Food preference in African Elephants *(Loxodonta Africana) and the impact of Bomas* in the vicinity of and in Maasai Mara National Reserve

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Photo: Erik Johansson

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Summary

In the Maasai Mara National Reserve the native people, the Maasai, have lived for a long time following their own traditions. Their traditional lifestyle is that of a nomadic people, leading their cattle to the best grazing. Sharing their land with a large variation of different animals, one of them being the African Elephant (*Loxodonta africana*), the Maasi people have since long adapted to a life side by side with these giants, as well as the fierce predators living in the area.

The aim of this study is to determine whether the Maasai settlement, known as Boma, has any impact on the elephants in the surrounding area. In order to conclude whether the bomas has an impact or not, observations of the wildlife were carried out. Observations were conducted in two different seasons, in December 2003 and May/June in 2004. The observations were made in selected locations at certain distances from the bomas which were set in order to compare the number of elephants close to the bomas, to their number further away i.e. in the Reserve.

Although the Maasai are living a way of life based upon hundreds of years of traditions, in recent years modern ways has caught up with them. They are now turning away from their nomadic lifestyle and the land is becoming privately owned. Instead they choose a more permanent settlement, in many cases turning to agriculture as their main source of income. The Maasais decision of a more permanent settlement is bound to have some sort of an impact on the wildlife. Elephants are large creatures and require vast areas to wander in search for water and food. In many areas of the world the elephant causes big problems for people sharing their land. They raid crops and are known to destroy large areas of vegetation when passing through. Agriculture takes possession of greater land areas than herding, and the area is thereby lost for the elephants to forage. This new development is also brought up and discussed in this report.

Sammanfattning

I Maasai Mara viltreservat bor Maasaifolket, de har bott i området länge och följer sina egna traditioner. Traditionellt är de ett nomadiskt folkslag som leder sin boskap dit det bästa betet finns. Då de delar området med ett flertal djurarter, däribland den afrikanska elefanten, har de för länge sedan anpassat sig, till ett liv sida vid sida av dessa jättar, såväl som de rovdjur som lever här.

Syftet med studien är att avgöra om Maasaiernas traditionella bosättningar, kallade Boma, har någon påverkan på elefanterna i omgivningen. För att kunna avgöra om boma har någon påverkan på elefanterna eller inte, utfördes observationer av djurlivet. Observationerna genomfördes under två olika säsonger, december 2003 och maj/juni 2004. De utfördes på utvalda platser på olika avstånd från boma, detta för att kunna jämföra antalet elefanter nära respektive långt ifrån bosättningarna.

Även om Maasaierna länge har levt sina liv med hänsyn till sina traditioner, har dagens moderna livsstil slutligen kommit ikapp. Idag är det vanligt att de väljer bort sin nomadiska livsstil för mer permanenta boenden, och istället förlitar sig på jordbruk som sin främsta inkomstskälla. Övergången till ett mer permanent boende kommer troligen att ha någon form av påverkan på de vilda djuren. Elefanter är stora djur vilka kräver vidsträckta områden att ströva på i jakt på vatten och mat. I många områden världen runt orsakar elefanter stora problem för människor som bor i områden med elefantpopulationer. De dras ofta till åkermark i jakt på mat och orsakar stor skada på växtlighet när de drar fram. Jordbruk och åkermark tar stora arealer i besättning, områden som elefanterna inte längre kan nyttja för sitt födosök. Denna nya utveckling behandlas också och diskuteras i denna rapport.

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1. Introduction

The African elephant (*Loxodonta africana*) has been wandering the plains of the Maasai Mara for millions of years. The Maasai people have considered the land their home for centuries. Gradually over the years, the area elephants have been able to use has decreased; also the Maasai tribes have been forced to live their traditional nomadic lifestyle in smaller areas. Their acceptance to the wildlife has proven a challenge, as many animals have lost large proportions of their natural habitat and their ancient trails. The Maasai are highly dependent on the grass surrounding their village for their cattle; all the products of their cattle are central parts to their way of life, nothing is wasted. Even the dung produced by the cattle is utilized. Food and water are resources both animals and people depend on for their survival. As the wild animals have been forced closer to the Maasai settlements, the risk of conflicts has increased (O'Connell-Rodwell et al., 2000).

1.1 The Study area

The Maasai Mara national reserve is located in southern Kenya, covering an area of 1530 km^2 on the border to Tanzania. The ecosystem stretches across the border although in Tanzania the name of the park changes to Serengeti National Park (Ogutu et al., 2009). The area is most famous for its massive migrations of great herds with zebras (*Equus burcheli)* and wildebeest (*Connochaetes taurinus)*, from one park to the other between July and October every season (Walpole & Leader-Williams, 2001). There are two rain seasons in Mara, between April and June and November and December. The rains make the park an ideal location for a great number of animals, grazers and predators alike (Ogutu et al., 2009).

Observations were made in the reserve as well as the adjacent group ranch in order to show the difference between the ecology in the park, as well as outside the border near the settlements.

1.2 The Animals

African elephants have been known to eat grass as well as shrubs and trees. Where and how they prefer to eat is still under discussion but their preferences seem to change during the season, depending on access to food sources (De Boer et al., 2000). The diet mainly consists of green grass and herbs when available during the wet season, in the late wet and dry seasons green leaves are preferred (O'Connor et al., 2007; Osborn 2004; Wittemyer et al., 2007). Bark and roots are consumed when leaf falls off and the grass is dry but can cause nutritional stress due to its higher contents of lignin and toxins. In addition trees also require more handling

Photo: Erik Johansson. Elephants visiting a waterhole, a vital resource for all animals to be able to survive in the reserve.

time and are not a preferable food source compared to grass (Osborn, 2004). They have a large variety of feeding behaviours depending on the environment, (Osborn, 2004) and are considered to be browsers as well as grazers. In a study made by Cerling et al. (2007) where confiscated ivory was studied to determine the food source, elephants in the Mara proved to have 33 % of their total diet consisting of grass. The food may vary in fibre, protein and the concentration of vital minerals and vitamins (Osborn, 2004; Rode et al., 2006). An elephant can survive on rather low quality food for a long time but as most animals it needs water on a regular basis (de Beer & van Aarde, 2008; Ulfstrand, 2003). An elephant spend most of the day foraging, up to 75% (Vancuylenberg, 1977; Wyatt & Eltringham, 1974), and it roams over large areas in order to find food. Elephants have a hindgut fermentation system, with a short passage time of their food intake.

Their retention time is short compared to ruminants, 14 h compared to 70-100h. As a result of the short passage time the fermentation of slowly digested cell material, especially cellulose, is limited. Not due to inefficient digestion but rather because of the limited amount of digestion time, elephants should therefore prefer food types which allows for a rapid nutrient intake (O'Connor et al., 2007).

1.3 The People

On the borders of the Kenyan wildlife reserve Maasai Mara there are great numbers of Maasai settlements, also known as Boma. The land is organized in "group ranches" of which seven are located in direct contact with the reserve boarder (Visitors guide to Masai Mara, Jacana. 2006). The Maasai allow their cattle, mostly cows, sheep and goats, to graze in the vicinity of the boma, keeping the grass surrounding their villages short.

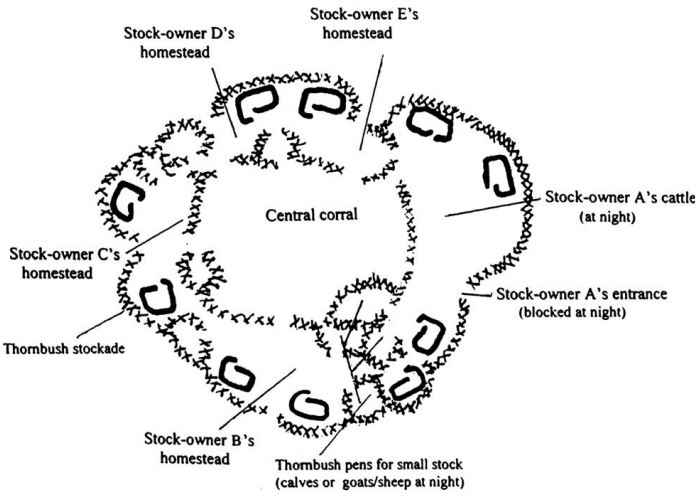

Photo: Stina Blomberg

Figure 1. *Outlay of a typical boma (Kolowski & Holekamp, 2006), fences and houses built with bushes from the surrounding area.*

As in most cases when large wild animals and humans share the land there is a great risk that conflicts arise. In the seasons where the grass has a poor quality elephants might seek food elsewhere, e.g. near the bomas where the soil is usually more nutritious due to the cattle faeces (Augustine, 2003). As a result the plants grow better and have a higher nutritious value than surrounding vegetation (Muchiru et al. 2009). This may appeal to the elephants in the area which can cause a problem for the Maasai people.

1.4 The Conflict

As the most nutrient soil is located around the bomas, elephants might concentrate their foraging to locations near them. Although meaning no harm their mere size makes them a nuisance at best, and they could even do lethal damage to people protecting their land and cattle. There may also be a conflict about the valuable waterholes (Moss, 2001).

In addition to the rising conflict about the graze there is also a trend within Maasai tribes to turn to agriculture. As the population is increasing the Maasai are forced to find new ways to feed their families. Agriculture takes large proportions of land in possession and wild animals' territories decrease even more. A large conflict in areas where elephants are present is the problems with elephants eating the crops (Osborn, 2004; Sitati et al., 2003).

1.5 Aim

The aim of this report is to find out and discuss these five main questions:

- Do bomas have any impact on the elephants in the study area?
- Where do the elephants prefer to forage and what factors are important in their selection?
- Is there a conflict between the elephants and the Maasai people in the studied area?
- If there is a conflict, why is there a conflict and is there a way to solve it?
- Is there a risk for conflict in the future?

1.6 Predictions

My predictions are that elephants spend most of their time in the park away from the bomas, though during the dry season there might be some conflict about the food around the bomas. The Bomas are likely to have a small but not insignificant impact on elephants.

2. Methods and Materials

2.1 Study area

The study was carried out in the Maasai Mara National Reserve (MMNR) and the adjoining group ranch, Koyake GR, in South-western Kenya (1°20´S, 35°08´E). The reserve borders the Serengeti National Park in Tanzania, and is a part of the same ecosystem. The study area covered ground rich in grass, both within and outside the park; hence the effect of livestock grazing was evident. In order to describe seasonal variations and its changing conditions two seasons were chosen. The observations were conducted during December 2003 and May-June 2004, because of the great difference in grass quality and grass availability between the seasons.

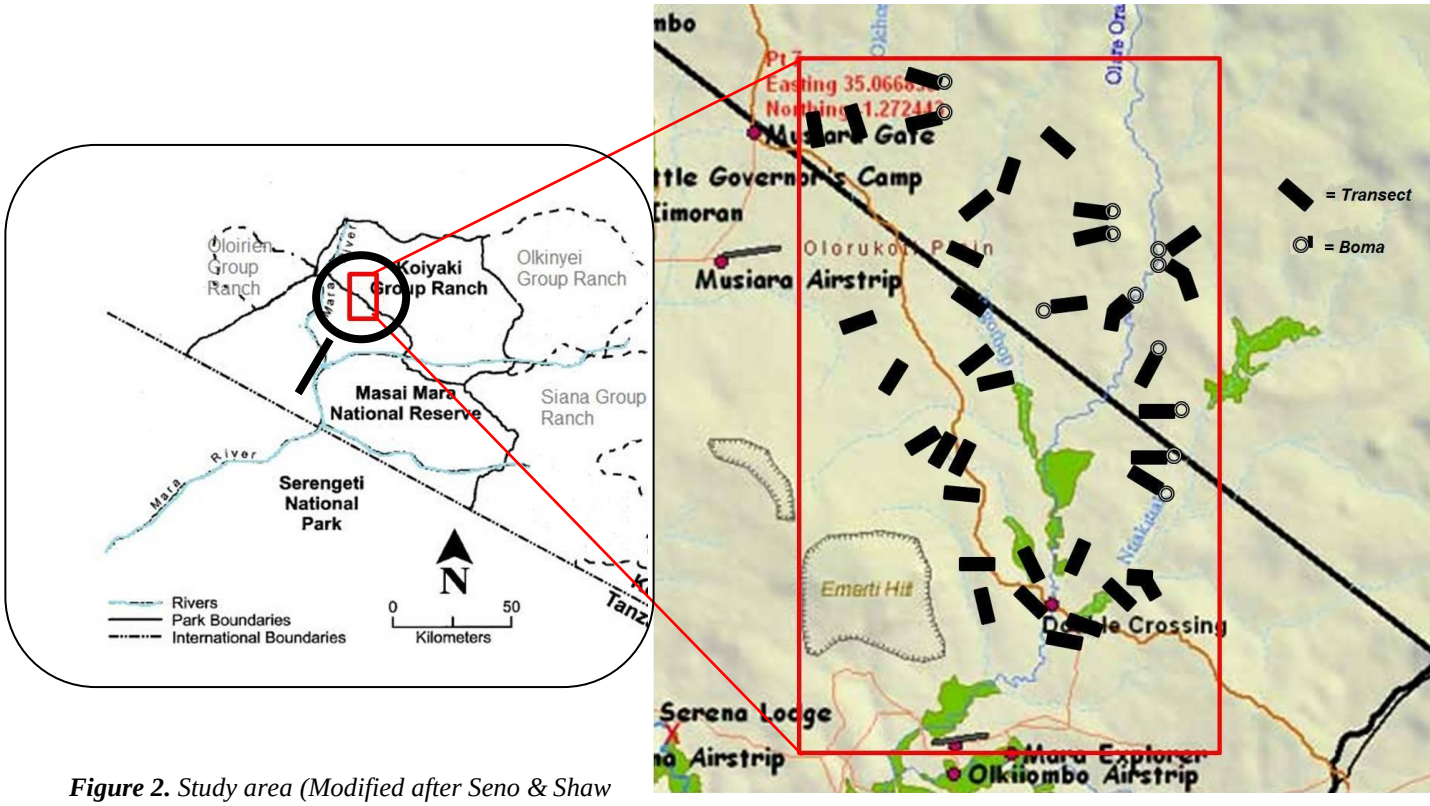

Figure 2. *Study area (Modified after Seno & Shaw 2007), Maasai Mara National Reserve and Koiyaki Group Ranch and the locations of the transects (Modified from Maasaimara.com).*

2.2 Selection of transects

Transects were defined as areas a 1000 m long and 300 m wide (i.e. 0.3 km²), with central points of 0.5 km (T1), 3 km (T2) and 5.5 km (T3) away from bomas. The central points were selected to create a gradually reduced impact of humans and livestock. The transect areas consisted of open grassland with no or few trees or shrubs, and topography chosen to allow good visibility.

A number of 12 bomas was considered sufficient to answer the question of effect of bomas on wildlife. In total 36 transects, three per boma, were included in the study. When the transect closest to the boma (T1) was selected, the following ecological features were recorded; soil type, termite hills, stones and vicinity to permanent water, shrubs and

woodlands. Thereafter, the T2 and T3 transects of the focal boma were chosen in order to match the same ecological criteria as T1, as closely as possible.

2.3 Recording method

Observations were made from the roof of a car, equipped with a GPS. The car followed the central line of the transect (hereafter called transect line), alternating the starting point between both ends. To prevent startling the animals on the first part of the transect, observations started when the car was 200 meters from the start or end point, aligned with the transect line. When there was a boma, river, hill or other physical obstacle that did not allow driving directly to the transect, the transect was approached from the side, usually in a 45º angle.

Data collection was systematically carried out on the three types of transects (T1, T2 and T3) every second hour evenly spread over day and night on both occasions. For each observation recordings of exact time, light intensity, weather, temperature, humidity, and phase of the moon were taken.

All animals encountered on the transect were included in the data collection. The number of elephants on the transect was counted and noted. The distance from the car to the animal was recorded with Leica© Rangemaster CRF 1200. The presence of people, cars, and livestock were recorded when within 300 m from the transect line. To record the impact of man and its livestock in the transect areas, a herd or gathering was recorded as one unit, independent of the number of individuals.

2.4 Position of the animals

The position of the animals was recorded in detail to enable calculation of number of animals per area unit. The distance between the car and an animal (or a cluster of animals) was measured. To calculate the distance between the transect line and the animal at a 90° angle, a protractor was used to determine the angle between the animal's position and the transect line. This angle, together with the distance between the car and the start point of the transect (not of the drive), was used to calculate the exact position of the animals on the transect. Calculations were made using sines law:

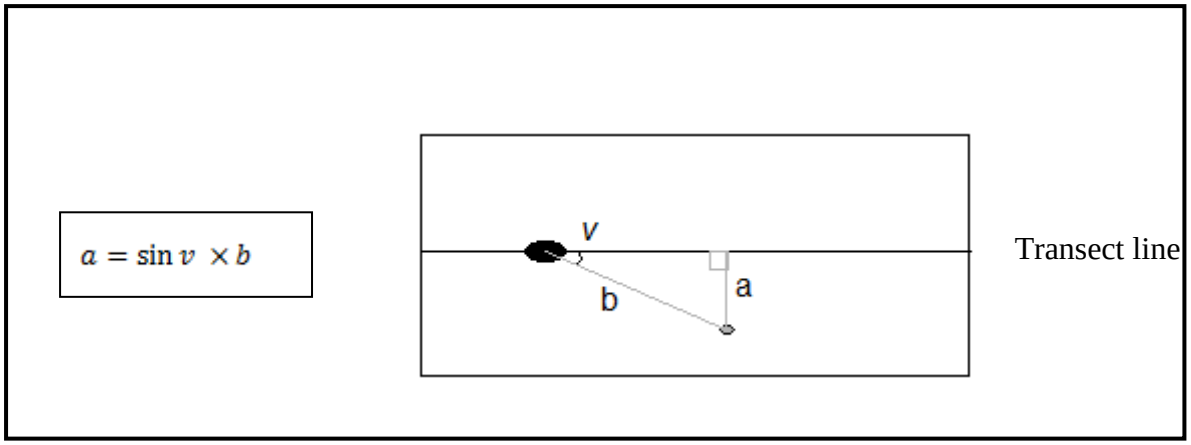

Figure 3*. Sketch of a transect area, explaining how to calculate the distance between the transect line and the observed animal. Using the law of sines with the measured angle* v *and the distance* b *from car to animal, the distance* a *was calculated.*

Animals found to be more than 150 m from the transect line were excluded from the data, as they were not present within the transect area. If the centre of a cluster of animals were located outside the transect all animals in the cluster were excluded. Likewise, when the cluster centre was located inside the transect all animals were included.

2.5 Statistical analysis

The collected data was sorted in Microsoft Excel® and analysed in MiniTab®. The data was tested for normal distribution using the Anderson-Darling test and were found not to be normal distributed. The non-parametric Kruskal-Wallis rank sum test was used to test for statistical significance.

3. Results

Most of the elephants (82.1%) were *grazing* when observed, the other behaviours observed were *standing* (3.6%) and *walking* (14.3%). The elephants *(n=28)* were distributed over eight different observations. The number of elephants in each transect was calculated to the mean number of elephants per square kilometers on the transects, as showed in *Figure 4*. The number of elephants per square kilometer in T1 was 0. On T2 there were 0.16 elephants/km^2 with a standard deviation of 0.34, and in T3 0.17 elephants with a standard deviation of 0.31.

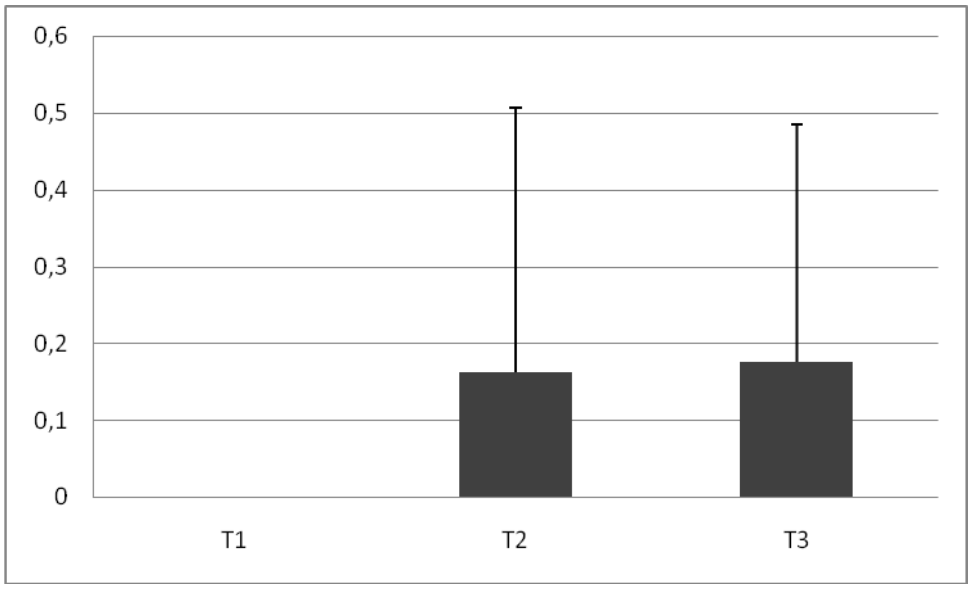

Figure 4. *The figure shows the mean number of elephants per km^2 in each transect.*

The main question when conducting the tests was; does the bomas have an impact on the elephants in the surrounding area? To be able to get a more precise result and to show whether there really was a difference in the number of elephant near the boma and in the park, the three groups where pooled into to two groups. As seen in *Figure 5*. T2 and T3 is combined to form a single group called Park, T1 is labelled Boma. The mean number of elephants per km^2 in the park when pooling the groups together, was 0.17 with a standard deviation of 0.32.

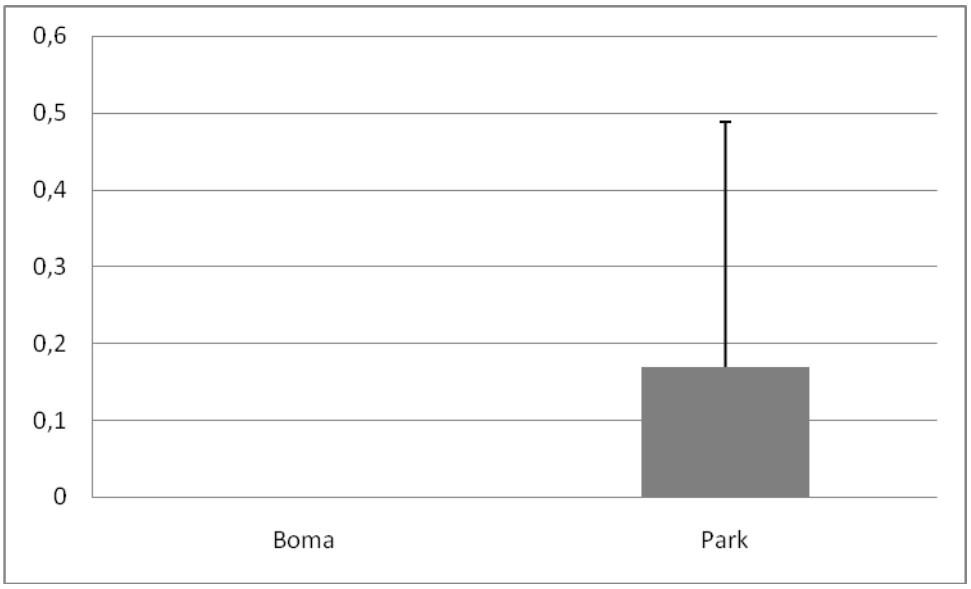

Figure 5. *The mean number of elephants per km^2 around the Boma and the Park. T1 is labeled Boma, transects T2 and T3are pooled together to form the group Park*

Although there were no distinct difference between T2 and T3, one can see that not a single elephant was seen in T1 in any of the observations. Kruskal-Wallis shows a significant difference between Park and Boma (H = 4.16 d.f = 1 p = 0.041) when adjusted for ties. Although Kruskal-Wallis use medians in calculations, mean value is shown in the descriptive statistics. As the median often is 0 the mean value is more informative. The results clearly show that elephants choose not to come near the bomas.

4. Discussion

The data collected in May and June 2004 clearly showed that elephants chose to stay well clear of the bomas. Not one elephant was recorded on the transects near the boma (T1). The reasons for this are not clear, but many factors may contribute to an elephant's choice in what area to forage.

Elephants are one of few animals that have little to fear from the big predators in the park. The only real threat is to the young elephants in the group, lions have been known to attack and kill elephant calves that have strayed from the herd. Predation on elephant calves is most common in the dry season, when the elephants have to travel long distance between waterholes and forage (Loveridge et al. 2006). However, as the predation on their calves is rather uncommon during most of the year, this means that elephants do not have to seek shelter in proximity to humans to get away from predators. This might be one of the factors why they rarely get close to the bomas, in contrast to smaller herbivores which sometimes are thought to find protection from predators in the presence of humans.

Another possible reason why the elephants don't go near the boma, in addition to the risk of being chased way, could be the fact that they simply have no business being there. Elephants are always searching for water and food, they move to where they can find what

they need to survive (Chamaillé-Jammes et al. 2007). Although more and more Maasai turn to agriculture they are still herders for the most part. As previously mentioned the ground around the bomas is more nutritious than surrounding area, however while the Maasai are still there they use a lot of the vegetation to feed their cattle as well as using trees and shrubs for building and repairing their fences. Also, the grass around the bomas is kept very short due to the cattle's grazing. When elephants eat they use their trunk to grasp the food, it's therefore reasonable to assume that elephants can´t grasp the very short grass that is left after the cattle. With this said, if the Maasais in the future were to farm their land and grow crops, the risk of conflict surely would increase (Osborn, 2004).

The nomadic lifestyle most Maasai tribes have lived is slowly diminished as the governmental policies evolve and land is more often privately owned. More importantly, Maasai are beginning to adopt a more permanent type of settlement. As the Maasai land was divided into group ranches, some researchers found the area where the wildlife could forage in the park decreased (Ottichilo et al., 2000). A study by Seno & Shaw (2002) showed that part of the inhabitants of the area feared that the forage would be insufficient for the wildlife confined in the park. Their way of life has always been a key component to benefit wildlife in the area as well as being a useful way of feeding their cattle. As the Maasai led their cattle over large areas, the land was kept open and ensured grazing for a multitude of species. Now as this system is decreasing there is a future risk of increasing conflicts with wildlife and a possibility that many Maasai tribes turn to agriculture as their foremost income (Seno & Shaw, 2002). Agriculture takes large proportions of land in possession and is permanent to one location. It is setting up a scenario for a conflict between human and wildlife. Agriculture leads to fewer grazing areas for the wildlife as well as offering a food source for the animals but a food source the Maasai will defend.

Due to their size and their foraging behaviour, elephants can cause a lot of damage to trees and shrubs when they make their way through the terrain (Chamaillé-Jammes et al. 2007; Guldemond & Van Arde, 2008). This is cause for many conflicts with farmers and herders alike. As elephants impose a threat to humans and their crop as well as being somewhat of a competitor of natural resources, there is reason to believe that Maasai will chase away elephants that get to close.

In Amboseli National Park in southern Kenya, studies have been conducted on the elephant population for over 30 years by researcher Cynthia Moss. Between the years of 1972 to 1999 the causes of elephants deaths were determined and registered, 67% of the deaths of adult elephants were caused by human activities. Most of these human related deaths are causes by spearing by the Maasai. Particularly in years where when the drought was at its worse, spearing was a common sight in the park. Elephants were in direct competition with the Maasai livestock for the very limited resources, which resulted in an increased number of encounters between humans and elephants (Moss, 2001).

In December only two separate observations of elephants in the studied area were made. There simply were nearly no elephants in the park or in the adjacent group ranch studied. The explanation for this is not entirely easy but some factors in the park change from May to December, one of these changes is the migration from Serengeti, Tanzania into Maasai mara, Kenya. Millions of herbivores wander into Maasai mara and cross the mara river in search for better grazing (Ogutu et al., 2009). When the wildebeest and zebras migrate back to Serengeti in the end of October the quality of the grazing in the park has been

diminished considerably. The elephants assumedly move to areas with better grazing and stay there until the grazing in the Mara has improved.

Elephants can give birth all year round but in a study on the Amboseli elephants by Moss (2001), she discovered that most births took place from May to November. If this is the case in the Mara as well, chances are that the elephants wander out of the park and away from the multitude of predators inhabiting the reserve. The escarpment bordering to the Mara Reserve is a good place to raise their young with fewer predators and more nourishment in the plants than in the reserve (anecdotal information), which at the time is crowded with zebras and wildebeests.

As the number of elephants is rather low in the study, the material has its limitations regarding interpretations based on the results. However, not a single elephant was spotted near the boma, despite numerous hours of observations. Elephants do not hide when approached by a car. In the Mara there were approximately 0,560 elephants per km^2 in 2003, which is equal to about 700 elephants in the reserve (Reid et al., 2003). All this taken into consideration, one can still assume that there simply are no elephants close to the bomas.

5. Conclusions

Even when considering the small number of elephants in the study one can still conclude that elephants are affected by the bomas, as they clearly don't make use of the land around the settlements for foraging. The way the Maasai make use of the land is not to advantage for the elephants. At the same time old bomas make for good nutrition to the vegetation for years after being abandoned.

Currently as the land is more often privately owned and used in agricultural purposes, the areas where elephants and other wildlife are able to graze are declining. If the trend continues in the Maasai society with a larger focus on agriculture, conflicts between man and elephant in Kenya may well be more frequent in the future.

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