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Nyckelord: elefant, *Loxodonta africana*, dygnsrytm, grovtarmsjäsare

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SUMMARY

Elephants are hindgut fermenters, which affects their diurnal rhythm. To reach their nutrient demands, elephants must eat almost constantly throughout the light part of the day. Sexual dimorphism may also affect their behavioral patterns.

To understand the elephants' normal living habits and foraging behaviour, we conducted a pre-study in the Mara Triangle, the north-western part of the Maasai Mara National Reserve. Each of four to six observers randomly chose a focal animal within the group of elephants by the criteria that they were adults and visible. During a total amount of about 100 observations hours, instantaneous sampling was used to record the behaviour of one specific elephant per observer. This was done every minute from an off-road car. The behaviours monitored were walking, standing, grazing, browsing, and a category called other behaviours that included nursing, drinking, defecating, urinating, self-grooming, other social behaviours, bathing, vigilance and other behaviours.

The time periods were divided into three different groups. The period between 8:00 to 9:59 and 16.00 to 17:59 was called early and late hours. Late morning was from 10:00 to 12.59 and afternoon from 13:00-15.59. The most common behaviour for all time periods was foraging while standing and walking was very limited. These results confirmed our expectations that elephants eat most of the day, even compared to other herbivores. Walking, standing and other behaviour was performed most in the period between 10-11.59 am while foraging was performed mostly during the first two hours and the last two hours. When looking into the difference between sexes, males stood significantly more than both the lactating and non-lactating females did. No other behaviours in the comparison between the sexes differed significantly.

Key words: Elephants, *Loxodonta africana*, diurnal rhythm, hindgut fermenters

SAMMANFATTNING

Elefanter är grovtarmsjäsare vilket påverkar deras dygnsrytm. Därför, för att nå sina näringsmässiga krav, måste elefanter äta nästan konstant under hela dagen. Könsdimorfism kan även den påverka beteende mönstret.

För att förstå elefanternas normala levnadsvanor och födosöksbeteende genomförde vi en förstudie i Maasai Mara National Reserve, Kenya. Varje observatör valde slumpmässigt ett fokaldjur i gruppen av elefanter med kriteriet att de var vuxna och inte hade ett alltför långt avstånd till oss och därmed var väl synliga. Under cirka 100 timmar av observationer användes momentan provtagning för att registrera beteendet hos elefanterna varje minut från en bil.

Tidsperioderna delades in i tre olika grupper. Perioderna mellan 8:00-9:59 och 16:00-17:59 kallades för gränstimmar. Perioden mellan 10:00-12:59 kallades för innan lunch och eftermiddag var perioden mellan 13:00 och 15:59. Det vanligaste beteendet för alla tidsperioder var födosök medan stå var det beteende som utfördes mycket sparsamt. Dessa resultat bekräftar våra teorier att elefanter äter större delen av dagen, även mer jämfört med andra växtätare. Beteendena gå, stå och andra beteenden utfördes mest mellan klockan 10-12.59, medan äta utfördes oftast under de första två timmarna och de sista två timmarna av observationerna. När man studerar skillnaden mellan könen, visade undersökningen att hanar stod betydligt mer än både lakterande och icke lakterande honor. Inga andra beteenden i jämförelsen mellan könen skilde sig avsevärt. Alla andra beteenden i jämförelsen mellan könen var icke signifikanta. Den största delen av detta har att göra med det faktum att vi hade för få observationer timmar som i sin tur berodde på de livsmiljöer vara mycket svårt att få på grund av regn, berg och sumpig områden.

Nyckelord: elefant, *Loxodonta africana*, dygnsrytm, beteende, grovtarmsjäsare

1. INTRODUCTION

1.1. African elephant

Elephants are the largest mammalian herbivores on earth (Owen-Smith, 1988), populating 37 out of the 53 countries in Africa (Blanc et al., 2007). The family *Elephantidae* is the only family in the order *Proboscidea* that are not extinct, the mammoth being the most recent one, got extinct for about 11.000 years ago (Shoshani, 1998). There are two types of African elephants, the savannah elephant (*Loxodonta africana africana*) which is found in Eastern and Southern Africa, and the forest elephant (*Loxodonta africana cyclotis*) which is found in central Africa (Congo) (WWF, 2007). There is also a third species of elephants, the Asian elephant (*Elephas maximus*) (Blanc et al., 2007). A mature elephant consumes about 1-1,5 % dry matter of their body weight (up to 200 kg) of grass in one day (Ullrey et al., 1997), much because of its poor digestibility, which ranges between 40-60 % depending on season and forage. This forces them to be grazing about 17 hours a day (Beekman & Prins, 1989). When you feed this much and are not a ruminant that regurgitates food, you are dependent on the teeth for mechanical degradation. The teeth therefore get worn down and this is why elephants exchange their teeth 5 times during its lifespan (Kingdon, 1979). When a tooth gets worn down, it is pushed forward from the back of the jaw and eventually pushed out (Kingdon, 1979). When the last set is worn down, the elephants get a hard time masticating the forage properly and eventually die from starvation (Kingdon, 1979).

1.1.1 Habitat

According to the African Elephant Status Rapport 2007 (Blanc et al., 2007), African elephants occur in habitats of large diversity, from tropical swamp forests to open and closed savannah, grasslands, wetlands and deserts. The same study shows that they are also able to move huge distances in their search for food, water or minerals. The forest elephant is found in the tropical rainforest zone of West and Central Africa, while the savannah elephant occurs in the rest of the range (Blanc et al., 2007).

The elephant in Africa is listed as Vulnerable in IUCN´s (International Union for Conservation of Nature) Red List of 2010. The major threats to its existence being habitat loss and fragmentation, poaching for ivory and meat and also the human-elephant conflict (WWF, 2007). In the majority of countries in Africa the elephant populations are now growing at a rate of 4 % a year (Blanc et al., 2007), much due to manage of the poaching by the CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) banning ivory trade in 1989. The habitat loss and fragmentation of land, on the other hand, is steadily increasing because of human population growth. Humans are continuing to expand their agricultural areas and thus the human-elephant conflict keeps growing when elephants are destroying crops (Blanc et al., 2007).

1.1.2 Hindgut fermenters

Elephants are, together with for example rhinoceros and horses, hindgut fermenters (Clauss et al., 2003). Their fermentation and digestion of cellulose is primarily located in the large intestine and cecum, whereas for ruminants the process occurs in the fore stomach. Hindgut fermenters´ ability to extract energy from cellulose digestion is therefore less efficient than in ruminants (Demment & Van Soest, 1985). Ruminants have a long passage time through the gut since the forage is being masticated and regurgitated several times, enabling that as much energy as possible is extracted from the food, this limiting their food intake as a side effect (Janis, 1976). While elephants, to make up for this poor digestion,

have a much shorter passage time and thus can eat larger amounts of forage and thereby reaching their nutrient demands this way (Beekman & Prins, 1989).

1.1.3 Foraging behaviour

The African Elephants are mixed feeders. They spend approximately 17 hours a day foraging everything from shrubs and grass to trees, fruits and herbs (Beekman & Prins, 1989). Earlier studies have shown that 80 % of the time is spent on feeding grass (Wing & Buss, 1970; McKay, 1973) but other studies have also shown that there are big seasonal fluctuations, browsing being more prominent during the dry season when the availability of grass is scarce (Beekman & Prins, 1989; Scott, 2009). One study have shown that even though the elephant spend up to 80 % of their foraging time grazing, the browse plants stands for a much higher quantity of carbon for organic growth (Sukumar & Ramesh, 1995) making it the more important nutrient.

The approximate time that elephants spend on feeding depends on a number of factors; the animals´ requirement of energy and nutrients, the amount of digestible food that is available and the rate at which food can be ingested, which is influenced by the distribution of the food (Beekman & Prins, 1989).

In all mammals, gut capacity increases in proportion to body weight with a one to one relationship. The larger an herbivore, the larger its GIT (gastrointestinal tract) capacity (Van Soest, 1996). Energy requirement on the other hand, is adapted to only increase with one third of the increase of the body weight ($BW^{0,75}$) (Van Soest, 1996). This has the effects that larger herbivores are able to reach their nutrient demands by eating food of poorer quality than smaller herbivores (Demment &Van Soest, 1985).

There are also other clear advantages of a large body size, such as being able to move greater distances in search for food and water and to use habitat resources unattainable for other species as well as the avoidance of predation (Owen-Smith, 1988). On the other hand, there are also some disadvantages of a large body size such as having fewer offspring, later mature sexually, and longer gestation times, all of which lead to long generation intervals (Owen-Smith, 1988).

1.1.4 Importance of conserving elephants

Elephants play an important role in the forest and savannah ecosystems in which they live. For example are many plant species dependent on passing through an elephant's digestive tract before they can germinate; it is calculated that at least a third of the tree species in west African forests rely on elephants in this way (Cochrane, 2003). Even if other herbivores species eats the seeds, they both have such a small intestine that the seeds get degraded and also do not travel the large distances that elephants does which leads to a wider distribution of the seeds. It has also been shown by Cochrane (2003) that seeds from *Balanites wilsoniana* have a better germination and also germinate earlier if they are passed through the elephant’s gut.

According to Western (1989) elephants’ browsing on vegetation also affect the structure of habitats and influence bush fire patterns. For example do elephants under natural conditions create gaps through the rainforest, enabling the sunlight to enter, which allows the growth of a larger variety of plant species. When a forest gets very dense, little sunlight is able to get through to the floor vegetation and thus only species that are not dependent on sunlight can grow there. The amounts of these shade tolerant species are very few (Western, 1989).

African elephants are also so called ‘flagship’ or ‘umbrella’ species for their habitats — that is, they are representatives of the biodiversity within the ecosystems they inhabit. Because these large animals need a lot of space to survive, the work for conservation of them will help maintain biological and ecological diversity over extensive areas and so help many other species in the areas (Blake & Hedges, 2004; Western, 1987).

In 2000, WWF launched a new African Elephant Programme that works for the conservation of elephants. The programme has set up a few important points that are found in the WWF species fact sheet of the African Elephant (2007). More specifically, the African Elephant Programme is aimed to*:*

“

- *develop and apply policies and legislation that create an enabling environment for elephant conservation*
- *conserve elephant habitat effectively in order to increase range and connectivity between populations*
- *reduce the illegal killing of elephants*
- *reduce illegal trade in major elephant product markets in Africa and Asia*
- *reduce human-elephant conflict*
- *improve the livelihoods of people living alongside elephants through economic development activities linked to wildlife conservation*
- *increase public support for, and participation in, elephant conservation.”*

In 1970 IUCN put together a group called the AfESG - the African Elephants Specialist Group with the purpose of conserving the African elephants. Since elephants inhabits 37 countries in Africa, AfESG with its approximately 45 members, is one of the largest specialist groups led by IUCN (Dublin & Hoare, 2004). It is also this group that distributes the African Elephant Database (AED) and puts together the African Elephant Status Report (AESR) every three to five years, the latest released in 2007.

Because of their large body size and their need for large habitats, elephants also contribute to a lot of ecological problems, destroying crops and grain stores, damaging trees, killing livestock, destroying water supplies and even killing people (Sukumar, 1990). Since 1979, the human population in the Trans Mara has more than doubled from 70,201 to 168,721 and the same trend is seen all over the continent. This population growth requires large amounts of land that was earlier only shared between the wildlife itself. Because of this there is now a greater contact between the humans and the elephants, which in turns leads to a conflict between the two. This has become one of the largest issues that AfESG has to deal with and it is now well known all over the world as the Human Elephant Conflict (HEC) (Dublin & Hoare, 2004).

1.2. Aims of the study

The aim with this study was to investigate the elephant's daily pattern of their behaviour. The aim was also to examine whether or not there is a difference between males, lactating females and non-lactating females. In a bigger picture, this study functions as a way to spread information about the elephants which in turn could lead to a larger acceptance and perhaps also counteract to the human-elephant conflict.

2. MATERIAL AND METHOD

2.1. Study area

The study was performed the Mara Triangle in Maasai Mara National Reserve (1,672 km^2), a part of the Serengeti-Mara ecosystem (Fig 1). The reserve was formed in 1965. In the western part of the national reserve, called the Mara Triangle (510km^2), the study was situated (Dublin, 1995). The Mara Triangle has a distinct demarcation between the Oloolollo Escarpment, the Mara River and the Tanzanian border. The ecosystem of the Mara Triangle is mainly open grasslands but also Balanite and Acacia woodlands.

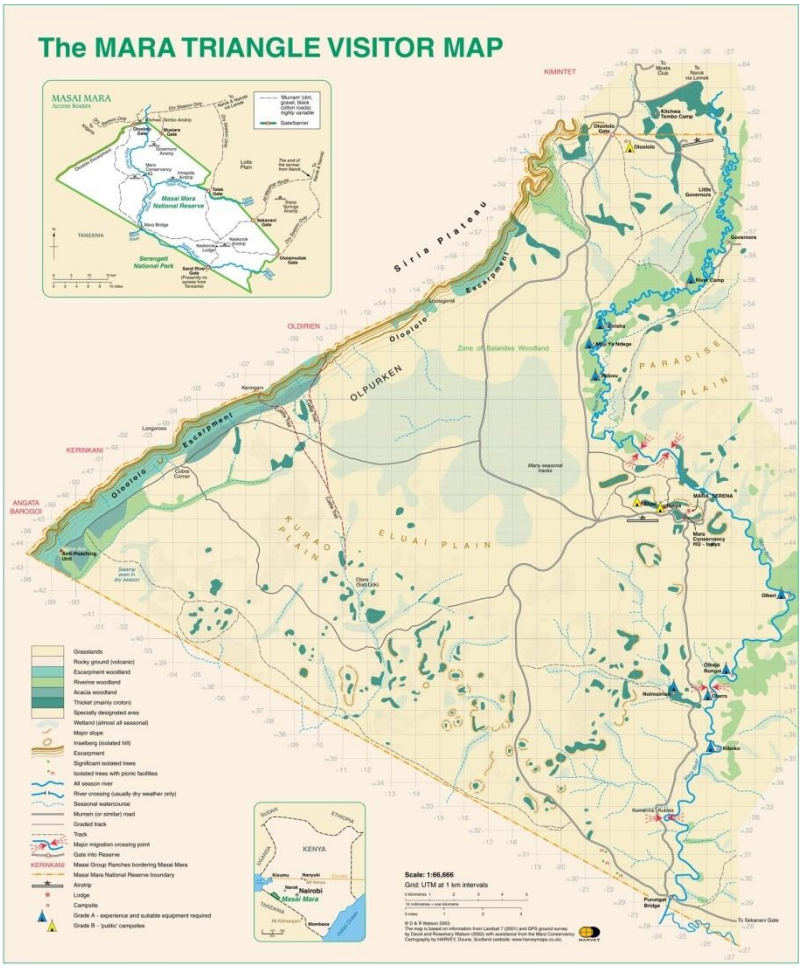

Figure 1. Mara triangle visitor map, with kind permission of Mara Conservancy, 2010.

Part of the grasslands also contains rocky areas and seasonal swamps. The annual rain season occurs from March to May and November to December. Despite its small size, Maasai Mara is a very important refuge to migrating animals during dry season because of its high rainfall, permanent water and high grassland productivity (Broten & Said, 1995). It is mainly wildebeest, zebras and gazelles that migrate between Serengeti and Maasai Mara

while elephants, giraffes, buffaloes and several antelope species live permanently in Maasai Mara (Ottichilo et al., 2000).

2.2. Study subjects

All elephants in the study were Savannah Elephants (*Loxodonta africana africana*). The chosen herd to be observed was randomly selected every day. The same herd was observed during the whole day if possible. Another herd was chosen if the observed group became unreachable due to swampy or rocky areas, or because of weather conditions. One main criterion was that the group should contain at least six adult elephants. Every one of the four to six observers chose one focal animal each to observe during the whole registration period.

2.3. Data collection

Instantaneous sampling was employed to monitor elephant activity and behaviour with one-minute intervals between the 17th and 24th of March 2010. A pilot study was performed one day prior to the study to obtain knowledge about which behaviours should be included in the study and how the study was going to be executed. Depending on weather conditions, the observations started at around 8:00 and lasted until 18:00. The observations were carried out from a Toyota Land Cruiser by between four and six observers. The distance to the herd was measured with a Rangemaster, during all observations. Binoculars were used when needed. The recorded behaviours were walking, standing, grazing, browsing, nursing, drinking, defecating, urinating, self grooming, other social behaviours, bathing, vigilance and other behaviour.

2.4. Data analysis

Since some of the recorded behaviours were very rare, I analysed the data for frequencies of walking, standing, grazing and a category called other behaviour, i.e. the pooled remaining behaviours. The frequencies of these behaviours were calculated from the definitive recording only; missing observations were not included.

The data was calculated as percentages of the total observing time. Since the data was not normally distributed, the frequencies was analysed using a non-parametric Kruskal-Wallis test.

2.5. Definition of behaviours

Table 1 show the definition of the behaviours that were registered during the observations.

Table 1. Definition of behaviours in the study of elephants in Maasai Mara during 2010.

Behaviour	Definition
Walking	Walking or running with all four limbs in motion without chewing or searching for food.
Standing	Standing up on four limbs either in sun or shade without chewing or searching for food. If the animal was more than 50% in shade this was recorded as (Sh), otherwise it was recorded as (S).
Grazing	Chewing, gathering or manipulating grass (G), herbs (H), mixed (M) or unknown (U).
Browsing	Chewing, gathering or manipulating shrubs or trees
Nursing	Offspring mouth within 10 cm of its mothers breasts.
Drinking	Trunk in water or putting water into its mouth with its trunk.
Defecating	Discharge of faeces.
Urinating	Secreting urine.
Self grooming	Scratching itself with trunk or against a tree.
Other social	Physical contact between elephants.
Bathing	Throwing mud, water or grass onto itself with its trunk.
Vigilance	Trunk raised above head.
Other	Any sort of behaviour that do not fit under any of the other columns.
Missing	Unable to identify behaviour or elephant was out of sight.

A total of 100 hours of observations were done. The behaviours were grouped into four different categories; walking, standing, foraging and other behaviour. Browsing and grazing were combined to form a new category called foraging. Behaviour such as nursing, drinking, defecating, urinating, self grooming, bathing, vigilance, other and other social were also merged into one new category called other behaviour.

3. RESULTS

3.1. Diurnal rhythm

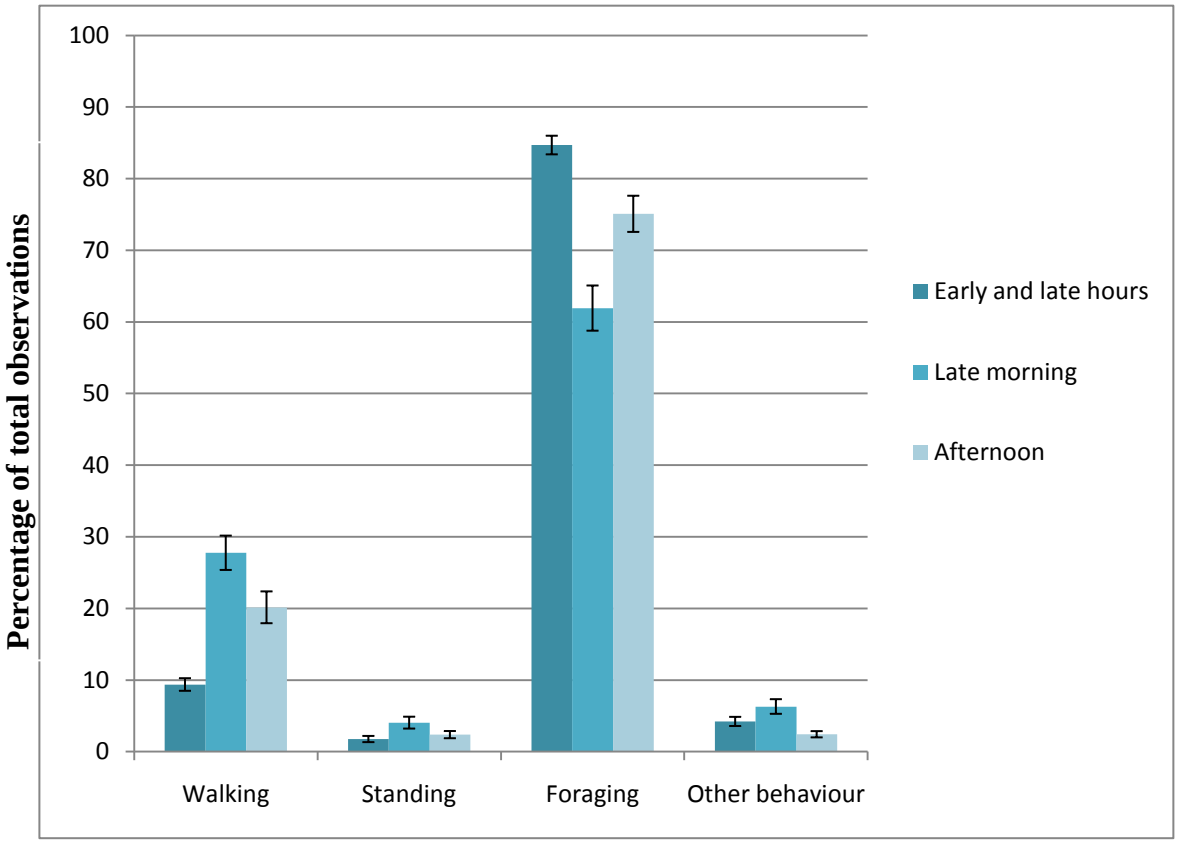

Figure 2. Frequencies of foraging and locomotion behaviours of the studied elephants in Maasai Mara in 2010 during different times of the day.

The distance to the herd was estimated to between 25-150 meters measured with a Rangemaster. All results in the study are presented as means +/- standard error. Figure 2 shows the distribution of common behaviours divided into three periods throughout the day. The observations were carried out between 8am and 17.59 pm. To get the time close to dusk and dawn in a single category, I merged the observations from 8:00 to 9:59 and from 16.00 to 17:59 to a period called Early and late hours. Late morning was from 10:00 to 12.59 and Afternoon from 13:00-15.59.

It is clearly shown that the behaviour that was performed the most was foraging, and standing overall was a relative rare behaviour. The elephants walked significantly more in late morning than during the early and late hours (Kruskal-Wallis test, $P<0.001$, $H=44.2$) as well as in the afternoon (Kruskal-Wallis test, $P=0.004$, $H=8.32$). They walked less during early and late hours than in the afternoon (Kruskal-Wallis test, $P<0.001$, $H=14.48$).

They stood more during late morning than the early and late hours (Kruskal-Wallis test, $P=0.014$, $H=6.02$). There was a statistical tendency for standing when comparing late morning to afternoon (Kruskal-Wallis test, $P=0.086$, $H=10.19$). The elephants foraged more during early and late hours than in the afternoon (Kruskal-Wallis test, $P=0.014$, $H=6.09$) and late morning (Kruskal-Wallis test, $P<0.001$, $H=35.78$). They also ate more in

the afternoon than in the late morning (Kruskal-Wallis test, P=0.001, H= 10.19). Other behaviours were carried out more in the late morning than in the afternoon (Kruskal-Wallis test, P=0.006, H=7.65) and also more in the early and late hours than in the afternoon (Kruskal-Wallis test, P=0.025, H=5.04).

The comparisons for standing between afternoon and early and late hours showed no significance and the same was seen for other behaviour between the early and late hours and late morning.

3.2. Differences between sexes

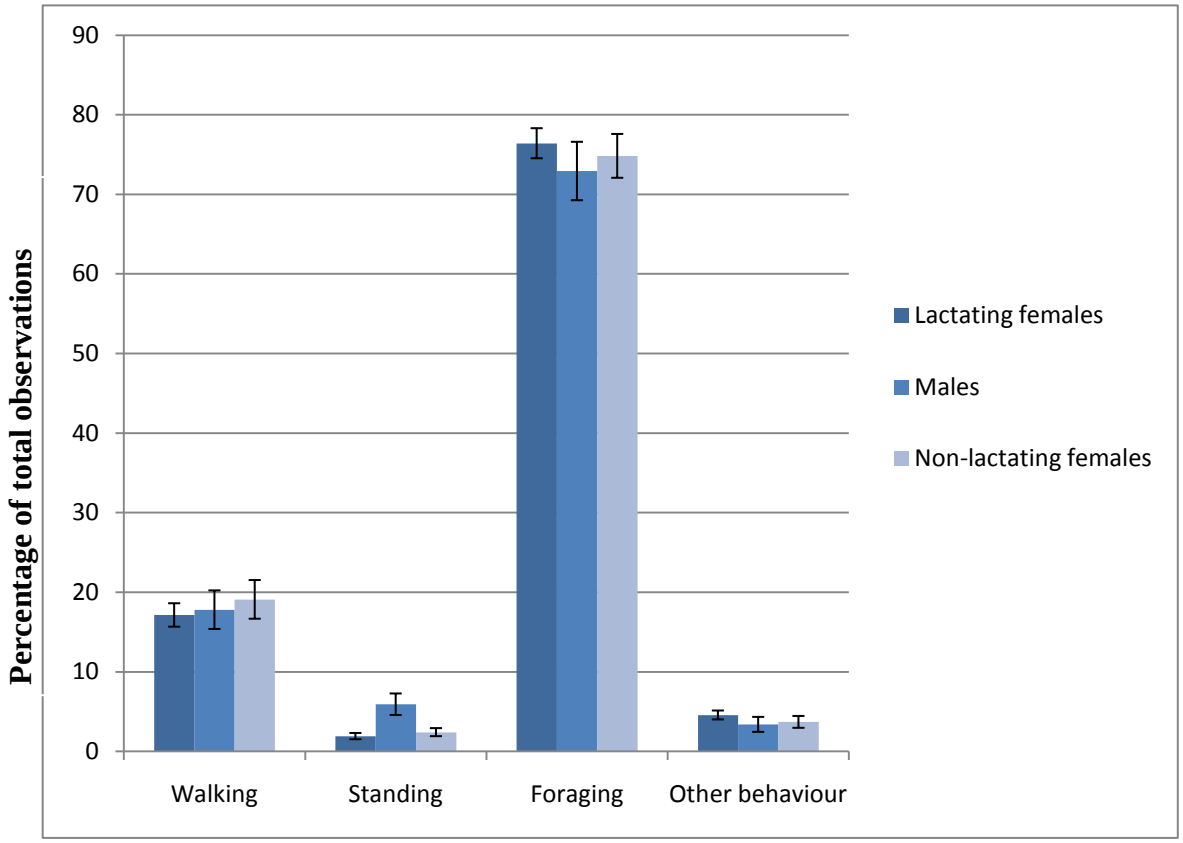

Figure 3. Frequencies of foraging and locomotion behaviours of the studied elephants in Maasai Mara in 2010 divided in males, lactating females and non-lactating females

Figure 3 shows the distribution of common behaviours divided in males, lactating females and non-lactating females. The sex affected the frequency of standing (Kruskall-Wallis test, P=0.015, H=8.34) but not any of the other behavioural categories. There were a total of 178 observations which each lasted for 30 minutes, made for females; 64 non-lactating, 114 lactating and a total of 25 observations for males.

4. DISCUSSION

The purpose of the study was to gain knowledge about the daily pattern of the elephants' diurnal rhythm. I focused also on whether or not sex and lactation affects their behaviour.

4.1. Diurnal rhythm

As expected had the elephants in our study a diurnal pattern where they for example walk twice as much during afternoon and more than three times as much during late morning than in the early and late hours. The fact that they ate more during the "Early and late hours" might be an explanation to this; one could draw the conclusion that instead of foraging, the elephants walk. This might be due to the extreme heat that appears during these hours. We could also see that it was during these hours that the elephants started walking towards the waterholes to cool themselves down by covering themselves with water and mud (personal observation). Another result that was seen during our observations, but is in the results included in other behaviours, is that the elephants never lied down. It was also very rarely we saw them just standing doing nothing else. Most of the time the elephants spent foraging, this supporting the data presented by Beekman & Prins (1989) that they eat approximately 17 hours a day. Some of the results might also be affected by the fact that we only studied the elephants between 8 and 17 every day and neither at dusk, dawn or night.

4.2. Differences between sexes

The results from the study showed that there were a slight difference in-between sexes and their time budgets. Males spent more time standing than both lactating and non-lactating females. This might have to do with the fact that males, to a bigger extent, are vigilant both towards us and other threats (Sukumar, 1990). This behaviour could in turn be explained by "male strategies" in which, because of the high competition of possible mates, males have to be more risk taking than females (Sukumar, 1990). This was the only significant result we achieved concerning sex differences. We also expected that lactating females would eat more than both of the other groups, or at least more than the non-lactating females, which is well known to be the fact for a lot of other species such as horses and cattle (McDonald et al., 2002). But because we did not get any significant results there, this conclusion could not be drawn from our study, although the mean values from Figure 3 are pointing towards that this is true. So if we would have had more observation it might be possible that we would have seen lactating females feeding more than non-lactating as well as males.

One could also expect that males and females would be significantly different in their eating habits because of sexual selection. Because of this, elephants have developed a sexual dimorphism; the males have a considerably larger body size than the females do and this forcing them to have bigger nutrient requirements (Ralls, 1977). This was not seen in the study. Even when combining the two groups "lactating" and "non-lactating" we did not get a significantly difference from the males. A closer look at the mean values of Figure 3 show that males eat lesser than both lactating and non-lactating females. Males had also a larger standard error bar than the other two groups, maybe due to the smaller number of males in our study. Elephants live in maternal groups and when the male calves born into the group get sexually mature, they leave for a life in solitary. Only for a short period of time during mating, the males are joined into a group again (Jensen, 1995). Due to this there might have been a distortion in the male/female ratio. There were 89 hours of observations made for females and only 12.5 hours of observations for males.

The fact that there were so much of our data that were non-significant could be due to our few observation hours, to get a more trust-worthy results, one would have wanted a lot more observations.

4.3. Reflections about material and methods of my study

Elephants spend most of their time awake feeding (approximately 80 % of the light hours, (Wing & Buss, 1970; McKay, 1973) to reach their nutrient demands. During the dry season, when the grass becomes less nutritious, they have to change their diet from grass to more nutritious plants such as leaves, fruits and shrubs. Another alternative would be to increase their intake or take larger bites. Because they already are feeding about 80 % of the time makes it very difficult for the elephants to do so (Owen-Smith, 1988). This is also supported by our study and is one of the things that surprised us in the beginning, but after further research was done and understanding how hindgut fermenters work this has now become very clear.

There were some practical issues that could have influenced the result of this study. First, it is hard to identify and follow the same individuals during several days. There were also at the time very few herds in a very large area. The majority of these areas were also inaccessible for us because of rocks, swamps and trees. At the end of our study period, the rain also started, which made it even more difficult. The roads became partly flooded and everywhere we went there was a risk of getting stuck. Furthermore, there is also a possibility that the results might not be representative. There had been a period of heavy rain earlier than normal during this dry season and this will almost certainly affect the quantity as well as the quality of both grass and trees, which might lead the elephants to eat more grass than they normally do. Another source of error is that we only observed the animals on daytime from 8 to 18 hours. We did not have the equipment needed, or the authority to study the elephants by night. And even if we did, it would probably have been too unsafe to follow them at night. By this I mean that during the day, you can see what the animals are doing and hopefully you see if an elephant appears vigilant and/or charges you, but at night the visibility is limited and therefore the risks are highly enhanced.

When we started out we also believed that the elephants would use shade to a greater extent during the hottest hours; they would keep in and close to forests and solitary trees to protect themselves from the heat. However, this was not observed in our study. The only time they stood under or close to a tree was when they were “self grooming” e.g. when they were scratching themselves towards a tree. Instead they seem to completely depend on the water and mud holes for cooling. Almost at the same time every day, around midday, they started walking towards these mud holes to spray water and mud onto themselves and thereby getting a good protection from the sun.

4.4 Possible solutions to the HEC

The African elephant *Loxodonta africana* poses a dilemma for conservation managers. The IUCN categorizes the species as Vulnerable because populations in Central, East and West Africa are in decline (IUCN, 2007) much due to the fact that the populations are small and fragmented (Blanc et al., 2002). Yet in southern Africa elephant populations grow rapidly in some protected areas and national reserve managers are concerned that high elephant densities will harm biodiversity by degrading ecosystems (Owen-Smith, 1996). But at the same time it has been shown that elephants play a very important role in contributing to a large biodiversity within their habitat.

The biggest concern at this point, I would say, is the Human-Elephant Conflict; it keeps people from wanting to help conserving the elephants. This in turn would lead to

conservation of areas over a large range and so also conserving the species of plants and animals living within it. A lot of research is now being undertaken to come up with a solution to this unfortunate dilemma. But the fact is that it is very complicated problem involving policies, legislation and the publics' opinions. To come up with a solution that fits all of the 37 countries where elephants exist is both time consuming and extremely difficult (Dublin & Hoare, 1997). For now, farmers rely on electric fencing as their most successful method for keeping the elephants off their crops. Disturbance shooting is also a commonly used method especially for "problem elephants" that keeps raiding over and over again. Other traditional methods used includes burning fires along the fields, beating drums, throwing missiles and chilli (*capsaicin*) based deterrents to prevent the elephants from approaching (Osborne & Parker, 2002). In a study made by Hedges and Gunaryardi (2008) it is though very unclear which factor it is that affects the elephants approaching or not since the chillies are often mixed with other deterrents. The elephants also get accustomed to the methods which make the farmers in need of constantly developing new methods to avoid habituation (Osborne & Parker, 2002). It is also in this area that even further research is needed to reduce the conflict between the two species that have inhabited earth the longest. Otherwise, it is hard to see a future for the elephants.

Another very important factor to bring some light onto is that 80 % of the elephants range lies outside of protected areas in Africa (Taylor, 1999). So even if there are regulations for conservation management in national parks, this only protects the animals while within the park. Therefore the regulations must come from a higher level. As it is nowadays, because of poaching and human activity, elephant numbers are way too high in the protected parks with the consequence of these being over browsed (Western, 1989). One idea is that since elephants seem to use so called corridors for their movements between their home sectors, it would be of interest to identify these crucial pathways and protect them (Douglas-Hamilton et al., 2005) giving elephants the opportunity to get a small but very important part of their land back, and also reducing the pressure on the national parks.

Finally, I choose to cite Dublin (2004) who confines the problem with the Human-Elephant Conflict in a good way; "*The future of the African elephant is now inextricably linked to its interactions with the people who share its range, and the ability of two of the world's longest living species to co-exist is one of the greatest challenges facing the management of this species and countless other species that falls under the elephant's conservation "umbrella".*

5. CONCLUSIONS

There were some clear differences in the behaviour standing between the sexes within the species. There is also an apparent diurnal rhythm where the elephants seem to prefer eating at the two first and the two last hours of our observations. They also start moving around mid day when the temperatures are at the highest level which also consists with our theory that instead of eating they try to find a waterhole to cool themselves down. These results might be of interest to people trying to solve the problem with elephants raiding crops. It could be useful to know when the elephants are most motivated to search for food to distinguish when and where intervention is needed. To spread the information and knowledge also in itself contributes to a wider understanding and acceptance in humans faced with the animals.

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