outcome, as it is a natural barrier to competition between cattle and wildebeest in a region so vital to the migratory populations that travel through Ngorongoro.[2, 9] This view is supported historically by the case of Trypanosomiasis which is transmitted by its host, the tsetse fly, to livestock populations in Tanzania leading to Rinderpest outbreaks in the 1890's. Rinderpest devastated populations of wildlife, livestock, and humans alike thereby allowing an increase in woody vegetation which would normally have been controlled by traditional burning and grazing. Woody vegetation harbors the tsetse fly, and so following Rinderpest control wildlife populations were able to flourish in tsetse infested areas while livestock could not. Though vaccinations were provided for Maasai cattle, the Maasai were still wary of these areas

which were known to be tsetse territories. Avoidance by the Maasai led these areas to become many of the present day protected areas in Tanzania.[2, 23, 24]

While such diseases helped establish wildlife abundant areas in Tanzania, Ngorongoro is much different. The NCA was formed for the good of wildlife *and* Maasai, consequently both should be able to live comfortably within its borders. MCF has devastating effects on Maasai livelihood with Maasai estimating a loss of Tshs 50,000 to Tshs 150,000 per affected cattle. Such losses include death, loss of milk production, and reduced price at market for sick cattle. More importantly, MCF affects mostly adult cattle in the NCA, especially females, which undermines the future viability of the herd as reproductive animals are removed.[9] The impact of livestock loss to Maasai livelihood and health has been discussed at length in previous sections, and MCF is a significant contributing factor to livestock population trends.

Exclusion from short grass grazing areas due to MCF transmission is not only devastating to the Maasai, but it is likewise having adverse affects on the highland region in the NCA. The Northern Highlands Forest Reserve (NHFR) is protected for its water catchment resources and its diverse wildlife populations. Maasai grazing in surrounding forested regions and within the NHFR itself brings many pressures to this ecosystem which has become apparent in recent years. Undesirable impacts of grazing have been found in regions of the NHFR, particularly the upper and lower edges, as well as in other unprotected forested regions within the NCA.[25] Maasai respondents to a study concerning the impact of MCF similarly voiced concern about overgrazing and soil erosion in the highlands. Thirty-three percent deemed soil erosion as problematic and 31% admitted to concern about overgrazing.[9] It is not surprising that the Maasai would be wary about these self-made impacts, as they traditionally seek to avoid such effects by management of herd movements by elders. Excessive grazing, then, is against their better judgment, yet they have no other option if they wish to avoid the wildebeest during calving season. Likewise, the Maasai are aware of the consequences of overgrazing, namely the further reduction of quality vegetation for their livestock.

Grazing impacts are coupled with burning activities which have been deemed out of hand by the NCAA and researchers.[25] Burning is conducted secretively, as the NCAA has made no effort to implement a controlled burning program. Such unplanned

burning may become excessive and out of control due to excessive brush growth. Benefits of burning will come through cooperation between the NCAA and the Maasai leading to the compilation of a detailed plan to implement controlled burns in the forested highlands of the NCA. Location and timing are vital factors that must be addressed during these endeavors, as moisture, wind velocity, and wind direction may dictate whether controlled burn activities will be successful or uncontrollable.

Such controlled burning measures will not, however, reduce the impact of livestock grazing on the highland region. In fact, increases in acaracide availability may allow livestock populations to rebound thus increasing grazing in these areas. Unless disease abatement is comprehensive, including tick repellant and advances in MCF vaccination, overgrazing will remain a threat to the NCA highlands. In addition, livestock raiding in the southwest corner of the NCA severely limits valuable grazing areas that would otherwise reduce usage of the highland areas during the wet season. Efforts should be undertaken to decrease raiding by increasing patrols in this area for the benefit of the Maasai and their livestock. These efforts by the NCAA will similarly benefit the NHFR and improve relations between the Maasai and the NCAA, as the Maasai realize the NCAA's concern for their well-being.

Essentially, livestock is the foundation of life for the Maasai, as can be seen by the devastating impacts that losses have had on Maasai livelihood. The Maasai believe that all cattle were put on earth for the Maasai, an indication that they perceive themselves to be innately a pastoralist people. They also believe that all pasture and water belong to the Maasai collectively, yet this ownership is primarily for the use of their livestock. Furthermore, their entire society is based upon livestock ownership, whether it is for food, sale, gift-giving, or as a sign of wealth. If the NCAA is dedicated to preserving the native people of this region, namely the Maasai, then it must also resolve itself to the preservation of their life source.

Conflicts

The NCA is an excellent example of a multiple land-use area, an idea that is being embraced by conservationists in many countries around the world. This is especially important in nations where people continue to rely primarily on the land for subsistence,

whether that utilization is for sole use by the family or for sale at marketplaces. Sometimes, as with large-scale agriculture, conflicts are too numerous and require people to be displaced for successful conservation. Pastoralism as practiced by the Maasai, however, has been deemed a lifestyle compatible with wildlife conservation. Due to the fact that the Maasai rely on their livestock for survival, specifically food, hide, and sale, they have not found it necessary to rely on wildlife products to fulfill these needs. The transhumant lifestyle of the Maasai traditionally reduces interaction between wildlife, people, and livestock thus minimizing disease transmission and grazing conflicts. Also, overgrazing and nutrient stripping/concentration are not problematic because livestock is moved relatively frequently to avoid such impacts and to ensure adequate pasture and water for their animals.

The concentration of Maasai within the NCA due to exclusion from surrounding areas in Tanzania as a result of conservation efforts has led to wildlife-Maasai conflict in this area, especially because the Maasai are becoming more sedentary due to the creation of villages by Tanzania, thereby reducing transhumance and increasing reliance on small-scale cultivation to supplement dietary requirements. The NCAA, though, has committed itself to the preservation of both wildlife and the Maasai in the NCA, therefore attempting to maintain the balance between these two entities as has been the case in East Africa for centuries. This balance, however, is trying to be kept in a demarcated region, only a small section of East Africa, otherwise known as Maasailand. The conflicts, then, are amplified in this small area as wildlife and Maasai livestock compete for valuable resources crucial to their survival.

Some of these conflicts have been discussed in previous sections in order to elucidate the current situation of wildlife, Maasai, and livestock in the NCA. It is beneficial, however, to reiterate these interactions before addressing the 1996 General Management Plan (GMP) for the NCA so that crucial issues will be at the forefront of the mind. Such conflicts are exactly what the management plan should try to address and resolve with the understanding that ideal situations may not be reached for all parties involved. The Maasai are not natural enemies of the wildlife of Ngorongoro, but unresolved or unaddressed conflicts may lead to the exploitation of wildlife to make

voices heard, utilization that may adversely affect populations highly valuable to the conservation community.

The largest area of conflict between wildlife and the Maasai surrounds access to grazing lands. The Maasai have been excluded from the Ngorongoro Crater except by permit for use of salt licks and water resources from the central lake, Lake Magadi. Similarly, grazing is allowed, but limited in the highlands region of the NCA in order to conserve the integrity of this region for its water catchment resources. The short grass plains, which runs along the northern area of the NCA is open for livestock grazing, but is generally avoided during the wet season due to the transmission of MCF. Most grazing resources for the Maasai livestock, then, are within what has been termed the "Pastoralist Development Zone" which lies between the short grass plains and the highlands regions. This zone also lies between the short grass plains and the escarpment; however this area is within the lower southwest region of the NCA where much cattle raiding occurs, and is thus underutilized to avoid these threats.

The Maasai livestock are reduced to wet-season grazing within the Pastoralist Development Zone which is also the location of villages, schools, health clinics, and roads. Much of this area is, however, avoided during the wet season, though, to create a buffer zone between the cattle and the wildebeest. Further grazing, as discussed in the previous section on Ngorongoro livestock, occurs in the highlands region where stock is exposed to a high incidence of tick-borne diseases which decimate the population and undermine Maasai livelihoods. Overgrazing and erosion have become a concern to Maasai and the NCAA alike in this area, as well as the influx of invasive and unpalatable species of vegetation such as *Eleusine jaegeri*. This invasion is unfavorable to both wildlife and livestock, yet the Maasai have no choice but to continue grazing in the same areas for fear of disease transmission.

The Maasai are able to move cattle down into the short grass plains after the peak transmission time has passed. Most NCA cattle present with clinical symptoms of MCF between April and September, though it is possible that an incubation period may be the cause of MCF symptoms in September. Wildebeest utilize the short grass plains for foraging and calving during the wet season, which lasts from December to June, and begin to shift North towards Kenya at the onset of the dry season.[9] Maasai may be

wary about moving cattle onto the short grass plains until wildebeest have departed with their calves into Kenya, causing them to be left with little vegetation for their livestock. After the migration has moved through an area, the grass is not only dry and less nutritious, but also very sparse. The dry season allows the Maasai full range of the NCA, but the livestock will continue to be nutritionally deprived.

Wildlife obviously benefit from this lack of competition during the wet season, and it is safe to say that they would be the dominant species in this region even if livestock were able to graze alongside of them in the short grass plains. Wildebeest numbers have skyrocketed in recent times and they are nothing less than stubborn. Upon my visit to Ngorongoro, these animals would refuse to move even as vehicles were near nudging them out of the way as they lay across the constructed road. The gazelle and zebra which accompany the wildebeest on their migration route are much more apt to be influenced by the presence of the Maasai and their livestock.

It is, though, essential to maintain proper corridors for the migration, as these species have been utilizing the same paths for centuries. As it has been termed, the Last Great Migration is a phenomenon and wonder that must be preserved for as long as possible. Tourists travel far and wide to experience this phenomenon and be awed by the abundance of wildlife that all demonstrate an innate drive to carry out this breathtaking ritual. While livestock grazing may not interfere with this migration, human settlements will create obstructions to long-used paths. This should be clearly avoided and should remain a priority in ongoing and future conservation efforts in the NCA.

Access to grazing land is, though, of primary concern to the Maasai, as their cattle are in poor condition and consequently more susceptible to sickness and disease. Lack of good pasture also reduces lactation which is a product that is essential to Maasai survival. Livestock health is strongly linked to the health of their owners, and increased stress on these animals has been one of the leading causes of Maasai reliance on cultivation within the NCA. With the lifting on the cultivation ban in the NCA in 1992, many families are relying on such practices to supplement their diets with grains comprising nearly 60% of Maasai nutritional intake.

Cultivation is not considered compatible with wildlife conservation, as it leads to increased settlement amongst the Maasai. Luckily, cultivation within the NCA has

remained small-scale mostly due to the fact that Maasai families do not have the time to devote to large acres of crops. Most time is spent tending the livestock and other grains may be purchased at market by trading cattle and small stock. If cattle numbers continue to decrease, however, cultivation may be relied on more fully to fulfill dietary needs. This would be very unfavorable for wildlife conservation because it will utilize land and water resources much more intensively than they are currently being used. Likewise, wildlife may cause much damage to agriculture through trampling and through ingestion of crop plants. Fencing out wildlife is currently not allowed in the NCA and conflicts would undoubtedly arise from these sources of destruction. It would most likely increase the taking of "nuisance" animals, which is the only time in which Maasai will intentionally kill wildlife.

It is consequently beneficial to the Maasai, livestock, wildlife, and conservationists that advances are made in the area of disease control and prevention in order to allow greater access of Maasai livestock to the more nutritious short grass plains during at least part of the wet season. There are, of course, pros and cons to any plan when affected parties are so diverse, namely wildlife, the Maasai, and livestock. Such access would reduce the need for cultivation, but benefits may be offset by other impacts that livestock may have on wildlife due to competition for resources and increased grazing pressure. As previously mentioned, any management plan will involve some give and take on both sides.

A study published in 2002 utilized a computer modeling system, SAVANNA, to assess the impacts of changes in livestock populations on wildlife and grazing resources. The model found primarily that livestock numbers were not being capped by reduced birth rate, but instead by increasing death rate, most likely due to disease. Importantly, when livestock populations were kept constant at a 50% increase from current population numbers, most wildlife populations were found to decline, such as elephant and warthog. Similarly, range quality decreased, as biomass of palatable grass species was reduced by approximately 15%. Unpalatable species increased by 10% during this same simulation. The model further estimated the impact of allowing cattle to graze in the southwest corner of the NCA which is normally avoided due to cattle raiding. Such impacts were insignificant to most wildlife except elephants which decreased by 22%. Also, if

livestock were able to utilize the plains during the wet season, the NCA could support 20,000 more cattle after 15 years.[26]

Studies were also conducted using the SAVANNA modeling system concerning the reduction in disease and its impact on livestock populations. The model assumed that most of the excess animals would be used for sale at market or slaughtered, and so did not have a significant impact on the environment or wildlife. When modifying survival rates of adults, additional animals of large and small stock ranged between four and seven percent, while also increasing birth rates. Likewise, when tick-borne diseases were reduced by half, an additional 5.7% of cattle were available, as well as 2.3% of goats and 6.3% of sheep.[26] Improved veterinary services may have a modest affect on the livelihood of the Maasai by increasing the number of animals for food, milk, and sale at market.

This study indicates the impact that increased livestock populations may have on the Ngorongoro system, showing reduction in wildlife and forage quality. However, it also demonstrates that Maasai livelihood will in fact be improved by veterinary services, access to short grass plains, and through the utilization of the southwest corner of the NCA. Further studies must, then, determine how much give and take is tolerable on either side without having extreme effects on wildlife populations and Maasai livelihoods. The question must be addressed as to how much of each wildlife population can be sacrificed to improve the lives of the Maasai. It is not a question of what is more important, but of avoiding extremes. The wildebeest population which has exploded in recent years may be quite resilient against competition with livestock. For now, however, this competition will not be too extreme due to the transmission of MCF. Until a vaccine is found to establish immunity, there will always be that natural barrier that reserves the short grass plains for the wildebeest and their calves.

The study does often make note of declines in the NCA’s elephant population. Elephants are not overly abundant within the NCA, and declines of 22% as seen from opening the southwest short grass plains to livestock grazing may pose a significant problem to conservation of this species in Ngorongoro. Only a few species were presented in this SAVANNA study, and it may be important to address all significant species in the area before making any changes to the system. While many species are

tolerant of human presence, others remain timid and may abandon their natural territories if that area is more frequently visited by humans and livestock.

It is also important to note that increasing wildebeest numbers may have adverse effects on other wildlife species as well. Just as increasing livestock numbers would amplify competition, grazing pressure, and trampling, it is likely that uncontrolled wildebeest populations would have a similar effect. The largest disparity, it seems, would be the fact that wildebeest are more specific grazers than cattle, and move on to new areas once their preferred species of grass has been depleted. Cattle, subsequently, may have a more adverse impact on vegetation because they are more generalist feeders than wildebeest and gazelles. The impact of overgrazing by livestock could be combated by planned grazing patterns set out by Maasai elders, as have been traditionally utilized in times of less restricted land-use. It has been seen, though, that the explosion in migratory wildebeest populations has had an effect on traditional migration timing and patterns. These populations have expanded their use of the NCA, with others moving directly into Kenya without stopping over in the NCA.[9] These changes could be adversely affecting other wildlife populations in the NCA and in Kenya that would normally utilize these areas in the “traditional” migration pattern.

Trampling is another main effect that herbivorous species have on their environment, leading to soil compaction and changes in vegetation at high animal densities. A study conducted in 1983 compared the hoof pressure between wild and domestic ungulates by dividing body weight by the sum of the hoof area.[2, 27] While wildebeest were not specifically addressed, Maasai zebu cattle and wildebeest are very similar in size and would therefore probably exert similar pressure.[2] The continual increase in wildebeest numbers, then, would likely have the same impact towards trampling effects as would an increase in cattle populations. Just as cattle would be herded in large groups, wildebeest (migratory and non-migratory) and herbivores in general, tend to live very social and gregarious lifestyles. It is highly unlikely to find wildebeest, zebras, or gazelle in small groupings.

If increases in livestock have an effect on wildebeest populations, it may be viewed as an alternate form of control for such an unrestrained population explosion. As wildebeest numbers expand, the NCAA may find it necessary in the future to control

these populations to retain the integrity of the Ngorongoro system and its other wildlife species which compete with the wildebeest for resources. After predation, the only other option for control would be selective culling which may not be acceptable with tourism in these areas. If livestock is able to provide the competition necessary to keep wildebeest populations at a sustainable level, this may be a less invasive, and more preferred, control measure. This would not only serve conservation efforts, but also improve the lives of the resident Maasai.

The findings of studies such as the one mentioned above, though, must always be taken with a grain of salt. Simulations that are able to predict the outcome of certain changes in an ecosystem are very useful and allow researchers to alter a variety of variables in different combinations to foresee the future and make the wisest conservation decisions. Such simulations are, like all "controlled" ecological studies, not completely accurate representations of the true ecosystem. Unlike other areas of research such as chemistry and biology, ecological studies can never control or account for the multiplicity of variables that are encompassed by an entire ecosystem. Predictions of drought, disease, fertility, mortality, and the movements of people and wildlife must be made through interpretation of past years and by best guesses. Those who understand ecology, however, also understand that studies and simulations like the ones mentioned above are all that can be relied upon to make the most educated decisions. So, while it may not be fully accurate to true-life happenings in the future, the SAVANNA study is most likely the best way to predict the outcomes of changes in the Ngorongoro system.

As mentioned above, disease outbreaks are extremely difficult to predict, especially because many are dependant on host species which are in turn dependant on vegetation, which is subsequently dependant on climate and weather patterns. Just as wildebeest transfer MCF to Maasai cattle, there is the likelihood that livestock may transfer other diseases to wildlife if contact occurs. The opening of the short grass plains to livestock will increase the incidence of contact between the two and it is vital to address disease possibilities so that epidemics will not occur that could threaten valuable wildlife populations as well as livestock. Especially important is the fact that wildlife species are able to travel into and out of the Crater, thereby transporting any diseases contracted outside the Crater to the protected populations inside the caldera. Without

even considering other species, a disease may eliminate the Black rhino population of the caldera that currently stands at fewer than twenty individuals. Consequently, efforts must be taken to reduce disease occurrence in Maasai livestock for the benefit of the Maasai and wildlife alike.

Outbreaks of diseases in Maasai livestock can be combated by increasing the availability of livestock health services. Vaccination for some diseases is available, such as Rinderpest and Anthrax, and early detection of diseases such as Foot-and-Mouth Disease can ensure that affected animals are quarantined. Discussions with the NCA Maasai have demonstrated that livestock owners are very aware of early signs of most diseases within the NCA, and therefore will be able to bring livestock to health facilities soon after the onset of symptoms.[9] Maasai are very attentive to their livestock and take care to groom and inspect their animals every morning before grazing and watering trips begin.[6, 14] Similarly, many Maasai use dogs as guards against predators for their herds and it is essential to address the likelihood of rabies outbreaks associated with these animals.

Even if the Maasai are able to maintain separation of livestock and wildlife during grazing, it is highly likely that interaction will occur at salt-licks and water sources. Water is an extremely valuable commodity in the Ngorongoro system, particularly because many are perennial sources. It has been mentioned earlier, however, that a great deal of these water sources are highly saline, especially water arising from natural springs. Even slow moving streams, as seen within the Crater, may become highly saline even though they did not begin this way, as high rates of evaporation concentrate minerals. Wildlife and the Maasai livestock utilize both fresh and saline sources, as Maasai believe the saline water to be good for sick cattle. This is the primary reason that the Maasai wish to retain rights to Lake Magadi in the Crater because its high salinity is believed to bring good health to livestock.[5]

Livestock and wildlife will meet, then, at these water sources because they are grazing in similar areas. In the past, the Maasai have kept wildlife away from specific water holes by constructing fences around the source; however these practices have been banned by the NCAA. If wildlife and people are to be maintained in the NCA, it is important that all players have access to the resources that are provided by this

ecosystem. Water development projects were undertaken in the NCA as compensation for Maasai exclusion from the adjacent SNP, through wells and redirected river water to reservoirs and troughs, to provide fresh water to people and livestock, yet these sources are not adequately maintained. Without these developments competition will remain over natural water sources and illegal fencing may take place in remote areas where patrols are inadequate. Fencing is not only detrimental to wildlife, but it is also wasteful for the Maasai, as large ungulates can easily knock down and trample these structures. Fences would need to be rebuilt frequently, thus increasing the utilization of forest products.

At this point in time, however, there is no such problem with interactions between wildlife and livestock at water sources due to the separation of these herbivores due to disease transmission. Currently, the water problem for the Maasai stems from this division. More specifically, the Maasai warriors must travel long distances with their livestock to reach adequate water sources which increases stress on the animals and reduces grazing time. Increased stress and insufficient nutrition in turn make the livestock more susceptible to diseases. All of these factors contribute to the undesirable state of being that Maasai livestock exhibit today. The Maasai, instead of grazing and watering their animals on the same day, will alternate these activities to achieve the maximum benefit of each. Water resources are similarly scarce for human consumption, and women are required to travel significant distances to obtain water and then must carry home large jugs to supply their family for multiple days. Upkeep of water development projects would make both of these situations less strenuous and would likely have no adverse affect on wildlife if water was taken from sources of great abundance.

In order to find ample amounts of water, Maasai will utilize hand-dug wells which will be owned by the one who personally dug them. This water arises directly from groundwater under the NCA and its components are therefore questionable. While this may have been a traditional source of water for the Maasai years ago, the abundance of agriculture surrounding the NCA brings some concern as to what contaminants may be present in this water source used for drinking and cooking in the household. The use of pesticides and contamination with wildlife fecal matter pose threats to Maasai health

through consumption of this water. Usage of water from development projects would be a healthier option as long as testing and treating were conducted on a regular basis.

Resources such as land and water which are a source of conflict between wildlife and Maasai also bring conflict with tourist facilities. Tourists flock from every part of the world to experience the wonder of the Ngorongoro area, whether it is for its history, its beauty, or its wildlife. The people that can afford trips to the NCA are usually foreigners, but more importantly they are people who are accustomed to a lifestyle that utilizes many more resources than the Maasai, or even the lodge employees. Valuable land is utilized for lodges, campgrounds, guide housing, lodge employee housing, and museums. Most of these facilities require electricity, water, food services, and other resources which may be directly extracted from the NCA environment. In other words, tourist facilities utilize resources that would otherwise be directed towards people and wildlife.

It cannot be denied, though, that tourism is highly valuable to the NCA and to Tanzania in general. The impacts of tourism, namely resource consumption, pollution, and the displacement of native people and wildlife, must be compensated to those that are impacted most significantly. Wildlife can benefit from tourism through conservation efforts funded by fees of entry and donations by visitors and tour operators. Conservation efforts may be supported by the government of Tanzania in an effort to support populations that continue to draw visitors to this nation, thus supporting the Tanzanian economy. Non-governmental and other wildlife organizations similarly support conservation programs through contributions from donors around the world. Visits to areas such as the NCA will boost assistance toward this cause simply because it is far more personal once tourists have witnessed the wonder of Ngorongoro and realize that natural systems such as this should be preserved. If nothing else, the beauty of the Ngorongoro Crater and the understanding that it is home to the Last Great Migration, one of the most awe-inspiring phenomena left in this world, would drive tourists to contribute to its protection in the future. Wildlife has certainly benefited, and can benefit more, from tourist activities in the NCA as long as impacts are kept at a minimum.

The Maasai have not benefited from tourism as much as would be hoped, especially because they too have lost land and resources much like the wildlife of the NCA. This contributes to one of the main causes of conflict between wildlife and the

Maasai, in that most money derived from tourism goes directly toward conservation efforts for the wildlife and little is given to the people of the area. This can cause resentment of the wildlife because wildlife has brought tourism to the region and in turn has negatively affected the Maasai. Efforts are being made in the NCA and throughout Tanzania to return some of the benefits of tourism to the Maasai and other native people through their participation in related activities; however corruption has made these efforts less successful than anticipated. Corruption is not seen amongst the Maasai, but in government officials who are employed to help the people undertake projects and business endeavors related to tourism. Much of the money earned ends up in the pockets of these officials instead of with the locals who participate in the projects. Unfortunately, the Maasai must rely on this help because they do not know how to undertake such projects on their own, and require guidance on business matters.

The help of non-governmental and international conservation organizations may be more beneficial to Maasai tourism endeavors. Revenue derived from wildlife-related tourism that benefits the Maasai would significantly reduce resentment towards wildlife and the NCAA, as well as reduce the need for cultivation. Many tourists are also interested in the lifestyles of the Maasai and would enjoy learning more about their history and culture. Developments in this area would also increase revenue derived from tourism that would benefit both the Maasai and wildlife through increased income.

Overall, there are many areas of conflict between the Maasai and wildlife with added pressure due to tourist presence in the NCA. These are the conflicts that need to be addressed by any management plan adopted by the NCAA in order to ensure the survival and health of wildlife, the Maasai, and their livestock. A good management plan must not address the needs of one party, but all of those involved with special focus on reducing conflict with respect to shared resources. Not only is a comprehensive management plan essential, but proper implementation must be guaranteed to make certain that the full benefits of the plan are achieved. If promises are made to the Maasai in the ways of livestock, water, and food development, they will expect sincere effort and at least some positive results. Likewise, if promises are made in the way of conservation efforts to concerned organizations, efforts and good results will also be anticipated by

these contributors. The NCAA currently has a management plan for the NCA that was adopted in 1996 and will be discussed in the following section.

The Ngorongoro Conservation Area General Management Plan and Recommendations

In 1996 the NCAA adopted a General Management Plan (GMP) after careful consideration of the current situation in the NCA with regards to the status of wildlife and of the pastoral Maasai who inhabit the area, as well as tourism-related impacts. In order to be successful in the future, the GMP must focus on balancing all of the contributing factors to the condition of the NCA as a whole by setting standards and limitations when necessary. On the other hand, the plan must also be flexible enough to allow for changes to be made when it is clear that standards are not feasible for the future. This is especially important because the GMP is designed to be implemented for ten years, after which the successes and failures will be assessed to create a more fitting plan for the subsequent ten years.

The current GMP was assembled by a planning team within the NCAA which reviewed recommendations set forth by an Ad-hoc Ministerial Commission with respect to vital changes that needed to be addressed in the new plan. Not all recommendations of the Ad-hoc Ministerial Commission were adopted, most importantly the proposal to continue allowing cultivation within the NCA. The final GMP for the NCA instead reiterated the plan to phase out cultivation over the next few years as was the arrangement when the cultivation ban was lifted in 1992. This situation will be discussed in more depth later in this section. It is important to note, however, that changes had been made to Ad-hoc recommendations which demonstrates that there are conflicting ideas of how to best direct the NCA, and what plans are adopted greatly relies upon the composition of the NCAA at any given time. The unheeded recommendations of the Ad-hoc Ministerial Commission nevertheless are preserved in their reports and can be returned to and adopted at later dates if alternatives do not bring desired results.

Many of the sections of the NCA's GMP provide excellent propositions, however the most exemplary plans in the world can be useless unless there is proper implementation of integral steps. The responsibilities of the NCAA are multifaceted, as it is charged with conserving not only wildlife as are most reserves in Tanzania, but also

with conserving the native residents and precious archaeological sites that are of world-wide importance. For years most efforts have been geared towards conservation efforts for wildlife, as this resource is what draws most visitors to the NCA and therefore generates the most revenue for implementation of the GMP. World-wide conservation efforts have displaced or short-handed native people in the sake of conservation, yet conservationists are beginning to realize that these decisions are not, in the end, beneficial to the wildlife or the people. Such partiality towards wildlife only creates animosity towards conservationists and wildlife alike and efforts can easily be undermined by backlash by current and former residents.

The NCA harbors a population of pastoralists that live a lifestyle that, out of all lifestyles, is most compatible with wildlife preservation. This fact has been widely recognized among interested parties, as well as the fact that the Maasai traditionally live in harmony with wildlife. A concerted effort by the NCAA and their proposed efforts in the GMP to ensure the livelihoods of the Maasai as pastoralists, also with the flexibility to allow alternate sources of food and income in times of need, will guarantee that this harmony is retained. Ngorongoro's wildlife is of worldly interest and holds a value that cannot be expressed in monetary terms. In general, the significance of wildlife conservation can be seen by the numerous organizations and laws throughout the world that work to ensure protection and survival to all species. The Maasai of the NCA could be integral players in the conservation of the area's wildlife if given the proper chance, however great commitment must be made towards training and aid during development. Benefits to the Maasai from wildlife-related tourism, as well as revenue from cultural and archaeological tourism, will ensure the success of both people and wildlife of the NCA in the future.

The 1996 GMP for the NCA covers many subjects, many of which will not be discussed in this paper. Vital pieces will be extracted and discussed that pertain directly to wildlife and the Maasai in order to maintain a particular focus to this paper. This section, then, is not representative of every proposal in the GMP and the full plan can be found in: NCAA, 1996, Ngorongoro Conservation Area General Management Plan. Ngorongoro Conservation Area Authority, Ngorongoro, Tanzania. Direct quotations are taken from coverage of the GMP in *Multiple Land-Use: The Experience of the*

Ngorongoro Conservation Area, Tanzania.[28] Direct quotations from the GMP will be shown in italics.

The GMP sets forth a set of NCA management zones which explicitly state the activities which will be allowed to occur depending on available resources and vulnerability of that region to adverse impacts. Zones include the Ngorongoro Crater zone, the Highland Forest zone, the Lake Eyasi Basin zone, the Pastoralist development zone, the Short grass plains zone, and the Oldupai Gorge palaeontological/ archaeological subzone. (Figure 24) Zoning is indeed important within the NCA due to a variety of very diverse environments within the area. Each environment varies with respect to wildlife use, pastoralist use, tourist use, vegetative structure, and susceptibility to impacts of these exploitations.

The Ngorongoro Crater Zone

The GMP claims that *the primary management emphasis in the Ngorongoro Crater will be to maintain the diversity and density of wildlife species for which the crater is internationally famous.* It similarly mentions that to ensure the health of wildlife populations that residents will be included in *an improved anti-poaching programme*. This effort to include residents is excellent for the Maasai, especially for warriors who are accustomed to guarding livestock for their families. This would require little training though Maasai would need to be accompanied by others that are able to drive vehicles. Such anti-poaching efforts should be expanded to all areas of the NCA, especially the highland region where elephants and leopards may be found.

This zone is also open to pastoralists *for salt and water by permit, and grazing will continue to be prohibited.* While some may not agree with the exclusion of the Maasai from this zone for grazing, it is essential to wildlife populations to preserve this area for their sole utilization with respect to pasture. The Black rhino population is highly vulnerable and any added stress may be unhealthy for recovery. The least amount of contact between humans and these populations should be achieved, especially when there is the possibility of disease introduction into these semi-isolated populations. Salt and water resources, though, are of great importance to the Maasai for use by their livestock and should be retained. The Maasai believe that the saline water of the central lake, Lake Magadi, provides medicinal properties necessary for ailing animals. Due to

exclusion from certain areas of the short grass plains region outside of the Crater due to MCF transmission, it is extremely important that the Maasai have access to these resources within the Crater. Impacts should be minimal and monitored regularly.

The Highland Forest Zone

The primary emphasis in this zone will be water catchment. This area is highly vulnerable to use by indigenous residents in the way of grazing, wood-cutting, honey-collecting, and fire-management. Many of these uses are prohibited by the GMP and the NCAA, yet still occur for subsistence purposes. There has been fire usage in this region due to the fact that grazing during the wet season cannot be accomplished in the short grass plains due to MCF transmission. More grazing pressure, then, is focused in this region and burning is implemented to produce more open grazing areas for livestock. The GMP claims that the *NCAA will collaborate with indigenous resident communities to control the use of forest resources and to permit limited grazing of forest glades during drought periods*, however the Maasai are forced to rely on this area during the wet season as well, or the intermediate zone between the short grass plains and the highlands.

In order to protect this zone, it is important that the NCAA works to open up other grazing areas such as the southwest corner of the NCA by increasing patrols against cattle-raiding. Likewise, efforts should be supported to develop a vaccine against MCF so that the Maasai may utilize more of the Short grass plains zone. Immigration should be prohibited to ensure that there will also be adequate grazing area within the Pastoralist Development zone when necessary.

Lake Eyasi Basin Zone

The GMP claims that *emphasis will be placed on reconnaissance and assessment* in this zone because information on this area is lacking.

Pastoralist Development Zone

This is a zone of many uses, but most are geared towards the improvement of Maasai livelihood. Generally, the GMP asserts that it will participate in *collaboration with resident Maasai and district government to improve schools, health facilities and other social services, as well as dips, cattle markets, and other facilities to support the livestock sector*. All of these proposals are necessary, but it is extremely important that services are not simply established and then left to deteriorate much like the water

developments discussed in earlier sections. These developments are vital to the improved livelihood of the Maasai and should be given adequate consideration, resources, and assistance.

Schools should be provided not only for children, but also for adults who wish to participate in tourism and conservation efforts. Children and adults alike are generally fluent in Swahili and their native Maa language, yet it is important that English be taught as well in these settings, as most employees of lodges and tour companies are fluent in both English and Swahili. This skill will be a key factor in the success of Maasai tourism initiatives which the GMP lists as *three cultural bomas, at Oloirobi, Oldupai Gorge and Irkeepus* as well as *wildlife viewing and walking safaris*.

With respect to health services, both human and livestock, the availability of medical resources must be assured so that the Maasai will continue to support these efforts. The Maasai are required to pay for these services and consistent usage will guarantee an influx of needed funds to purchase supplies. The greatest problem with livestock health has been the unreliability of access to acaracides which has created much frustration among the Maasai that rely upon these services. A reliable source must be found, whether it is within the country or outside of Tanzania, that can make certain that these products will be available consistently. This will promote a trusting relationship between the Maasai and the NCAA.

Donations of supplies from outside organizations should be accepted and programs should be established to encourage the participation of professionals and students from other countries in efforts to promote health. Similar programs function throughout many countries, including African nations, such as Doctors Without Borders. While there should be full-time staff for medical services, both human and livestock, the establishment of such programs could promote added expertise and man power in times of need. A similar program should be established for veterinary practices with domestic animal vets from around the world as well as students who are in their rotational years and seeking experience. A program such as this will not only provide an exceptional opportunity for these students, especially because they will be exposed to highly diverse situations and diseases, but will also benefit the livestock development program and the Maasai who utilize these resources.

Efforts should be made to employ Maasai at cattle dips and supply them with training necessary to carry out these jobs. The GMP also states that *NCA residents will be solicited to assist in the protection of palaeontological / archaeological sites and in future surveys*. Again, guard jobs are excellent sources of employment for Maasai men and require little training from the NCAA. If there is enough interest, it is feasible that each person will not be required to work on a daily basis. One concern among lodge owners is that the Maasai are unreliable due to the priority that they give their livestock. If workers are not required everyday, the benefits of Maasai employment may be more achievable.

The GMP also makes the assertion that management *will focus on maintaining essential wildlife corridors and habitats, improving range conditions for livestock and wildlife, and providing for sustainable use of forest products . . . .* Wildlife corridors are of extreme importance to the annual migration, and it is therefore essential that they are preserved by detailed planning of the locations of bomas and other development structures. The extreme increase in the population of migratory wildebeest in recent years, as discussed earlier in this paper, has altered the traditional migration pattern.[9] Consequently, it is vital that efforts be made to assess new patterns to determine if new corridors have been, or are currently being, established by the herds. This research should be addressed during development plans for the future.

Short Grass Plains Zone

The GMP recognizes that the *grasslands of the Serengeti and Salei plains within the NCA are critical calving grounds for the wildebeest herd during their annual migration and important wet season pastures for many of the Maasai residents of the NCA and neighboring areas.* With respect to these uses, the GMP asserts that efforts will be made to *maintain the viability of the grasslands, protect the wildebeest calving areas, and to extend livestock grazing by controlling cattle raiding*. Reduction in the incidence of cattle raiding is essential if grazing areas are to be expanded for the Maasai livestock. Currently, conflict between wildebeest and cattle with respect to MCF transmission impedes the use of much of this zone by the Maasai during the wet season. It is similarly clear that the main impediment from grazing in the southwest corner of the NCA is the threat of cattle raiding. The current status of Maasai livestock, with most family's stock

numbers being below subsistence levels, does not accommodate any further losses, especially those that can be avoided. Reducing the threat of raiding in this corner of the NCA would be of great benefit to the Maasai and their livestock.

Efforts should focus on increased patrolling of this region and could employ Maasai in this endeavor. The problem, mainly, is that the people doing the raiding come from outside of the NCA and are armed with guns. The Maasai, who carry only spears and knives, stand no chance against these attacks and therefore choose the only option available, avoidance. Armed patrols will provide the necessary force to keep raiders away. Such patrols can also serve as anti-poaching units for wildlife in this corner. The study discussed earlier which utilized the computer software SAVANNA mentioned that increased use in this region may adversely affect elephant populations. Patrols can protect these animals from poaching and research should be conducted once Maasai presence arrives to assess the impacts on these populations. Obtaining access to these pastures for the Maasai, however, should be of utmost importance to the NCAA.

Every effort should be made as well to maintain the grasslands for the migratory wildebeest population. The explosion of this population will significantly increase grazing pressure, trampling, erosion, and the susceptibility of the grasslands to the growth of unpalatable and invasive species. Plans should be initiated to work with the Maasai to conserve these grazing areas over the entire short grass plains region. Traditional use of fire for range management should be focused on and utilized to bring new growth and reduce the prevalence of unpalatable species. Maasai can be employed in these measures, as their traditional knowledge and expertise will be fundamental to the success of this project. Prohibition of fire management has led to bush encroachment along the border of the highland forest region and the Pastoralist Development zone, therefore the introduction of fire should be accomplished with great care. Later fire management will be less precarious and can be accomplished with less supervision by the NCAA. If Maasai are given better access to short grass plains regions for grazing and watering purposes, they will have less reason to bring fire into the highland and short grass regions illegally.

Oldupai Gorge palaeontological / archaeological Subzone

This region includes areas of great historical importance which are extremely vulnerable to overexploitation by wildlife, residents, and visitors. Because of this, the Antiquities Act of 1964 designated a five kilometer area around the gorge for protection against development and tourism. According to the 1996 GMP, *indigenous residents will be allowed to graze, develop appropriate water infrastructures, and build bomas in controlled sites within* this region. The NCAA is willing to allow impacts in this area as long as the integrity of the resource is not at risk by such actions. This subzone falls within the Short grass plain zone and the Pastoralist Development zone and has valuable resources of pasture, water, and salt licks utilized by both wildlife and the Maasai. Periodic assessments should be undertaken to ensure that impacts in this area are minimal by both human and wildlife sources. Again, the explosion of wildebeest may have adverse effects on important archaeological sites.

The significance of this subzone warrants a high level of protection, yet this protection is compatible with controlled Maasai development as well. The NCAA recognizes that the residents can play an integral role in protection and interpretation of this resource by claiming that the *DOA* (Department of Antiquities), *NCAA, and indigenous residents will work together to ensure that undesirable human activities such as construction of permanent structures, cultivation, and other major ground disturbing activities are not allowed at important cultural resource sites.* Resident Maasai should be employed to guard important areas from human and wildlife utilization. Similarly, Maasai should be included in interpretation of the history of the site and the history of their people in this area. Future studies and digs in the gorge should include Maasai that wish to participate in such activities.

After addressing the different zones of the NCA, the GMP goes on to discuss more specific aspects of proposals made in these areas. One of the first areas covered concerns water resources within the NCA. The status of past water development projects is quite poor, with less than half of these sources in working order. The first important proposal made in the GMP with respect to water is to *assess hydrological resources and demands for water, and the impacts of existing development.* This proposal is extremely

essential for the NCAA to undertake, as water is currently being extracted for a variety of purposes without any knowledge of how sustainable this use may be in the future. Little research has been conducted to assess available groundwater and true flow rates of the major streams in the area. Similarly, there is no accurate data on rainfall and water catchment resources.

Water is presently being extracted from the Crater for use by tourist lodges and river sources are being redirected for use by Maasai, livestock, and staff villages. Cultivation by the Maasai and staff is utilizing more water resources than normal and if livestock development is successful there will be more cattle to supply with drinking water. The GMP proposes to *require water conservation methods (water conservation and harvesting) for any new construction and encourage rehabilitation of existing facilities to conserve water*. These methods are likely to be expensive and may require significant updates in facilities that were built years ago. Nonetheless, efforts should be made to enforce this proposal and time limits should be established so that goals will be achieved in a timely fashion. Most businesses will not voluntarily install new, and generally more expensive, technologies for water conservation into their facilities and instead need incentives such as time restraints and penalties. It may be beneficial for the NCAA to institute a fine for non-compliance within the allotted time allowance.

The plan to incorporate water conservation by facilities for tourists and the NCAA is vital to ensure an adequate supply of water for residents and wildlife in the future. The NCAA notes in the GMP that they must *clarify water rights and recognize use by wildlife and indigenous residents as a first priority*. Recognition of this fact requires that the NCAA focus on developments that will provide better access to water by the Maasai. Conflicts with wildlife impede usage by the residents and their livestock; therefore it is essential that past water development projects be repaired and maintained to avoid clashes between these two entities. If water is harnessed and directed to allow greater availability to residents, there will be no need for the illegal fencing that occurs around water points in order to reserve sources for pastoralist use. The NCA already has many of these developments; however lack of upkeep has rendered most of these options useless. A relationship should be created with a technician or group of technicians who can be contacted when repair is necessary. This person, or people, should be a reliable

source that will work efficiently to restore this critical resource to the people. It will most likely be more beneficial if this group is employed only within the NCA, as it can serve both the NCA as a whole as well as tourist facilities.

The GMP looks to *establish a programme for monitoring water quantity and quality*. Wildlife and the Maasai alike utilize natural water sources which may be subject to contamination by various activities in the surrounding areas. Agricultural communities which surround the NCA could be leading to pesticide runoff which contaminates the groundwater from which residents, livestock, and wildlife drink. Water may similarly be contaminated by wildlife, livestock, and human feces, as well as sewage from tourist facilities. Frequent water monitoring must occur to assess the quality of water in the NCA so that actions can be taken to mitigate problems. These efforts can be undertaken by research teams, by the Maasai, or through cooperation of both entities. The excellent knowledge that the Maasai possess of the NCA will make this task more efficient and more thorough. As development occurs in the areas surrounding the NCA and as populations of people, livestock, and wildlife expand, water monitoring will become more essential to ensure the health of resident wildlife and people.

Clarification of water rights is important with respect to man-made water projects because it must be understood that these sources are for communal use by resident Maasai. Traditionally, those who construct or maintain a water source will have primary rights to that water[29]; however this may not be feasible within the NCA. Simple maintenance of water sources can, and should, be undertaken by the Maasai residents with larger jobs being left to more qualified workers. Regular check-ups and notification of problems can be accomplished by the Maasai, yet it is possible that they may view these efforts as an indication of primary rights. It must be clarified that care-taking of water developments is a job, not ownership. There are too many Maasai within the NCA to provide primary rights to all families, especially because most will probably wish to claim ownership of the more productive developments.

There is also the possibility of formalization of water rights among the Maasai, in which people pay user fees for the water development sources and thereby achieve “rights” to a specific source depending on their location. The Tanzanian government has been conducting water formalization experiments in various areas in the nation since the

mid-1990s.[30] Results of these experiments demonstrate that implementation of formal water rights, thereby nullifying customary water arrangements, have mostly been negative and have caused many more problems than had previously existed. Payment of user fees has led people to feel that they can utilize their water source in any way they please, thereby increasing pollution and reducing flow to downstream users.[30] In situations in which people are extracting water from natural sources it is nearly impossible to control the amount of use. Experiments have also found that most users are more respectful of arrangements made between villages as opposed to government imposed systems. Those who exploit sources are shunned from their peers and have bad omens placed upon them, whereas government programs would only impose a fine.[31]

Just as the Maasai pay for medical treatment for themselves, their families, and their livestock, fees for improved water access will allow better funding toward development and upkeep of water systems. The experiments mentioned above have proved unsuccessful, demonstrating that rights cannot be assigned to specific water sources. User fees within the NCA should be yearly payments that allow access to all water sources, and the specifics of this arrangement should be made clear to the Maasai. Funds received from these fees are for the sole use of development and maintenance, their payment is not an indication that the Maasai are allowed to manipulate sources in any way they please. If this point is not clear, it will be assumed that fences can be constructed to deter wildlife usage. Similarly, if this assertion is made and this fee is implemented, it is vital that the NCAA ensure the maintenance of water sources at all times. Fees paid by users will lead to an even greater expectation that upkeep is guaranteed; this is a rightful and warranted expectation. Though damages will occur, repair should be as expeditious as possible. Maintenance will be difficult during the wet season, when roads may be almost impassable, thereby making it imperative that the Maasai are trained to conduct small repairs.

Preservation of working water developments for use by the Maasai will open up more natural water sources for wildlife and reduce conflict, as water development sources are utilized by livestock as well. If livestock are watered at these points, there will be less need to water stock during grazing and more time can be spent feeding. Thus, maintenance will benefit wildlife as well as the Maasai and their livestock. Likewise, this

separation will reduce the likelihood of disease transmission between herbivores and will reduce the amount of time within the water catchment areas of the highland region that harbor tick-borne diseases.

The NCAA understands the conflicts between the Maasai and wildlife and attempts to find ways to balance both interests within the NCAA. Corridors are of great importance for migration patterns and the GMP pledges to *work with indigenous residents to prevent wildlife corridor disruption* as well as *prohibit new construction in corridors or important habitats, reduce or eliminate any existing disruption.* (Figure 25) As mentioned previously, the first step towards achieving this goal should be to undertake research of old and novel corridors with respect to the modified migration pattern in order to make educated decisions on the locations of new developments.

Restrictions on boma location and development projects for the sole benefit of wildlife will very likely lead to increased animosity toward the NCAA and wildlife by the Maasai, but it should be made apparent that corridor preservation is beneficial for all residents that utilize these zones. If restricted, migratory herds will find new paths and destroy much of what lies in their way. This is true of bomas that are constructed or cultivation that is undertaken in the way of an established corridor. Trampling and erosion that result from migratory movement does not create ideal locations for Maasai developments. In 1996 the NCAA mapped major wildlife corridors within the NCA, and it is apparent that most pass through the Pastoral development zone as migrating animals move towards the Ngorongoro Crater. Looking at this map, it would be beneficial for the Maasai to reside in the southwest and northeast corners of the NCA to avoid interactions with wildlife corridors. The availability of the southwest corner of the NCA is, as previously discussed, highly dependant on increased patrolling to curb livestock raiding.

If efforts are made by the NCAA to improve the livelihoods of the Maasai, the residents will be more willing to participate in programs and conservation efforts to benefit the wildlife. For instance, the GMP proposes to *support research on threatened plant species* as well as *continue intensive monitoring of black rhinoceros* and *support research on species for which there is insufficient information (e.g., giant forest hog, lammergyer, pancake tortoise).* Many rare species, other than the black rhinoceros, may be found throughout the NCA, especially in the highlands zone. These areas are

frequently traveled by the Maasai for various reasons and consequently are well-known and understood. The indigenous knowledge of the Maasai should be utilized in order to gain more information on the ecosystem and the wildlife that inhabits the area. The Maasai are excellent wildlife trackers and may also be able to provide valuable information on threatened plant species populations throughout the NCA.

Indigenous knowledge would also prove useful for research in the highlands region, as the GMP wishes to *prepare a forest type map and support research on forest composition, structure and impacts of fire and human use.* The NCAA should employ the expertise of the Maasai in these areas, as they are likewise aware of overgrazing, defoliation, and erosion impacts due to human and wildlife influence. Because the Maasai are dependant upon the resources of the forest for survival they will be willing participants in conservation efforts to ensure continued use in the future. Over-exploitation of the environment is not a traditional custom of the Maasai, yet compaction of people into small regions such as the NCA has led to these effects. Traditionally, elders of villages would utilize their knowledge of range management to alter livestock grazing patterns and controlled burns as necessary to ensure the retention and re-growth of palatable species of grass. Accordingly, the Maasai are as concerned about overgrazing and erosion as the NCAA and other vested interests. Residents may also have a better understanding of natural delineation in forest type and structure which may be integral to mapping the forest and understanding habitat preferences of wildlife.

The GMP seeks to utilize indigenous knowledge in range management as well by developing a *fire management programme based on scientific and indigenous knowledge in cooperation with residents.* Thus far such efforts have not been made and fire is still restricted within the NCA.[7] The Maasai traditionally utilize fire management to ensure good pasture for their cattle, and this becomes even more essential when pastoral movement is restricted within a particular area such as the NCA. This is especially important because livestock grazing is further constrained due to conflicts with wildlife. The current situation of the Maasai does not foster unfulfilled promises, but instead leads to distrust of the NCAA and creates feelings among the Maasai that they are of second priority in the management of the NCA. Fire management will not only benefit the

Maasai livestock, but it will correspondingly be advantageous for the wild herbivores who utilize the same pastures by reducing invasive plant species.

Extreme care should be taken to guarantee that fires are small and controlled, especially because this technique has not been employed in the NCA for many years. Lack of fire control has given rise to bush encroachment along the ecotone of the highlands and short grass plains, thereby creating a greater possibility for fires to become unmanageable if proper precautions are not taken. Traditional and novel techniques for control should be assessed to determine the appropriate approach for the implementation of fire management in the NCA.

Selective burning and reduction of bush encroachment can also contribute to the reduction of tick-borne diseases by keeping tick populations under control. Insects that live in bushy areas, such as ticks and tsetse flies (which transmit Rinderpest), can be controlled through a combination of cattle dipping and controlled burning. Disease control has been found to be one of the largest constraints to successful pastoralism within the NCA, with the Maasai indicating that ECF is the most serious disease that their cattle experience.[9] The GMP addresses disease control by stating that it will *conduct research and monitor disease threats, areas and time of the year of susceptibility* as well as *emphasize disease control instead of cure, particularly control of ticks and tick-borne diseases.* Control can, and should be, achieved through controlled burning within the highland region and through improved dip facilities within the Pastoral development zone.

There are a number of dips within this zone, yet supplies and workers are scarce.[9] Acaracides are in high demand, but are not consistently available. This program may benefit from the inclusion of outside organizations for supplies and man power. The GMP notes the NCAA's acceptance of external help, as it wishes to *improve veterinary services for indigenous residents and encourage private sector to supply veterinary medicine.* As previously mentioned in this section, programs should be established to foster international veterinary internships or rotations for students who wish to study abroad and are interested in foreign livestock disease control. Medical students currently participate in similar programs during their rotational years and a comparable program would be beneficial to provide additional help to livestock

veterinary services in the NCA. The Maasai should also be trained and employed to work at dips alongside professionals.

Adequate payment should be required from the Maasai who utilize these services to ensure sufficient funds for continued supplies of acaracides and other veterinary provisions. The program should seek out and accept contributions from organizations, as well as volunteers from these and other international associations. The Tanzanian government has acknowledged, through the designation of the NCA as a multiple-land use area that they value the survival of the traditional Maasai lifestyle and culture which relies mostly upon livestock husbandry for subsistence. Likewise, the lifting of the cultivation ban in the NCA by the Prime Minister in 1992 carried with it the stipulation that these practices be eventually phased out due to the incompatibility of cultivation with wildlife conservation and because the Maasai are not traditionally cultivators. Therefore, the GMP claims that it will *promote the livestock sector as the basis for food security.* Thus, great efforts should be made to obtain funding from the government as well in order to permit the improvement of Maasai livelihood through the enhancement of livestock services within the NCA. The NCAA should create an agreement with a reliable source for obtaining supplies. There should be, at any given time, enough supplies to last at least a few months in case adverse weather conditions prohibit new shipments.

The second most important livestock disease in the NCA is MCF and its impact has been discussed at length in previous sections. It is important to note that MCF is restricting usage of the short grass plains region during the wet season, also known as the season of wildebeest calving. The loss of good pasture due to the exclusion of Maasai livestock from this region has unfavorable effects on livestock health and contributes to overgrazing in available areas. At present the only solution is to open up the southwest corner of the NCA to grazing by curbing cattle raiding by outsiders because there is currently no vaccine for MCF.

During a study on the impact of MCF in the NCA, the Maasai noted that their concerns about MCF had been ignored by the government and organizations that donate to the NCA. It is possible that this arises from the fact that MCF is not internationally significant enough to warrant funds or that it is believed that the disease is a way of

reducing the impact of the Maasai on wildlife. Studies have been conducted on possible MCF vaccinations, and promising results have been obtained in rabbit studies, yet no studies have been performed with cattle. The support of vaccine development is, however, overwhelming among the NCA Maasai with 98% (of 72 respondents) claiming that they would use a vaccine if it was available with most owners willing to pay for this service. If studies were undertaken to determine the feasibility of possible vaccines in cattle within the NCA, some owners purported that they would provide their cattle for the test.[9]

Support is present among the Maasai further indicating that MCF is a significant problem for their livelihood, therefore efforts for vaccine development should be supported by the NCAA and the Tanzanian government if they wish to preserve the pastoral lifestyle of the Maasai and phase out cultivation. Participation by the Maasai in livestock programs will help create a feeling of empowerment because people will be working alongside the NCAA and other organizations to improve their own future. Livestock is of utmost importance to the Maasai; as a result they will be highly supportive and willing to participate in endeavors to help their animals.

The NCAA through the GMP hopes to *promote the livestock sector as the basis of food security* and to *assist with restocking poor and destitute families.* Restocking may be a good idea for the poor and destitute, however these efforts will likely cause animosity amongst the Maasai who are not receiving these benefits from the NCAA as well. While Maasai culture promotes food and livestock sharing between families, this goodwill is also expected to be returned someday if the lending family is ever in time of need. “Hand-outs” from the NCAA may not be given the same level of respect and acceptance because it is not part of their traditional culture and is not between the Maasai. It may be necessary to supply all families will extra livestock in order to curb hard feelings, as most NCA Maasai are experiencing hard times.

If helping all families is not possible, livestock development projects should be relied upon, including disease control, improvement of water sources, improved access to grazing areas, and improved market auctioning in order to improve livestock amongst the Maasai as a whole. Then, those families that were able to benefit from these services can again participate in traditional livestock sharing with poor families. Programs could be

established, as well, that encourage poor and destitute families to seek out employment so that they can purchase animals at market. These families will most likely have the most time to devote to such jobs because less time will be spent maintaining the livestock. Also, if destitute families have at least a small number of cattle, the NCAA could establish programs to help breed the cattle.

The GMP wishes to *phase out cultivation in the NCA in keeping with the Prime Minister's directive of September 1992.* The Ad-hoc Ministerial Commission, in preparation of the 1996 GMP, suggested that small-scale cultivation be allowed to continue within the NCA along with monitoring to deter expansion.[21] Phasing out of cultivation is not feasible until livestock numbers are adequate for subsistence, or until enough supplies of grain are made available within the NCA for purchase by the Maasai. Thus far, food stores have been unsuccessful and unreliable. With 60% of the current Maasai diet being derived from grain, it is not feasible to phase out cultivation until that caloric intake is replaced by another reliable source.

Cultivation on a small-scale may be sustainable and compatible to some extent with wildlife conservation, but it should definitely not be allowed to expand. If cultivation is continued, monitoring must be strict and fines must be imposed upon those people or villages that exceed the limit. Entire village fines may have more of an impact because people will not wish to disgrace their fellow homestead residents. Control will be difficult, and it would be easier to simply phase out cultivation, yet this is not feasible until livestock has been stabilized at a sufficient level to ensure survival of the Maasai. After livestock numbers have risen, many Maasai may choose to convert back to a truly pastoral lifestyle anyway, and phasing out cultivation will not receive as much backlash by the residents. The Maasai will continue to supplement their diets with grain, but it will be purchased at markets by the sale of their cattle and small stock just as they had done before. At this point cultivation can again be restricted, when the Maasai are sure that they can survive with only their livestock and purchased grains.

If cultivation is to be restricted among the Maasai, it must also be restricted among the NCAA staff and lodge staff that also reside within the NCA. Families of the NCAA have larger plots and also are able to hire workers to tend their crops, thereby being able to support more acreage. This has more of an effect than do Maasai crops, yet

this may be alleviated by the suggestion to move the NCAA headquarters to just outside of the NCA. In essence, the Maasai need to be given a feeling of security which can be fostered by the NCAA and the GMP by implementing the livestock developments that it has suggested, as well as providing grain for purchase by the Maasai on a consistent basis. It is also important that the quality of Maasai life be monitored and progress within the livestock sector carefully watched to ensure that the present situation is not encountered again in the future. If such efforts had been made earlier, this crisis could have been avoided and cultivation may never have had to have been introduced into the NCA at all.

Similarly, the concerns of the NCA Maasai must be considered when decisions are made that affect their lives or their livestock. Problems associated with livestock diseases, water development, and health issues will be first experienced by the Maasai and these issues can be tended to more quickly if their voices are heard. Living throughout the NCA, residents are more likely to detect problems before scouts or the NCAA. This involves not only problems associated with the Maasai themselves, but also with wildlife populations and forest resources. Heeding the opinions and ideas of residents will build respect between the NCAA and the Maasai, leading to a more cooperative relationship which will in turn promote better, and more efficient, decision-making. It is not enough to simply allow a member to sit on the decision-making board; the needs, requests, and ideas must be given respect and true consideration before the Maasai will feel like stewards of the NCA, instead of intruders.

The Maasai have been requesting land rights in the NCA, yet their requests have been denied for fear that these rights will be used to abuse the land through extensive cultivation and other exploitative activities. The NCAA is not willing to give up rights and lose control when changes may need to be made in the future. Most importantly, the Maasai wish to claim a place that is their own, a place from which they cannot be evicted in the future as they have been in the past. With development and agriculture growing along the boundaries of the NCA, it is important for the Maasai that places are left where they can carry out their traditional culture, just as areas have been preserved for wildlife. Luckily, wildlife and the Maasai can live together harmoniously as long as a balance can be found by the NCAA through the GMP.

To establish a sense of security for the Maasai with respect to land, the NCAA must control immigration from the surrounding areas. The GMP clearly addresses this issue, but makes no true claim that it will work to halt the influx of people for the sake of the Maasai and the wildlife. The GMP states that it will *clarify the definition of "indigenous resident,"* that the NCAA will *implement Pastoral Council decisions regarding control of immigration*, and that it will *conduct research to determine the causes of immigration.* The Pastoral Council is a grouping of elders from pastoral villages within the NCA that was created to be a decision-making body. This council, however, has no power to implement their decisions; yet one member sits on the NCAA board and voices the opinions of the Pastoral Council to this decision-making body which maintains enforcement powers. The GMP acknowledges that immigration should be considered, but it does not recognize it to be a problem.

Control of immigration is vital to ensure that residents have proper access to resources. If residents are to be charged for water user fees, medical care, and veterinary services it is important that they have sole or at least primary access. Especially in the case of access to pasture, resources are already restricted due to conflict with wildlife. A roster should be compiled with the names of residents and those people should be given primary rights to the NCA, with ultimate land control by the NCAA. Use by outsiders should be approved by the Pastoral Council and the NCAA, however full habitation should be restricted except by marriage.

Presently, there is no restriction on who enters the NCA for grazing and watering purposes. It will be beneficial if the traditional designation of primary and secondary user rights applies to the NCA as a whole, instead of to select areas for each village within the NCA. Small fees may also be collected from secondary users and put towards development projects and range management endeavors to reduce the added stress of additional users. The number of secondary users should be controlled through permits, and fines should be submitted to those who violate these requirements. If problems arise, the Pastoral Council and the NCAA can place restrictions on days of use or hours of use per day. The NCA and the Crater should remain open for ceremonial purposes of other tribes and ethnic groups.

Restrictions on secondary user rights and enforcement of these measures will help to alleviate the overexploitation of pasture, water developments, and forest resources. There are signs of excessive use in the forest by villages surrounding the NCA by pole-cutting for building materials and ring-barking of living trees for fuelwood.[25] The NHFR is integral to the NCA's residents and wildlife for its water catchment ability making preservation of this area imperative. If border control is achievable and secondary user rights are selective, many of the pressures in the NHFR and the rest of the highland region can be relieved and brought to a manageable level.

Nevertheless, control of immigration and the assignment of primary user rights for the resident Maasai will bring the sense of security that the Maasai have been looking to achieve. While the NCAA will retain supreme control over how land is utilized, it should be made apparent that eviction is not one of the NCAA's delegated rights. Also, the Pastoral Council should have a voice in the decisions pertaining to land-use to ensure that the residents' concerns are being heard. The Maasai are not looking to undermine wildlife conservation within the NCA through their support of cultivation or their request of land rights; instead, they are hoping to find a sense of place and a feeling of security for the future. Alternatives that are more compatible with wildlife conservation should not only be offered, they should actually be implemented in a timely fashion so that the Maasai will not have to resort to other more destructive means to ensure their survival. The NCAA can do a great deal more for wildlife conservation by simply working with the residents to maintain their livelihoods and improve their situation in the NCA.

The Maasai do not only wish to be assured that they have a permanent home in the NCA, they also desire to participate in making decisions on current and future plans for the area. Discussions throughout this paper have made it apparent that any alteration in the management of the resources of the NCA will ultimately affect the Maasai, thereby making it vital that the residents have input on the use of resources, how funds are allocated, and improvements to wildlife conservation efforts. Currently, the Maasai participate in a District or Pastoral Council in which elders, who are the primary decision-makers of the villages, congregate and discuss the needs of the people and all factors that affect their daily lives. The GMP expresses the need for *expanding the Pastoral Council membership* and the need to *provide the Pastoral Council with agreed*

responsibilities. Membership on these councils is essential to acquire a true understanding of the needs of the Maasai, as well as their ideas for improvement of the current situation. Membership may be limited due to the lack of responsibility and empowerment that the Pastoral Council has been assigned, thus giving the residents a feeling that their input is not adequately valued by the NCAA.

The GMP states that a single member of the Pastoral Council is to sit on the NCAA Board and represent the feelings and views of the residents of the NCA. As the number of people expands rapidly in the NCA, it will be necessary to elect more than one representative for the entire population. Multiple Pastoral Councils should be developed and each should represent a particular section of the Pastoral Development zone. All of the elders of these sections should meet monthly to discuss any problems, concerns, or ideas to ensure that issues are addressed as quickly as possible. Each of the Pastoral Councils should have an elected representative to sit on the NCAA Board to voice the specific concerns of their area. If the southwest corner of the NCA is opened to grazing, the pastoral zone will be greatly expanded and will require more specific representation of each area because situations and concerns will be extremely diverse with respect to resource use, wildlife conflict, conservation efforts, tourism participation, and interaction with surrounding communities.

The Ad-hoc Ministerial Commission suggested that annual plans be developed through cooperative efforts of the NCAA and the Pastoral Council regarding community development.[21] This is an excellent decision, and one that is not mentioned in the GMP. The residents should be fully informed of the intentions of the NCAA with respect to livestock development, health facility improvements, food and water developments, and education. The Maasai should also participate in these developments through construction efforts, road maintenance to ensure food and medical supply delivery, and assistance in livestock sale, propagation, vaccination, and pesticide application. The residents should have to pay for services as much as they are able and they should work with the NCAA to generate improvements in a more efficient manner. The developments addressed in this yearly action plan should be prioritized by necessity and given time estimates depending on feasible completion dates and the availability of funding. These

time expectancies should be reasonable so that residents will not expect results sooner than possible, as this will only harbor distrust and hard feelings.

It is important that the Maasai are able to participate in determining future developments and projects that occur within the NCA by sitting on the NCAA Board, voicing their opinions, and voting on propositions. People around the world wish to have their voices heard through voting for issues that concern their town, state, and nation; the Maasai wish for this same responsibility and involvement. The ability to make decisions that will help to decide the management of their home will give the residents a sense of empowerment that is greatly needed to enhance support of conservation projects in the NCA. Involvement in creating programs and developments will subsequently stimulate more interest in direct participation in these programs, such as cultural bomas and wildlife tracking tours hosted by residents.

The GMP has recognized that programs relating to wildlife tourism and education about Maasai culture can have great income-generating potential for residents who participate. Thus, the GMP plans to *provide loans to individuals and groups and identify other potential sources of funds.* The NCAA should look into acquiring funds and expertise from outside organizations that are active in Tanzania such as independent conservation organizations interested in African wildlife. The importance of resident involvement in wildlife conservation is being recognized by most conservation organizations and many are becoming involved in these efforts. Because Ngorongoro hosts a great number and diversity of wildlife, as well as the world's last great migration, programs such as these will very likely find a great deal of interest easily. Not only will these organizations provide funding, but they will also help to establish the programs and provide expertise and advice on improvements in the future. This will require less involvement and monetary support from the NCAA, and will likely reduce the corruption that is associated with many community projects that are directed by outside administrative sources. Volunteers that are truly working for the pure sake of conservation will be less likely to take advantage of the naïveté of the Maasai with respect to business ventures.

It is suggested in the GMP that the NCAA should work to *train residents in tourism and related skills and encourage their employment by tourism companies.* This

proposition will work well with respect to lodge employment or through the establishment of markets in which the Maasai may sell hand-crafted goods such as beadwork and carvings. These products can also be sold at the cultural bomas, however for tourists who do not make a stop at these bomas, markets should be set up to allow further access to these goods. Upon my visit to East Africa, I found that the goods sold in lodge gift stores paled in comparison to those sold at the actual Maasai boma. The handicrafts of the Maasai are truly remarkable in beauty and detail and should be given a proper setting for their sale. The market which I visited divided the revenue between the families of that village, with the largest percentage going to the family that actually produced the good. This way, the entire village benefited from the purchase instead of just one family. This sharing, again, is what enables the Maasai to survive during hard times.

It does not seem feasible for the NCA Maasai to participate in tour companies that are not actually located within the NCA due to communication difficulties. The NCA is already far removed from the "outside world," and this separation will cause many problems. Instead, the Maasai should work as trackers or walking tour guides for lodges who also supply day tours for visitors. More importantly, though, Maasai villages should establish walking tours of their own that originate from the cultural bomas. These tours will cover relatively unexplored areas of the NCA that would be of great interest to visitors. Walking tours of the highlands region will be of particular interest to many people, especially because this area houses very different populations of wildlife from the grassy plains of the Crater. Many visitors travel to Africa to experience the vast array of bird species and the highlands region provides an extremely different environment for bird-watching. The knowledge of the Maasai with regards to wildlife and their environment should be harnessed for tourism efforts and research needs. Participation in these activities will provide added funds to the involved villages.

The GMP called for the establishment of three cultural bomas which is not only important to provide needed revenue to residents, but also to preserve the traditional Maasai culture. Tourists are exceptionally interested in the Maasai culture and way of life because it is completely different from modern life in developed countries. The lives of the Maasai are highly reminiscent of the way in which our ancestors may have lived

years ago and it is because of this that people are interested in becoming educated about their culture and daily activities. Through the establishment of cultural bomas, which are entirely separate from actual bomas, the Maasai can inform people about their lives while also preserving sacred acts. Special ceremonies such as weddings, births, and the celebrations of progression into manhood and womanhood should be kept private so as not to deteriorate Maasai culture. The fact that their culture has remained intact despite the constant development surrounding their villages warrants a great deal of respect and appreciation. These cultural bomas, however, should be expanded to include the tour options mentioned above to increase visitor interest and revenue for the Maasai.

The participation of the Maasai in wildlife related tourism should not be underestimated. While most people might believe that the only benefit to be derived from such an endeavor will be added revenue to the Maasai, there is also significant benefit to the wildlife of the NCA. By gaining monetary benefits from wildlife conservation, residents will begin to appreciate wildlife more and will be more willing to support efforts for their continued survival. This translates into increased support for research projects, a greater understanding of management practices that favor wildlife conservation, and an increased ability to tolerate the imposition that thousands of tourists can inflict on the residents of the NCA. In other words, the Maasai will promote tourism because it will bring added revenue and will provide funding to support the wildlife that in turn supports their livelihood.

The effects of this increased level of tourism throughout the NCA should be adequately monitored to ensure that the programs are not adversely affecting the environment to a significant extent. For this reason, passive tourism should be promoted in these remote areas. Tourism should be restricted to walking tours and the visitation of cultural bomas with vehicular travel utilized only for transport to and from these locations. Programs in these areas should be solely projects established and run by the Maasai, not by the large tour companies that provide tours of the Ngorongoro Crater. This will guarantee that Maasai programs are not out-competed by larger companies, thus providing more security and assurance for success.

To further ensure the success of the Maasai, whether it is in the establishment of tourism companies or in finding employment opportunities with lodges, education must

be available within the NCA. It was discussed in previous sections that NCA lodges, as compared with tourist facilities in Kenya, cannot claim a high proportion of Maasai workers. One of the reasons for this disparity may lie in the fact that the Tanzanian Maasai are not as fluent in English as the Kenyan Maasai. Kenya's national language is English, whereas Tanzania's national language is Swahili, making English a third language for the Tanzanian Maasai after their cultural Maa language and Swahili. Because a great deal of tourists speak English, it is imperative that the Maasai be educated in this language so that they may be better competitors for jobs in the NCA. Schools should focus on teaching English at a young age, as children are able to learn languages much quicker then adults. This focus should not, however, take away from other important skills such as math and traditional management of livestock.

For the generations of Maasai that are currently of working age, schooling can be offered to teach English and other skills that will be necessary for tourism-related jobs. For efficiency, separate schools could be developed relating to specific positions. This will also guarantee that classes are not too large for teachers to handle and that students will obtain the adequate attention to successfully learn the skills. These schools will also be important in the future because Maasai families generally only send one or two children to be educated because of monetary reasons and to ensure that there are sufficient people to care for the livestock. Thus, those children who were not chosen to be educated in childhood may eventually choose to attend one of the trade-schools later in life.

Teachers can be hired from outside of the NCA to teach trades and English and can be given incentives such as free lodging within the NCA. It is difficult to find teachers due to low wages and the inadequacy of schools in this region of Africa, therefore incentives must be developed to pique interest. Funds from NCAA revenues should be devoted to educational development within the Pastoral Development zone, as well as funds paid by the Maasai for the education of themselves and their children. Contributions from the Maasai will become more feasible as livestock developments are undertaken causing average wealth to increase. As the Maasai learn these skills, they can become teachers in the future as well, thereby reducing the need for outside help. If educators are difficult to find, though, organizations that specialize in these projects, such

as the Peace Corps, can be utilized. Nevertheless, education should be a top priority in pastoral development goals of the GMP.

While significant efforts should me made to encourage Maasai involvement in wildlife-related tourism, these endeavors should be isolated to the less frequently visited regions of the NCA. In other words, the Ngorongoro Crater should not be subject to any further impacts by new tourism opportunities. Similarly, access by the Maasai should continue to be restricted unless permits are issued for particular uses. The caldera is a precious zone that should be restricted from overexploitation at all costs. Due to the relative isolation of the caldera and its wildlife residents, any slight impact could become quickly amplified and have devastating effects on the system. For instance, diseases introduced in the Crater will quickly spread and can easily decimate entire populations of animals such as Black rhino, lion, cheetah, and jackal that naturally occur in low numbers. This effect can be exacerbated by the low genetic diversity that plagues these small populations, thus making them more susceptible to diseases and compromising their ability to recover from illnesses.

If nothing else, the Crater should be a highly conserved zone for the protection of the resident Black rhinos which are of immense international importance. The current GMP recognizes the value of these animals and consequently calls for extreme efforts towards their conservation. The impact of poaching on the Black rhino in the Ngorongoro Crater in the past has led the NCAA to command 24 hour patrols by rangers for each individual rhino. While this may seem extreme, the NCAA is not willing to take any chances with the remaining animals. The Black rhinos of Ngorongoro are not valued simply for the fact that they are genetically isolated, but also as a symbol of African wildlife and as a great attraction for tourists from around the world.

To guarantee the continued health of the Crater system, it is essential for tourism to be more restricted, in terms of the number of vehicles allowed to enter on any given day. The 1996 GMP requested that the NCAA *in Ngorongoro Crater, reduce the number of vehicles to fifty at any one time, and increase the number of visitors per vehicle by significantly increasing cost per vehicle to enter the crater.* Allowing visitors to remain in the Crater all day is acceptable and likely reduces the traffic and impact on access roads. Visitors should be restricted to one day in the Crater with second day access only

permitted upon payment of a significant fee. Lodges and tourism companies should emphasize other activities throughout the NCA such as cultural bomas and walking tours with the Maasai to entice longer stays and to divert some attention away from the Crater. Thus, expanding the use of the entire NCA would support Maasai tourism endeavors and reduce the impact on the caldera and its resources.

The abundance of vehicles in the caldera on a daily basis is significantly affecting the wildlife of the Ngorongoro Crater; whether the effects of humans are good or bad is difficult to say and greatly depends on the situation. Most species in the Crater are extremely tolerant and comfortable with the presence of humans and their vehicles, even at close distances. Lions, warthogs, wildebeest, and buffalo will carelessly approach vehicles as if they are just a different species of animal. While this adaptation is excellent for wildlife viewing, it is possible that this will adversely affect wildlife by making them more susceptible to poaching. Wildlife naturally would avoid unnecessary contact with humans, but constant tourism has caused animals to become unusually acclimated to human presence. To reduce this impact, the number of vehicles should be limited in the Crater and designated distances set by the NCAA should be strictly followed by tour guides. These restrictions should be enforced by rangers posted in the Crater and fines should be imposed upon violators.

The tolerance of humans in close proximity can be beneficial to wildlife for the purpose of protection against poachers as well. This will allow rangers to keep closer watch over the animals to enforce harassment restrictions against tour companies and to ensure that poachers are not hunting species in the Crater. Wildlife outside of the Crater will not have this adaptation because tourism has been low in these areas. As tourist interest increases throughout the greater NCA, however, allowable distances should be established by the NCAA so that animals will not become too comfortable with tour vehicles. This is of even greater importance outside of the Crater where poachers have easier access because of open borders.

Research should continue to be conducted on species within the Crater, focusing mostly on the genetic diversity of small populations. The lion population in the caldera is of some concern after rebounding from the impact of the epidemic of biting flies, as well as the Black rhino, cheetah, and jackal populations. The GMP addresses these issues

asserting that they plan to *support further research into genetic isolation and inbreeding in black rhino and lion* and to *continue intensive monitoring of the black rhinoceros.* Similarly, the GMP calls for *research on species for which there is insufficient information (e.g., giant forest hog, lammergeyer, pancake tortoise).* This further research on rare species will most likely take place in forested regions such as the Lerai Forest within the Crater and the highlands region of the greater NCA. As previously mentioned, the Maasai will be of great help in identifying these species and locating their populations because of their excellent knowledge of the natural environment of the NCA.

Buffalo have recently increased in the Crater and there is no explanation, as of yet, for this occurrence. The NCAA should seek out and support studies concerning this explosion of buffalo to determine the causes and to establish whether these species are becoming somewhat migratory in nature. Also, the impacts of these species should be researched, as the effects of this species may be much like that of the Maasai cattle which have been banned without permit from the Crater. The buffalo may be evolving to fill the niche the Maasai livestock previously occupied in this ecosystem before their exclusion.

As Maasai livestock developments improve Maasai livelihoods and increase livestock numbers, it is essential that the impacts of these changes be researched at an early stage to identify the effects on NCA wildlife. Again, this may be an alternate form of control for wildebeest populations and impacts on this population should also be studied even though they are not a species at risk. These changes will take years, however subtle differences may provide clues to bigger changes, good and bad, in the future.

Plant species within the NCA are insufficiently documented and studied, and the GMP only addresses the fact that the NCAA should *support research on threatened plant species.* Efforts should be made to conduct new studies concerning plant species and associations within the NCA. Indigenous people can also be of help in this area, as they can identify rare species and provide information on the animals that utilize them or the medicinal qualities that they provide. With the exceptional variety of ecosystems within the NCA, there are likely many species and relationships that have not yet been discovered.

Finally, major water sources within the Crater and throughout the entire NCA should be monitored regularly to document the effects of human and animal use, as well as to identify contamination problems from surrounding agricultural communities or from tourist facilities. The health of the NCA's water sources will ultimately determine the health of the resident people, wildlife, and livestock. Simple water tests can be conducted frequently to determine if threats are present so that actions can be taken quickly to alleviate these problems.

Conclusion

The tentative naming of the Ngorongoro Crater as "the eighth wonder of the world" is by all means a fitting designation; however the Crater and the NCA as a whole exhibit a much greater significance than simple beauty. The water resources of the NCA are indeed "springs of life" in that they support a vast number of wildlife, humans, and livestock perennially, all of which are competing for the same valuable resources. The fact that the NCAA works to preserve both native human and wildlife populations is a noble attempt to move forward in wildlife conservation to a setting in which humans are not ostracized from their homes in the name of conservation, but are instead active participants in those efforts. Many regions of plentiful and diverse wildlife are working to establish similar situations, and many have already succeeded. Conservationists are realizing that to be truly successful, they must solicit the cooperation of native people for their indigenous knowledge and to build respect, instead of resentment, for their native wildlife.

In 1996 the NCAA accepted a GMP that addressed the management problems that had been encountered in the preceding years with respect to Maasai populations and wildlife. Studies conducted by the Ad-hoc Ministerial Commission and independent researchers found Maasai livelihoods to be bleak and far from any level of subsistence. The NCAA has, in the past, tried to alleviate this poverty by lifting the cultivation ban within the NCA, thereby allowing the Maasai to supplement their diets with home-grown grains instead of selling their few cattle at market to meet these needs. While supplementing their diets with grain will help to relieve the high levels of malnutrition, cultivation is not compatible with wildlife conservation. If cultivation is kept on a small

scale, this practice will be sustainable without much adverse effect on conservation efforts in the NCA. The lifting of the cultivation ban, however, is only temporary until other changes can be made to improve the situation of the NCA Maasai.

The most important change that must be made, for the sake of both the Maasai and wildlife, is to implement livestock improvement projects concerning pasture availability, disease abatement, and access to water resources. If the NCAA reinstates the cultivation ban before livestock issues are adequately addressed, the people will undoubtedly lash out against the NCA wildlife. The Maasai understand that the restrictions that are imposed upon them are for the benefit of wildlife which has been the primary focus of NCAA efforts for many years. Thus, concern over the health of the Maasai and their livestock will reduce this resentment against wildlife and build respect for the NCAA. Otherwise, the Maasai may begin utilizing wildlife to supplement their nutrition and to make their voices heard by the NCAA.

The wildlife of the NCA can similarly benefit from the inclusion of the Maasai in tourism efforts, as programs run by natives will increase interest in the greater NCA and will relieve pressure on the Crater. As the residents begin to acquire income from these endeavors, they will find new value in the preservation of the NCA wildlife because it will directly benefit their lives and contribute to their survival as well. Similarly, Maasai participation in research will help to reveal novel information that can be used to improve conservation efforts. Lastly, utilization of traditional methods of controlled burning will improve pasture for wild herbivores as well as Maasai livestock, while also reducing the impact of tick-borne diseases.

The wildlife of Ngorongoro is truly extraordinary and the conservation of the species and the area as a whole are supported by many organizations and laypeople alike. Many of these people, though, only know of the wildlife and are not educated about the native Maasai and their amazing culture. Consequently, many people are supportive of removing these populations and focusing all efforts and funds towards species protection. The NCAA must work to not only highlight the value of the resident wildlife, but also educate people about the Maasai and their long history of living side-by-side with the NCA's beloved animals. The myth that all native people that live in wildlife rich areas

participate in poaching should be shattered through the understanding that Maasai traditionally do not utilize wildlife species for subsistence.

Lastly, immigration into the NCA must be adequately controlled to ensure that wildlife populations and Maasai people have access to sufficient amounts of resources. This is especially true of developments to improve pasture and to provide better access to water. Many of these developments will be built, maintained, and carried out by the resident Maasai giving them primary rights to those resources. Overuse by passers-by will only add to the deterioration of the water pumps or pasture without providing the work to help maintain these sources of life. Similarly, more people will lead to greater congestion in the Pastoral zone and will eventually interfere with wildlife populations and their migration routes.

In essence, there are many changes and advances that must be made within the NCA that have the potential to improve the situation for the Maasai and wildlife alike. Supporting the involvement of native people in wildlife conservation and tourism can help wildlife through information acquisition and by increasing Maasai wealth and their respect for NCA wildlife. The Maasai should not feel second-best in the NCA, but should instead feel like equal partners with the NCAA and other organizations that are working towards preserving this outstanding region. A new harmony between the Maasai and wildlife can be achieved, yet this harmony will find each side benefiting from the other, thus ensuring the survival of both entities. Upon the ten year anniversary of the NCA's GMP, the NCAA should support active participation of the Maasai so that their needs and ideas can be heard and so that conservation efforts can be proposed that will work to the advantage of wildlife and Maasai alike.

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