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David Jonsved

Skara 2015

Etologi och djurskyddsprogrammet

Photo: David Jonsved, 2015

Studentarbete **Nr. 607**
Sveriges lantbruksuniversitet
Institutionen för husdjurens miljö och hälsa

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Handledare: Jens Jung, Inst för husdjurens miljö och hälsa
Examinator: Claes Anderson, Inst för husdjurens miljö och hälsa
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Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap
Institutionen för husdjurens miljö och hälsa
Box 234, 532 23 SKARA
E-post: hmh@slu.se, **Hemsida:** www.slu.se/husdjurmiljohalsa

Abstract

The behaviour of the red-tailed guenon (*Cercopithecus ascanius*) was studied over the course of nine days in the Sabaringo forest surrounding Kichwa Tembo Tented Camp near the Masai Mara National Reserve, Kenya. A focal animal instantaneous sampling method with a one minute interval was used to record the behaviours of the monkeys for approximately 12 hours a day, the day being divided into six shifts á two hours. This method has proven successful in earlier studies of red-tails in this area. The study subjects included both lactating and non-lactating females, juveniles and on some occasions the resident male.

The purpose of this study was to examine the grooming behaviour of red-tailed guenons and whether or not the occurrence of grooming varies depending on monkey type (lactating or non-lactating) and time of day. The results show that grooming occurs throughout the day with the morning (09:00) being the period when most grooming occurs. It was also found that lactating females spent slightly more of their time grooming than did non-lactating individuals. Presented at the end of the discussion are suggestions for further research in this area, including the possible role of facial expressions and other subtle social signals, the significance of which body parts are being groomed as well as the different functions of grooming.

Sammanfattning

Beteenden hos den rödsvansade markattan (*Cercopithecus ascanius*) studerades under nio dagar i Sabaringoskogen kring Kichwa Tembo Tented Camp beläget nära Masai Mara National Reserve i Kenya. Den valda metoden för att observera markattorna var en fokaldjursobservation med momentan registrering en gång i minuten. Observationerna pågick ungefär 12 timmar om dagen i sex skift om två timmar. Denna metod har visat sig användbar i tidigare studier på markattor i området. Både lakterande och icke lakterande honor observerades, såväl som juveniler och vid enstaka tillfällen den bofasta hanen.

Syftet med studien var att undersöka om förekomsten av putsning (*grooming*) skiljer sig mellan lakterande och icke lakterande individer och huruvida dessa beteenden varierar beroende på tid på dygnet. Resultaten visar att putsning sker under hela dagen, men att morgonen (09:00) är den tid på dygnet då putsning var vanligast. Vidare visade det sig att lakterande honor spenderade lite mer tid på putsning än vad icke lakterande individer gjorde. I slutet av diskussionen presenteras förslag på vidare forskning inom området, såsom betydelsen av ansiktsuttryck och andra subtila sociala signaler, betydelsen av vilka kroppsdelar som putsas samt de olika funktionerna av putsning.

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1. Introduction

Sociality is a common trait among most primates and one that would never had arisen without some evolutionary advantages to the individuals within these species (Alexander, 1974). However, these advantages come at a cost. In order for these relationships to persist, primates must spend time and energy on maintaining the social cohesion of the group. This means that social species have to spend time and energy in order to maintain group cohesion which, in turn, allows them to reap the benefits such as predator protection, resource defence and higher reproductive success (Alexander, 1974). The present study examines the primary behaviour of maintaining social relationships in red-tailed guenons, namely grooming, and how it varies throughout the day and between lactating and non-lactating individuals.

2. Background

2.1 Species Description

The red-tailed guenon (*Cercopithecus ascanius*), also known as copper-tail guenon or red-tailed monkey, belongs to the diverse genus known as *Cercopithecus* in the larger primate family of *Cercopithecidae* and is most commonly found in the central and eastern parts of the African continent (Groves, 2005). The taxonomy of this group of primates is still being debated to some extent but there are thought to be some 20 species of *Cercopithecus* which are further divided into around 50 subspecies (Butynski, 2004). The red-tailed guenon is classified as "Least concern" by the IUCN red list and is thought to be threatened only locally where logging or other habitat degradation occurs (Oates *et al.*, 2008).

Like many other *Cercopithecidae*, the red-tailed guenon is equipped with cheek pouches used for storing food, not entirely unlike a hamster (Butynski, 2004). They are easily distinguishable from other guenons thanks to the clearly visible white heart-shaped nose, the white whiskers on the sides of the face as well as the long, copper red tail after which the species is aptly named. Females and males are almost identical in appearance, the only noticeable difference being the larger size of the male. Infants have a greyish colour all over their body while the adults are a brownish grey on their backs with a white belly, nose and whiskers. They are primarily an arboreal species and are the most active at sunrise, in the early afternoon and again a short period right before sunset (Buxton, 1952).

2.2 Feeding Habits

The red-tailed guenon is primarily frugivorous (Rode *et al.*, 2006) but has also been observed eating insects (Cords, 1986) as well as leftover food scavenged from trash cans or the ground (Bektić, 2009). Red-tailed monkeys have also been observed raiding cocoa plantations in Uganda (Baranga *et al.*, 2012). According to a study by Bryer *et al.* (2013) red-tails spend approximately 70% of their time feeding, most of which was in polyspecific associations with blue guenons (*Cercopithecus mitis*), red colobus (*Colobus badius*), black and white colobus (*Colobus guereza*), mangabeys (*Cercocebus albigena*) and L'Hoest monkeys (*Cercopithecus lhoesti*).

2.3 Social Organization/system

The red-tailed guenon lives in groups of 20-45 individuals consisting mostly of females with their offspring, juveniles and usually only a single resident male (Struhsaker, 1980; Jones & Cords, 1983; Bush, 1988; Windfelder & Lwanga, 2004). Once a male reaches maturity it will leave the group and live a mostly solitary life (Cords, 1987). Solitary males not belonging to

any particular group are called non-resident males and have been known to form so called "bachelor groups" consisting of a number of males living together males sometimes associate and mate with females during the breeding season. These females usually belong to a harem, meaning that females in oestrus are not always successfully monopolized by the resident male of a group (Cords, 1983; Jones & Bush, 1988). These associations with males from bachelor groups can last several weeks during which multiple copulations by non-resident males may occur. The competition for females can at times be fierce, as can the subsequent fights occurring between males, which often end in serious injuries (Cords, 1983). The red-tails can be territorial in the sense that they defend a specific home range or territory from neighbouring groups, as seen by Cords (1983). However, they have also been known to take a different approach to territoriality by defending discrete food resources as opposed to entire home ranges (Brown, 2013).

The many different relationships that arise from living together in such a social system is maintained mainly through grooming, as is common among a variety of primate species (Lehman *et al.*, 2007). Grooming also removes ectoparasites from the fur and skin of the monkey being groomed, reducing the risk of infections and diseases from ticks and similar parasites (Freeland, 1981). The larger a group is the more time has to be spent grooming in order to maintain social cohesion, meaning time is one of the constraints on group size (Chapman & Chapman, 2000; Lehman *et al.*, 2007; Grove, 2012). Other known constraints on group size are the amount of available food (Chapman & Chapman, 2000) but also the size of a certain part of the brain known as the neocortex, which determines the information-processing abilities of a species (Dunbar, 1992). The theory is that a larger the neocortex allows the monkey to process and keep track of a higher number of individuals and what their social status is, in relation to themselves. Should the group size exceed the maximum viable group size as determined by constraints such as time, food and cognitive abilities, group cohesion decreases and the red-tail group can fission into smaller groups in order to decrease competition for limited resources and thus increase group stability (Windfelder & Lwanga, 2004).

There are many possible reasons for why sociality and group living evolves in a species. The most common is thought to be protection from predators, which in the case of red-tailed guenon would include birds of prey and possibly leopards (Struhsaker & Leakey, 1990; Treves, 1999; Treves, 2002; Bryer *et al.*, 2013). Other possible explanations for sociality include foraging advantages, resource defence (Brown, 2103) and reproduction (Pope, 2000) but most likely it is a combination of multiple factors that led to group living among primates.

Primate social groups do not necessarily need to be monospecific. In fact, there are several examples of polyspecific groups that occur naturally where two or more species of monkeys associate with one another (Cords, 1990; Chapman & Chapman, 1995; Struhsaker, 2010). The same benefits can be found in polyspecific groups as in monospecific groups, such as increased predator avoidance due to a higher aggregate vigilance (Cords, 1990). These polyspecific groups have even resulted in successful hybridizations between different species of *Cercopithicidae* in the wild (Detwiler, 2004; Detwiler *et al.*, 2005).

2.4 Aims of the study

The purpose of this study was to examine social behaviours of the red-tailed guenon to find out if there were any temporal variations in grooming as well as comparing grooming in lactating and non-lactating individuals. The following questions were of special interest:

- Does the frequency of grooming and other social behaviours vary over the course of the day?
- Is there a difference in grooming behaviour between lactating and non-lactating individuals?

In addition to answering these questions, a secondary purpose of the study was to acquire first hand experiences of fieldwork and to evaluate the methods used.

2.5 Hypothesis

I hypothesize that grooming will increase sometime after an early morning feeding bout. My theory is that this early grooming activity will serve as a kind of "greeting period", during which social bonds within the group are re-established after the monkeys having slept all night. I also predict that grooming, as well as other activities, will decrease towards the middle of the day due to the expected increase in temperature. As for the differences between lactating and non-lactating individuals, I predict that the lactating females will be more reclusive and therefore spend less time engaged in grooming behaviour than the non-lactating individuals.

3. Material and Methods

3.1 Study site

The Sabaringo forest in and surrounding Kichwa Tembo Tented Camp is located in Southwest Kenya at the north-eastern edge of the Maasai Mara National Reserve (1°14'57.4"S, 35°00'37.4"E). Kichwa Tembo Tented Camp is made up of approximately 40 tents, a restaurant area, a bar and a swimming pool, all of which are available to guests. In addition to this, there are several managerial buildings, a staff canteen, a football field, living quarters for the staff (approximately 10 houses), garages, a workshop and a laundry. The study area overlapped with the staff living quarters, which meant there were a fair amount of staff members circulating and going about their daily business during the observations.

The entirety of the camp area is surrounded by an electric fence designed to keep larger mammals and predators such as impalas and lions out, while still allowing smaller animals such as warthogs (*Phacochoerus africanus massaicus*) and mongeese (*Mungos mungo*) free passage.

The forest itself consists primarily of deciduous tree species, the most common ones include *Ficus thonningii, Ficus sur, Warburgia ugandensis, Diospyros abyssinica, Euclea divinorum, Teclea nobilis* and *Elaeodendron buchananii*. In addition to these tree species, there are a variety of shrubs and vines. In general, the study area is easily traversable via roads or footpaths with a few exceptions where the understory is too thick or when the nearby Sabaringo River poses an obstacle. The small Sabaringo river runs through the forest and near the staff quarters and is crossable by a number of bridges within the study area as well as on foot on a few locations during the dry season. Even though the flow of the river is decreased during the dry season, water still runs in the river all year round. The heavy rainy season starts in April and ends around June; there is usually also a shorter rainy season around November. Once the rainy season starts, the flow of the river increases significantly and crossing it on

foot without a bridge becomes a dangerous undertaking or even impossible for humans, but of course not for the monkeys.

3.2 Studied animals

The study area is home to at least one group of red-tailed Guenons consisting of roughly 25 - 30 individuals. In this group there are approximately four lactating females with infant offspring, ten non-lactating females and ten juveniles and one resident male. In addition to the red-tailed guenons, the forest is home to a group of blue guenons (*Cercopithecus mitis*), some vervet monkeys (*Chlorocebus tantalus*), tree hyraxes (*Dendrohyrax arboreus*), and a large number of warthogs (*Phacochoerus africanus massasicus*). All of the studied monkeys moved around freely in the trees, on the ground, over rooftops and other manmade structures and they did not seem to be very concerned with the proximity of humans. The monkeys have been living in this forest since before the camp was established and are at least to some extent habituated to humans, which allowed us to get very close to the monkeys and to get a better view of their behaviours.

3.3 Observations

During the days before the observations used for this study, we carried out a small pilot study where we familiarized ourselves with the study area, practiced following and observing the monkeys and tried to learn from the Masai assistants how to identify some of the common tree species. We also tested and subsequently modified our observation sheet which was based on previous studies by Bektić (2009). By following the monkeys during these days we were able to get a rough picture of where they could usually be found in the morning, where some of the commonly utilized feeding trees were located and which routes were used by the monkeys to traverse the study area.

The observations were carried out in pairs using instantaneous sampling of a focal animal with one minute intervals between the 28th of March and the 5th of April. One person, either a masai or a student, was responsible for observing the monkey while their partner kept track of the time and filled out the observation sheet based on what the observer said. The GPS position of the focal animal was recorded by the observer every five minutes using a Garmin Oregon 550t GPS device and noted by the writer. If the focal animal was lost for any reason or went too close to an occupied tent, the observer quickly chose another focal animal. In order to tell the two datasets of each day apart we labelled the observation sheets with "Observation #" one and two depending on which set they belonged to. We also labelled the GPS devices to make sure that the waypoints for each day and observation number were stored in the same device. Other control data included weather, page number, start and end times for each sheet, time of arrival in the morning, as well as the names of who was doing the observing and who was doing the writing. Each behavioural sheet contained 30 lines representing 30 minutes and all control data was written down on each new sheet

Four students and three masai fieldworkers were involved in the data collection which allowed us to have two pairs of observers and writers in the field at any given time, each pair observing one monkey. We split the day into six shifts to allow for some resting periods in between observations and to ensure that the observer is able to stay focused for the duration of the observations. These breaks were usually used to input the data into an Excel spreadsheet. The observations were scheduled at 07:00-08:30, 08:30-11:00, 11:00-13:00, 13:00-15:00, 15:00-17:00 and 17:00-18:30. Start time and end time were chosen based on experiences from the pilot study where we decided that any observations made prior to 06:40 and after 18:30

could not be considered reliable as there was not enough light to accurately distinguish the behaviours of the guenons in addition to them being difficult to differentiate from the blue guenons. In the event of heavy rainfall, observations were too difficult and hence paused until the rains had ended.

Behaviour	**Definition**
Sitting	Rear leaning against something while less weight is put on postal limbs
Standing	Bodyweight distributed on any number of limbs
Lying	Belly, back or side is bearing a considerable part of the body weight
Walking	Moving slowly with surface contact
Running	Moving quickly but not jumping
Jumping	Propelling the body using the legs into and through the air from one surface to another to cause the body to drop or fall down from one surface to another
Foraging	Manipulating a food source using the hands or mouth. Examining nearby (>0,5m) food sources. Includes eating or chewing food
Grooming	Picking the fur, scratching, licking
Playing	The focal animal engages in wrestling, grappling or is lunging at one or more monkeys in absence of apparent aggression or discomfort
Scanning	Head turns sideways ~90^{o} back and forth at least twice
Body contact	The focal animal is in direct body contact with another individual while stationary. No other behaviours are visible
Unknown behaviour	The monkey is visible but its movement/posture/behavior is impossible distinguish

Table 1. Ethogram of behaviours registered at each one minute interval..

Behaviour	Definition
Nursing/Suckling	Baby closes its lips around the nipple of a lactating female.
Mating	Copulation
Antagonistic	Fighting, threatening posture directed towards another individual, biting, wrestling, grappling or lunging at another individual with apparent aggression possibly resulting in an increased distance between the involved individuals.
Begging	Staring at a human carrying something that might be considered edible.
Receiving food	The focal animal is given a piece of food, either directly (a human hands the food to the focal animal) or indirectly (a human throws/leaves food near the focal animal).

Table 2. Ethogram of continuosly registered behaviours.

The ethograms (Tables 1 & 2) show the definitions of the different registered behaviours. Antagonistic behaviours and nursing were not included in the analysis as they were irrelevant to the purposes of the present study. Sitting, standing, lying and scanning were all combined into a "Stationary" category and walking, running and jumping were combined into a "Moving" category for the analysis. All behaviours in the ethogram are mutually exclusive and only one behaviour was registered at each sampling, with the exception of rare behaviours which were registered continuously. The data was managed and rearranged in Microsoft Excel and subsequently pooled and analysed in Minitab 17 Statistical Software. For descriptive data, all observation of the entire study were summarized and then the percentage of observations were calculated. For statistical analysis, each day per monkey type (lactating vs non-lactating) was first pooled to one value per day and monkey type. Then the data was tested for normality distribution and, since normally distributed, analysed with ANOVA GLM.

4. Results

4.1 Temporal variations

These results presented are based on descriptive data. Considering the temporal variations in behaviour, grooming occurred throughout the day but showed a slight peak at around 09:00-09:59 after which a steady decrease in grooming was observed for the remainder of the day (Fig. 1). Around the same time, there was also a slight increase in the category of behaviours known as "Other" which includes playing and body contact as well as any behaviour that could not be categorized in any of the predefined behaviours of the ethogram. Foraging took up 38.5% of time in the early mornings (07:00-07:59). In addition to this, monkeys spent 40,2% of observations at this time stationary without performing any other behaviours and 15,2% with moving. This left little time for grooming at this time, but as foraging decreased from 07:00 to 13:00 grooming increased slightly. In total, grooming was seen in 9,6% of observations.

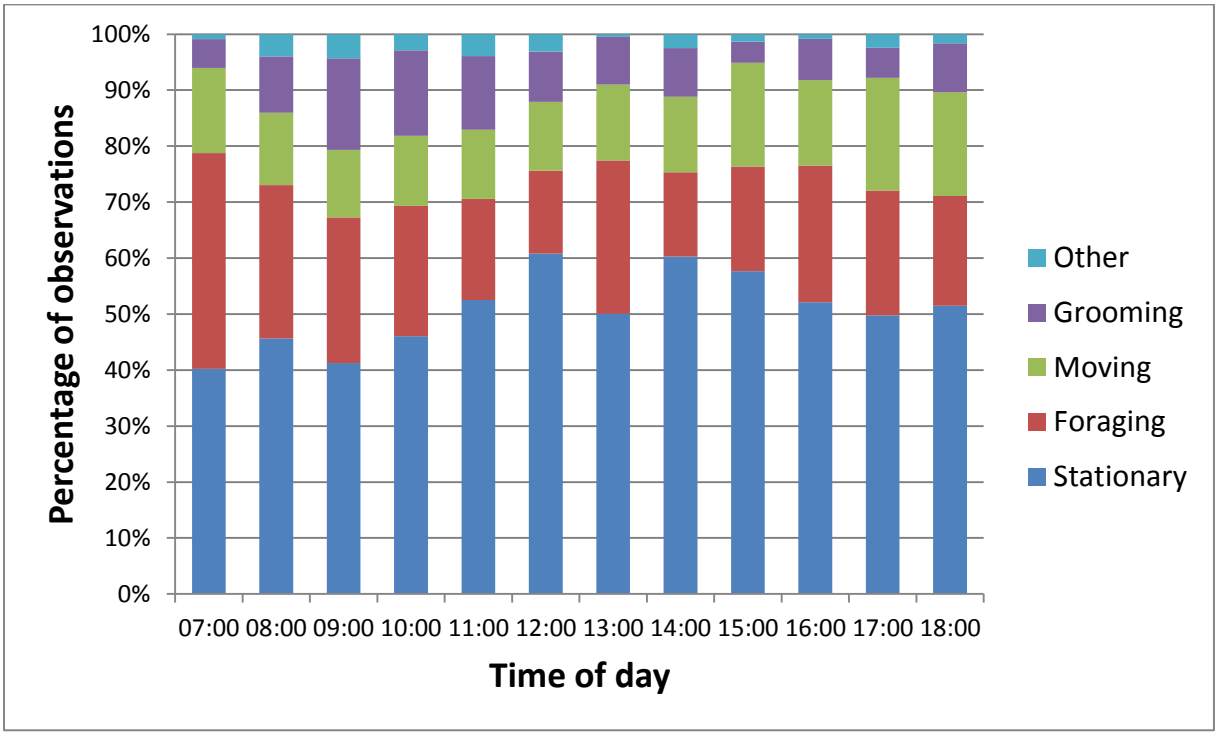

Figure 1. Percentage of observations for different behaviours and postures over the course of eleven hours.

4.2 Lactating vs Non-lactating females

Lactating females spent almost twice as much time grooming compared to non-lactating individuals, the largest difference seen in any behaviour (Fig. 2) ($F = 21,42$ $P = 0,004$ ANOVA GLM). Another difference is that non-lactating individuals were more mobile and moved in 15% of observations whereas lactating females were moving in 12% of observations. Both lactating and non-lactating monkeys spent approximately 50% of observations stationary, either lying down, sitting, standing or scanning in any of these postures, with no statistical differences found between lactating and non-lactating females.

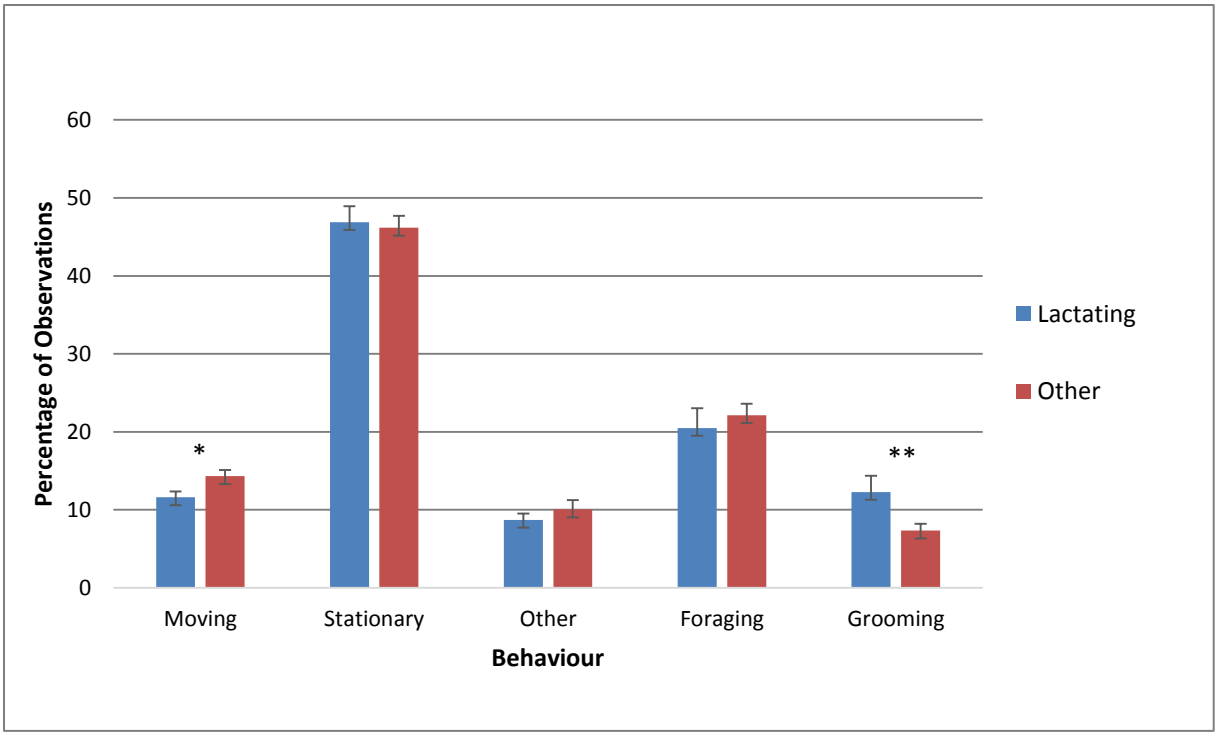

Figure 2. Percentage of observations for different behaviours split into lactating and non-lactating .

Figures 3 and 4 show descriptive data how lactating females differ from non-lactating females and other individuals in their behaviour throughout the day. Lactating females show an increase in grooming at 14:00-14:59 which is not present in the non-lactating individuals who were more stationary at this time. The behavioural pattern for the lactating females also fluctuates more during the day, with greater differences in the occurrence of different behaviours from hour to hour.

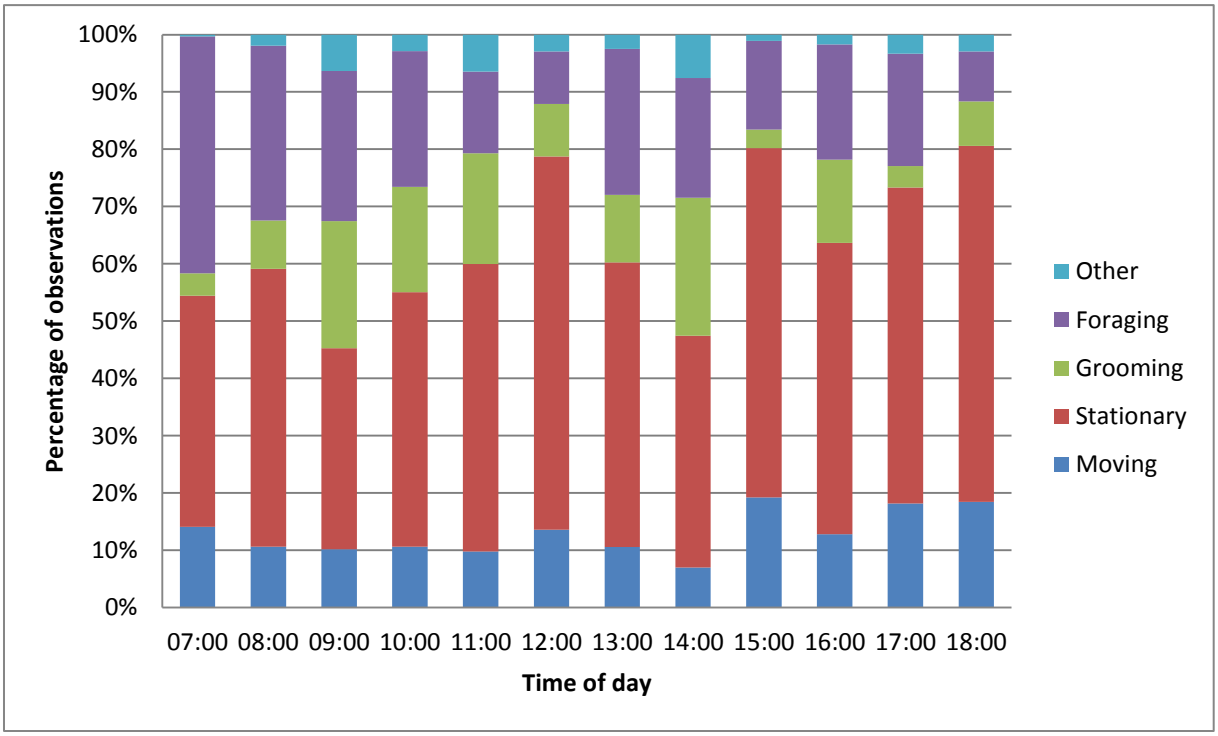

Figure 3. Percentage of observations for different behaviours and postures of lactating females over the course of eleven hours.

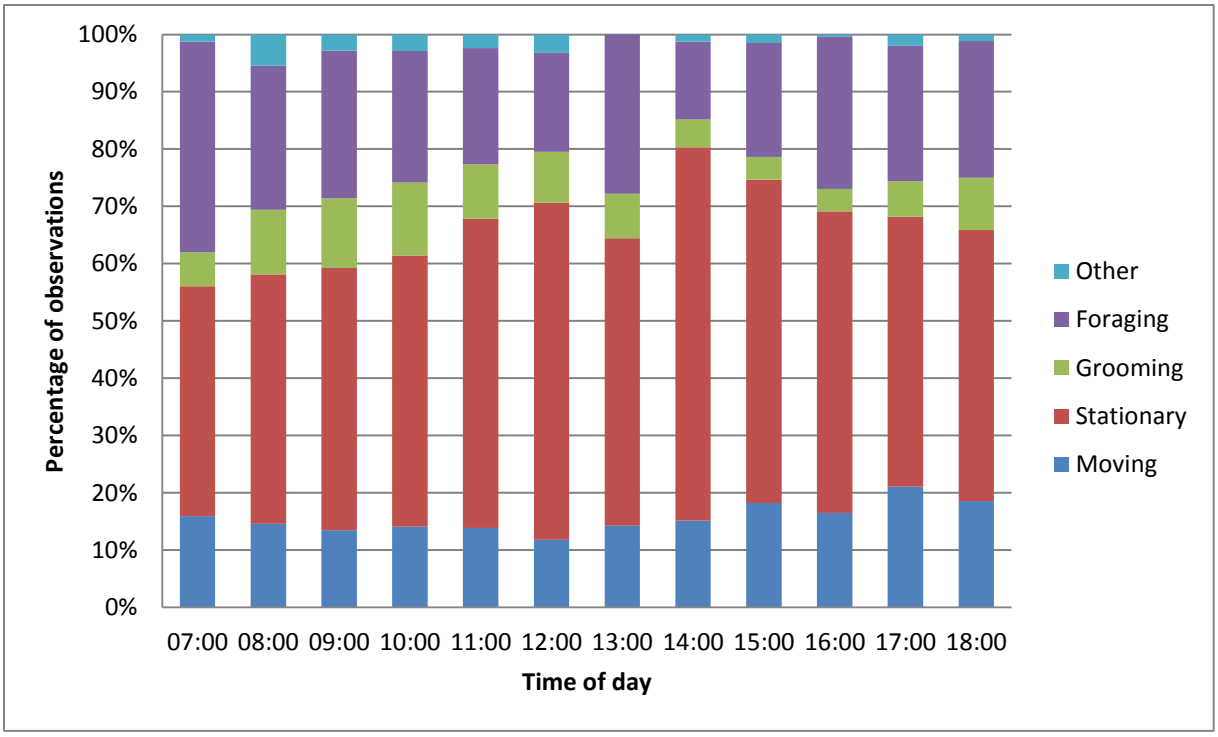

Figure 4. Percentage of observations for different behaviours and postures of non-lactating individuals over the course of eleven hours.

5. Discussion

5.1 Temporal variations

My results indicate that grooming is a behaviour performed throughout all of the active hours of the red-tails, albeit in decreasing frequency from 09:00 and onwards, confirming my hypothesis that there would be a peak of grooming activity after the initial feeding bout at the beginning of observations. No clear, discrete grooming periods could be identified. It is interesting that behaviours such as playing and body contact, which are categorized in the present study as "Other", also increased as the occurrence of grooming peaked. Playing is considered a social behaviour (Worch, 2012) and as such, I do not find it surprising that play behaviour would increase when grooming increased as the solicitation of play might be easier in an already social environment.

As for body contact, the connection with grooming is maybe a bit easier to explain. Grooming requires the monkeys to be in very close proximity to one another, making observations of body contact (without grooming) more likely. The underlying reason for the peak in grooming at 09:00 is unknown, however, but it would seem as though time spent foraging up until that point is instead reallocated for grooming as there is a slight decrease in foraging and stationary behaviours at 09:00 (Fig 1). The brain is a very energy demanding organ (Aiello & Wheeler, 1995) and therefore it may be that the combination of potentially well fed monkeys and a relatively low temperature in the morning makes the cerebral activity of grooming more likely.

A study by (Buxton, 1952) found that the activity of the red-tails in Zika Forest, Uganda peaked at sunrise (06:00) and sunset (18:00) with two additional activity peaks at 08:00 and 15:30, respectively. The observations by Buxton (1952) are not as detailed as in the present study, however, and only postures, feeding and movements were recorded from stationary

observation posts. Observing only from stationary observation posts means that there is a risk the data will be skewed as there might be spatiotemporal differences in certain behaviours that are not observable using this method. If, for example, the study subjects only forage at certain times, and their feeding area of choice is near the observation posts, most observations will probably be of foraging monkeys which means that many behaviours are left unaccounted for. Furthermore, Buxton (1952) did not record data on grooming which makes comparisons with the present study difficult.

According to Bryer *et al.* (2013), red-tails spend 90-95% of their time feeding, traveling or resting, which leaves only 5-10% of their time available for other behaviours. One would assume that "Other behaviours" includes behaviours such as grooming and play, but seeing as they are merged into one category it is impossible to know the prevalence of each individual behaviour which, again, makes comparisons with the present study difficult. The 5-10% of "Other behaviours" reported by Bryer *et al.* (2013) could therefore be relatively consistent with the present study in which red-tails spent 9,6% of observations grooming, but there is no way ascertain this. To me it seems more likely that the results of the present study indicate a higher occurrence of grooming than found by Bryer *et al.* (2013). I am able to draw this conclusion as the present results show that all of 9,6% of observations were of grooming, whereas the 5-10% of "Other behaviours" reported by Bryer *et al.* (2013) may in fact contain a lot of different behaviours other than grooming. The reason for this difference is difficult to explain, but one theory is that the anti-predator fence around Kichwa Tembo has successfully decreased the predation pressure on the red-tails, thus decreasing the need for vigilance in the red-tails. If less time is spent on vigilance and anti-predatory behaviours, more time is left for other behaviours such as grooming.

As the day went on, there was a slight increase in movement in the afternoon which can probably be explained by the fact that the monkeys at this time started to move away from the center of the study area to sleep in more secluded areas. By the end of observations, the red-tails had usually either settled down high up in the canopies of the trees in one of two geographically distinct areas. It is my assumption that this is where the monkeys slept, but as darkness fell observing them further became nighimpossible. This means that there is a possibility that the red-tails kept moving to some unknown location, or even started grooming again, before settling down for the night. One would need special equipment in order to observe the red-tails after dark, something that was not an option in the present study.

5.2 Lactating vs non-lactating

The present study found that lactating females spent slightly more time engaged in grooming behaviours than did non-lactating individuals. These results differ somewhat from Dias *et al.* (2011) who studied black howler monkeys (*Alouatta pigra*) and found that the time budget of lactating females differs from non-lactating individuals in that they spent significantly less time socializing. Dias *et al.* (2011) also found the sociality of lactating females to decrease during the last third of the lactation period. Since our data only covered nine days and we had no way of telling how long any given female had been lactating, we could not make a similar comparison in the present study. In order to get a better understanding of the grooming behaviours in red-tailed guenons, these variations need to be studied and expanded upon. To me it is not unexpected that lactating females should have a different time budget, however, seeing as they have an infant to care for which can be quite energetically demanding as well as time consuming (Lee, 1996), even if my own hypothesis predicted this difference to be in the opposite direction of the actual results of the present study. If one considers the high energy demand of lactation in combination with the high energy requirements of the brain as discussed earlier (Aiello & Wheeler, 1995), it would seem as though grooming is a behaviour

that is very highly prioritized by lactating red-tail guenon females as they spend significantly more time grooming in spite of these costs. However, even though the sample size consists of approximately 3,000 observations, these are gathered from only four lactating females. Therefore, caution is to be observed before drawing conclusions about differences between lactating and non-lactating guenons.

The bond between mother and offspring is very strong and according to Broad *et al.* (2006) the social interactions of lactating females are almost exclusively directed towards the infant which might explain why lactating females were seen grooming more often than non-lactating monkeys in the present study. However, the present study did not include the recorded data on the participants of each grooming bout in the results, something that would have been useful to determine whether or not the difference in grooming is due to the mother grooming her infant or not. Seeing as the infant is almost always close by or even attached to the belly of the mother, a lactating female is able to groom her infant for most of the day, should she so desire. Non-lactating red-tails will most probably be further apart from one another than a mother and her offspring and, as such, will need to seek out or happen upon a groomee in order to engage in grooming.

Palombit *et al.* (1997) studied female baboons and found that many females would form strong relationships with certain males by way of grooming and general association. The reason for this is thought to be protection for their infant and themselves from other, potentially infanticidal males. In the present study, only one adult male could be identified within the group. However, it was not always possible to tell a male red-tail from a female red-tail due to their very similar appearances. It is possible that the lactating females in the present study spent more time grooming for the same reasons as the baboons in the study by Palombit *et al.* (1997) and that the grooming is directed towards the resident male of the red-tail group. It may also be that the higher occurrence of grooming is due to a combination of the lactating females grooming both their infant for bonding purposes and the resident male for protection.

5.3 On the function of grooming

The main function of grooming is assumed to be maintenance of social relationships within the group (Lehman *et al.*, 2007) but it is also important to consider another aspect of grooming, namely hygiene and health (Freeland, 1981). This fact might influence our interpretations of the importance of grooming for sociality. In their study, Freeland (1981) examines the ectoparasite pressure on blue monkeys (*Cercopithecus mitis*), red colobus (*Colobus badius*) and mangabeys (*Cercocebus albigena*) and the role that grooming plays in keeping the fur of fellow group members clean from such parasites. It should come as no surprise that more mobile individuals were exposed to a higher risk of being attacked by ticks and similar ectoparasites, which means that these monkeys will require more grooming in order to stave off this threat.

Had the present study been more focused on detailing and describing the individual relationships, this fact would have been important to consider as it raises interesting questions about the purposes of grooming. Taking the hygienic aspect of grooming into consideration, it is important to be cautious when drawing conclusions about the purpose and goal of observed grooming bouts. It may very well be that there are subtle differences in grooming for social reasons and grooming only for ectoparasites which we have yet to discover. If the performance of grooming was based purely on social relationships and needs, this would imply that individuals who spend more time maintaining their relationships with other group members would have a better hygiene and therefore a higher fitness. I think it’s safe to

assume that most grooming happens as the result of hygienic and/or social needs and that it cannot be explained by any single behavioural or physiological need. Time spent grooming should therefore not be used as a definitive measure of sociality in primates in my opinion. In addition to the possibly ambivalent nature of grooming, there are other cues that play an important role in the social lives of primates, such as gazes, facial expressions (Burrows, 2008) and perhaps even more subtle signals which we are yet to discover.

For a more in depth look at the significance of grooming for group cohesion, it would have been interesting to be able to tell different individuals apart and, in doing so, get a clearer picture of the different types of relationships within the group. As it stands, there may have been different subgroups within the main group of red-tails which, due to the inability to identify individual monkeys, remains undiscovered.

5.4 Interspecific sociality

A brief report by Gathua (2000) mentions a few occurrences of interspecific grooming between the red-tailed and blue guenon which the author observed during another, larger study. In total Gathua (2000) recorded only three occurrences of grooming and four instances where grooming was solicited but did not occur over the course of 18 months and as such should only be taken as anecdotal evidence of interspecific grooming. In the present study, only one such occurrence was observed and noted for its rarity throughout all observations, albeit in a much shorter time span than Gathua (2000). Interspecific sociality such as this is interesting in that its purpose is not immediately apparent. It has been argued that interspecific associations happen because of common food sources or anti-predatory benefits (Struhsaker, 2010) but this does not fully explain why individuals of different species would groom one another. Based on the scarcity of evidence of interspecific grooming it seems unlikely that it is a crucial part of polyspecific associations and the cohesion of such groups. To me it seems more likely that grooming between species occurs as a kind of exploratory behaviour towards the other species. Further research is needed regarding the interspecific sociality of these species in order to ascertain the reasons for such observations.

5.5 Evaluating the study methods

Seeing as the study site is a camp with tourists, this posed some limitations with regards to our observations, as management had requested we kept our distance from occupied tents. This meant that focal animals could not be followed in certain areas, resulting in gaps in our data that could have been avoided had we had full access to the entirety of the study area at all times. Another noticeable source of data gaps was the heavy rainfalls which started around the time of observations and forced us to seek shelter and interrupt a number of observation sessions.

Furthermore, the preparations for the observations could have been more thorough as there was still some confusion about the methods even after the study had begun, which meant a lot of the data had to be double checked afterwards. A study like this requires that all participants, be they students or assistants, are well familiarized with the methods beforehand so as to avoid unnecessary confusion.

On occasion, the two teams of observers would accidentally observe the same focal animal for some time, most likely due to lack of communication, resulting in some behavioural data being registered twice. When such a mistake was noticed, one of the teams quickly switched their focal animal but the identical data was not discarded which means that there are some unaddressed errors in the used dataset. To avoid this, the two teams could have been assigned

to only one type of monkey (lactating / non-lactating), but seeing as there were only four or five lactating females in the group of monkeys this was not really feasible.

5.6 Directions for further research

To expand on the findings in the present study, researching the possible subtle differences in grooming would be quite interesting. Does the grooming of different parts of the body bear any significance for the relationship between the groomer and the groomee? Does facial expressions and posture play a role in grooming? What is the dynamic of giving and receiving grooming in different species? How much of grooming is for hygienic reasons and how much is for social reasons? These are just some of the questions that would be interesting to examine in order to get an even deeper understanding of primate sociality, where grooming evidently plays a big part. I would also like to see more studies on the details on interspecific social interactions and the mechanics behind them.

Seeing as primate sociality is such a wide area, there are many different aspects besides grooming that would be interesting to explore further. One such aspect is the phenomenon that could be described as primate culture and how different populations show different behaviours in similar habitats. A prime example of this would be the Japanese macaques (*Macaca fuscata*) who bathe in hot springs as way of thermoregulating themselves in the cold environments of Jigokudani in central Japan (Hori *et al.*, 1977; Zhang *et al.*, 2007). This behaviour of sitting in hot springs was more common in dominant females and their offspring than in subordinate individuals and is thought to be passed on, as it were, to younger generations of macaques as they stay with the group. Immigrant males did not bathe in hot springs, indicating that it is indeed a learned behaviour found only in certain populations (Zhang *et al.*, 2007). The mechanisms behind the transfer or teaching and learning of such habitual behaviours between individuals are still unclear and as such provide a great opportunity for future research in a very interesting and different area of primate sociality.

6. Summary

In the present study, I have examined the grooming behaviours of the red-tailed guenon (*Cercopithecus ascanius*). Grooming is a behaviour that is performed in order to keep the fur of fellow monkeys clean from parasites, but it also serves as a way to maintain social relationships within a group. This is important if the group is to stick together and function as a unit, which has a lot of benefits. One example of such a benefit is the increased protection from predators. The way this works is that a larger group will have more vigilant monkeys that can spot predators from afar, and subsequently warn fellow red-tails about this threat. It is also a statistical effect, since a large group means a smaller risk for each individual to be caught by a predator.

I wanted to find out when the red-tails groomed one another and whether or not lactating females differed in their grooming behaviour from non-lactating individuals. My fellow students, our assistants and I did this by observing the behaviours of a single individual red-tail at a time, noting what it was doing once a minute for approximately twelve hours a day for nine days. I then analysed the collected data in order to see if there were any correlations between grooming, time of day and monkey type (lactating or non-lactating).

The results of the study showed a peak in grooming behaviour at around 09:00 after which its occurrence steadily decreases for the remainder of the day. As for the lactating females, they were found to spend 5% more time grooming than did other red-tails. These results are discussed and different theories as to why these differences in grooming behaviour exist are presented.

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