

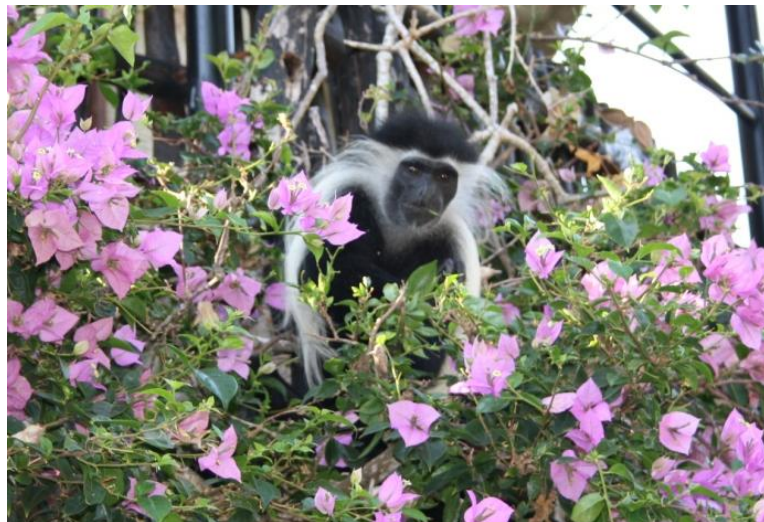


Behaviours of wild male and female *Colobus angolensis palliatus* during morning and afternoon in Diani Beach, Kenya

Beteenden hos vilda Colobus angolensis palliatus hanar och honor, mellan morgon och eftermiddag i Diani Beach, Kenya

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I denna serie publiceras olika typer av studentarbeten, bl.a. examensarbeten, vanligtvis omfattande 7,5-30 hp. Studentarbeten ingår som en obligatorisk del i olika program och syftar till att under handledning ge den studerande träning i att självständigt och på ett vetenskapligt sätt lösa en uppgift. Arbetenas innehåll, resultat och slutsatser bör således bedömas mot denna bakgrund.

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ABSTRACT

Colobus angolensis palliatus is a small old world monkey inhabiting southern coastal Kenya to southern Tanzania. The species activity budget is known to vary between seasons and areas, probably due to differences in group sizes, diets, predatory presence and resource competition. The variations between male and female activity budgets are reckoned to be a result of pregnancy and lactation. The aim of this study was to investigate potential differences in behaviours between morning and afternoon periods and between males and females. The study was carried out in two forest fragments in Diani Beach on the south coast of Kenya. A total of four groups of *C. a. palliatus* were observed during an eight day survey, divided into morning and afternoon observation periods. The method used during the recordings was focal sampling with instantaneous recording. The results indicate differences in proportions of observations spent on behaviours between morning and afternoon periods. The variations in the behaviours feeding (27.0 vs 48.6 %; $P < 0.001$), resting (59.1 vs 39.7 %; $P < 0.001$) and auto grooming (3.8 vs 2.5 %; $P = 0.018$) may be due to ambient temperature, predatory avoidance, competition over resources or season and area. There were no differences in social behaviours and moving between morning and afternoon. There were no differences in the proportion of observations spent on feeding, resting, auto grooming, moving and other behaviours between males and females. However, females spent more time with social behaviours compared to males (2.0 vs 0.4 %; $P = 0.009$), probably due to more allo grooming among females.

SAMMANFATTNING

Colobus angolensis palliatus är en liten apa tillhörande parvordningen gamla världens apor. Underartens område sträcker sig från Kenyas södra kust till södra Tanzania. Deras aktivitetsbudget varierar mellan olika säsonger och områden och denna variation tros bero på skillnader i gruppstorlekar, kost, predationstryck och konkurrens över resurser. Variationer mellan hanars och honorers aktivitetsbudgetar tros vara resultat från dräktighet och digivning. Syftet med denna studie var att undersöka eventuella skillnader i beteenden mellan morgon och eftermiddag samt mellan hanar och honor. Studien genomfördes i två skogsfragment i Diani Beach på Kenyas södra kust. Sammanlagt observerades fyra grupper av *C.a. palliatus* under en åtta dagars period, uppdelat i ett pass på morgonen och ett pass på eftermiddagen. Metoden som användes under studien var fokaldjursobservation med momentan registrering. Resultaten visar på beteendeskilnader mellan morgon och eftermiddag. Variation hittades hos beteendena födosök (27,0 mot 48,6 %; $P < 0,001$), vila (59,1 mot 39,7 %; $P < 0,001$) och putsning (3,8 mot 2,5 %; $P = 0,018$). Dessa skillnader kan bero på temperatur, predationstryck, konkurrens över resurser eller årstid och område. Inga skillnader mellan morgon och eftermiddag hos socialt beteende och förflyttning påträffades. Det hittades inga skillnader mellan hanar och honor i beteendena födosök, vila, putsning, förflyttning och övriga beteenden. Dessa resultat kan vara effekter av gruppstorlek och säsong. Honor spenderade mer tid på sociala beteenden jämfört med hanar (2,0 mot 0,4 %; $P = 0,009$), detta beror troligen på att social putsning är vanligare hos honor än hos hanar.

1. INTRODUCTION

1.1. The Colobus monkey

1.1.1. General description

The genus *Colobus* is an old world monkey inhabiting parts of west, central and east Africa. The subspecies *Colobus angolensis palliatus* Peters 1868, is one of six to eight subspecies of the specie *Colobus angolensis*, and this small colobine inhabits southern coastal Kenya to southern Tanzania (McDonald & Hamilton, 2010). *C. a. palliatus*, like other black and white colobines, has black fur with a white brow band, cheeks and throat. The shoulders of the *C. a. palliatus* are long haired with white epaulettes and the tail end has short white hair (Groves, 2007). The sexual dimorphism is very small and it is therefore difficult to recognize individuals (Teichroeb et al., 2005). The male is somewhat bigger in size and weigh in average 12 kg compared to the females 7.5 kg (Kanga & Heidi, 1999/2000). The most characteristic differences between the sexes are the white hair on the hindquarters, *C. a. palliatus* males have a white band whilst females have white patches (Groves, 2007).

A group of *C. a. palliatus* normally contains typically about 6 individuals but the group sizes can differ between everything from 1 to 13 individuals (Kanga & Heidi, 1999/2000; Anderson et al., 2007b). The groups can be both uni- and multi male (Harris 2005); often a group consists of adults, sub-adults and juveniles of both sexes (Kanga and Heidi, 1999/2000; Fashing et al., 2007).

1.1.2. Activity Budget

The activity budget of behaviours such as feeding, moving and resting in black and white colobines can vary to a large extend between different subspecies (Dasilva, 1994; Fashing, 2001b; Teichroeb et al., 2003). This variation may take place because of differences in group sizes, habitats and diets. There is also evidence of competition over resources between different troops of colobines and between colobines and other monkey species in the same area. The competition over resources may force the colobines to adjust their time budget and their circadian rhythm (Teichroeb et al., 2003). As in other social diurnal monkeys, *C. a. palliatus* must also balance their activities according to climate (Korstjens et al., 2010) and to the presence of predators (Stanford, 2001). This means that the time budget is as likely to be influenced by temperature as well as dietary considerations (Korstjens et al., 2010). Since colobines are known to forage in habitats were they have been hunted in the near past they are believed to adapt their behaviours according to their predators behaviours (Stanford, 2001). In addition to differences between groups there are also intergroup variations in activity budgets in colobines. The largest variations in male and female behaviours are the amount of time spent on feeding. This variation is believed to mainly be due to different nutritional needs as a result of pregnancy and lactation (Dasilva, 1992; Teichroeb et al., 2003).

Normally colobus monkeys have short feeding bouts in the morning between 06:00-09:00 h and later in the afternoon between 16:00-17:00 h (Lowe & Sturrock, 1998; Teichroeb et al., 2003; A. Donaldson, personal communication, March 23, 2011). Resting behaviour takes place throughout the day (Teichroeb et al., 2003) and especially during mid day when the temperature is high (A. Donaldson, personal communication, March 23, 2011). Black and white colobines tend to spend a higher percentage of their time on resting than on feeding and this pattern is shown throughout the year (Teichroeb et al., 2003). Although colobines

do spend much of their time resting independent of the seasonal changes, the food availability and physical condition forces the monkeys to regulate their activity budget. When the high-quality food decreases the colobines lower their activity level and therefore spend even more of their time resting (Ding & Zhao, 2004).

The social behaviour of the colobus monkey is not frequently shown and occurs at a low level all through the day (Teichroeb et al., 2003). On average, black and white colobus monkeys spend somewhere between 2-10% of their time budget on social behaviours (e.g. Fashing, 2001; Teichroeb et al., 2003; Fashing et al., 2007).

1.1.3. Foraging behaviour

Colobine monkeys are extremely arboreal and regarded as a specialist folivore (Dasilva, 1992; Daegling & McGraw, 2001; Anderson et al., 2007b). Hence, they are very dependent on the forest it inhabits (Anderson et al., 2007c). Depending on where the colobines live, they are sympatric throughout their habitats (Daegling & McGraw, 2001) and feed from several tree species (Anderson et al., 2007b). The diets of the colobines can vary between different areas (Daegling & McGraw, 2001) and different seasons (Saj & Sicotte, 2007) and as a result of this the food consists of different amounts of fruits, seeds and leaves (Daegling & McGraw, 2001). The diet is known to diverge related to the abundance of preferred food items and when food of higher quality, such as fruits and seeds, is absent the diet contains more leaves (Saj & Sicotte, 2007). The colobine stomach is somewhat familiar to that of ruminants in the fact that food is digested by micro-organisms in the fore-gut (Dasilva, 1992) and this gives the colobines capability to digest low quality forage like mature leaves (Fimbel et al., 2001).

1.1.4. Threats and conservation status

The IUCN red list (IUCN, 2010) has estimated *C. a. palliatus* as *least concern*, but according to Anderson et al. (2007b) the colobus monkey is predominantly vulnerable to threats and may go extinct because of deforestation. Their habitat becomes gradually more fragmented by resort, roads and commercial development. Roads divide the monkeys' home-ranges (Kanga & Heidi, 1999/2000). To move through their habitat the monkeys frequently have to cross the roads and this might lead to injuries and death by cars (A. Donaldson, personal communication, March 23, 2011). An additional threat to the colobus monkeys existence is hunting. However, hunting is not a major threat in Diani (Kanga & Heidi, 1999/2000). Natural threats to the colobus, such as predators, are known to be lion (*Panthera leo*), leopard (*Panthera pardus*), chimpanzee (*Pan troglodytes*) and crowned eagle (*Stephanoaetus coronatus*) (Macintosh & Sicotte, 2009).

1.2. Aims of the study

The principal aim is to investigate if the methods used during this study are applicable when observing *C. a. palliatus* and therefore can be used in further studies in this area. The knowledge about these monkeys's behaviour can later on be applied in the conservation of their habitat. Additional to this overall aim, the aim is also to investigate if there are any differences in the proportion of different behaviours between morning and afternoon. The aim is also to study if there are any variations in proportion of different behaviours between males and females.

2. MATERIAL AND METHOD

2.1. Study site

2.1.1. The Kwale District

The coastal District of Kwale in Kenya is under an ongoing modification and the forests at Diani beach is no exception (Anderson et al, 2007b). The Kwale District is an 8322 km² large area consisting of agricultural land, woodland, grassland, swamp, shrub land, mangrove forests, dry forests, and forestry plantation. The habitat is fragmented into 124 forest fragments (255 km²) (Anderson et al., 2007a), and Brooks et al. (2002) describe the district as a biodiversity hotspot. Due to habitat destruction, Brooks et al. (2002) listed the region as one of 11 priority regions for international conservation investment. The Diani forest contains the second largest *C. a. palliatus* population in Kenya and the total number of individuals observed in this region is 332 individuals divided into 50 groups (Anderson et al., 2007a). The forest at Diani Beach is 4.5 km² (Anderson et al., 2007a; c) and under constant threats, such as illegal logging, charcoal production, firewood collection, hunting, and encroachment from mining, development, and agriculture (Anderson et al., 2007a). The majority of the forest patches in Diani inhabited by *C. a. palliatus* is privately owned and therefore unprotected (Kanga & Heidi, 1999/2000; McDonald & Hamilton, 2010) with the exception Shimba Hills National Reserve (Kanga & Heidi, 1999/2000). During the last 20 years over 75% of the forest cover in Diani Beach has been degraded (Kanga & Heidi, 1999/2000; A. Donaldson, personal communication, March 23, 2011).

2.1.2. Diani Beach

The study was carried out in two forest fragments in Diani Beach (4° 18' 00" S and 39° 35' 00" E) on the south coast of Kenya, approximately 30 km south of Mombasa. The Baobab forest is fragmented into two sites on each side of a main road. The two sites are divided by a road but still considered as one forest since the monkey troops in the forest frequently cross the road to the other side. The Baobab 1 forest (BBF1) is a pristine forest positioned on the coast side of the road, stretching all the way down to the shore. The forest contains many exotic and native trees of various heights. Some parts of this forest are highly affected by humans because of a hotel positioned close to the beach and also because of eco tours in the forest. The Baobab 2 (BBF2) forest is also a pristine forest situated inland on the other side of the road, opposite to BBF1. The BBF2 site has minor human impact, such as housing and the forest contains tall trees of native origin. The Colobus Trust forest (CTF) is a degraded forest stretching from the main road all the way down to the beach. The forest is under great amount of human pressure such as housing, hotels and smaller roads. The forest contains both exotic and native trees and plants of various heights.

2.2. Study subjects

The study subjects were four groups of *C. a. palliatus* monkeys inhabiting the two described forest fragments in Diani Beach, Kenya. The two troops observed in CTF are in this study called CT1 and CT2. CT1 consisted of 9 individuals - 2 males, 4 females, 1 sub-adult and 2 juveniles. The CT1 troop was highly habituated to humans as their home range was just around the Colobus Trust facilities. The troop had also earlier experiences as study subject for behavioural studies (A. Donaldson, personal communication, March 23, 2011). The CT2 group consisted of 9 individuals - 3 males, 4 females, 1 sub-adult and 1 juvenile. CT2 was also habituated to humans since their home range were around hotels and other human activities.

In BBF1 we observed one group of colobines, hereafter referred as BB1. The group consisted of 5 individuals – 1 male, 2 females 1 sub-adult and 1 juvenile. BB1’s home range was spread around a hotel and the monkeys were therefore highly habituated to humans. In BBF2 we studied one group, called BB2, consisting of 8 individuals - 1 male, 5 females, 1 sub-adult and 1 juvenile. The human activity in BBF2 was limited and the group BB2 was therefore not as habituated to humans as the other troops in this study.

2.3. Data collection

The data was collected between the 25th- 29th and 31st of March and between the 1st and the 2nd of April 2011. The observation days were divided into two periods, one in the morning and one in the afternoon. The morning period started 06:20 and ended 09:00 whereas the afternoon period began 16:00 and ended 18:00. The method used during the recordings was focal sampling with instantaneous recording divided into 20 minutes sessions. Each session consisted of a 15 minutes observation bout followed by a 5 minutes break. During these 15 minutes, recordings were carried out at one minute intervals, using a stopwatch (Q & Q). There were two focal animals selected randomly among the visible members and they both were changed after each 15 minutes observation session. Depending on the visibility of the group members, the same individual could be chosen twice or more in a row. Only one behaviour at a time was registered and in case the colobines performed several behaviours simultaneously, only the main purpose was registered. During the study the age of the monkey was recorded and the individuals were divided into one of the three categories; adult, sub-adult or juvenile. The classification of the monkey’s ages was determined by their size. Alongside with the age, the sex was recorded for the adult individuals. In the beginning and end of every 15 minutes observation session, the position of the monkey troop was marked using a GPS (Garmin Oregon 550t). The recordings were conducted by three Swedish bachelor’s students, one Irish master’s student and two Kenyan field workers, divided into two teams. Each team consisted of two students and one field worker and the members of each team were not fixed and changed from day to day. Every student observed one of the four troops of monkeys two times each and every troop was observed during four days (table 1). The two teams observed different troops at different sites and one troop was never observed two days in a row. In this study we collected a total of 103 hours and 8 minutes of data.

Table 1. Observation schedule including date, observer and troop.

Date	Julia	Camilla	Robert	Maria
Friday 25/3	CT1	CT1	BB1	BB1
Saturday 26/3	CT2	BB2	BB2	CT2
Sunday 27/3	BB1	BB1	CT1	CT1
Monday 28/3	BB2	CT2	CT2	BB2
Tuesday 29/3	CT1	BB1	CT1	BB1
Thursday 31/3	CT2	CT2	BB2	BB2
Friday 1/4	BB1	CT1	BB1	CT1
Saturday 2/4	BB2	BB2	CT2	CT2

The ethogram used in this study included 14 behaviours, five positions and eight different food items (table 2). Together with the behavioral observations the tree species the monkeys were positioned in and eating from was registered.

Table 2. Ethogram including behaviour, position of the monkey and food item.

	Behaviour	Definition
Basal behaviours	Feeding	Placing of leaves, flowers, fruits etc., into the mouth, also chewing. The search for food using visual scanning in combination with grasping or searching with arms.
	Resting	Lying or sitting when not doing other activities. This includes vigilance.
	Auto grooming	Individual picking through its own fur, including scratching.
	Moving	An individual using its limbs to move from one point to another.
	Drinking	Water ingestion.
Social behaviours	Positive social interaction	Physical interaction with one or more individuals of the same species with no distress or moving away. Includes copulation.
	Negative social interaction	Physical interaction with one or more individuals of the same species. One or more individuals show alarmed or distressed behaviour by the contact.
	Allo grooming	Picking through the fur of another individual.
	Clinging	Infant or juvenile clinging to another individual.
	Playing	One individual is playchasing or being chased by another individual. Also includes two or more individuals wrestling.
	Interspecific interaction	Interaction with another monkey species.
	Calling	When one or more individuals vocalize
Miscellaneous	Other	Behaviours not defined in the ethogram.
	Out of sight	Lost monkey or behaviour not clear.
	Data deficient	Troop not located.

	Position of the monkey	Definition
	Top canopy	10 meters and above.
	Mid canopy	Between 5- and 10 meters.
	Low canopy	5 meters and below.
	Manmade structure	E.g. walls, roofs, bridges etc.
	Ground	Ground.
	Food item	Definition
	Flower	Flowers, including flower buds.
	Fruit	Fruits.
	Seed	Seeds.
	Fossil coral	Fossil coral.
	Mature leaves	Mature leaves.
	Young leaves	Young leaves, including leaf buds.
	Unidentified leaves	Unidentified leaves.
	Other	E.g. bark, soil, lichen, insects etc., or unidentified food item.

2.3.1. Data analysis

We collected data from 30 observation periods, 14 mornings and 16 evenings. At two scheduled mornings the monkey troops were not located. The collected data were pooled by observation periods in Microsoft Office Excel 2007. We calculated the percentages of different variables by each observation period and the data were tested for normal distribution of residuals (Anderson - Darling test). The mean \pm standard error of mean (SEM) was calculated in Minitab 15. The P-value, F-value and degrees of freedoms were retrieved by ANOVA GLM (General Linear Model). The level of statistical significance was $P < 0.05$.

The behaviours positive social interaction, negative social interaction, allogrooming, playing, clinging, interspecific interaction and calling were summarized to “social” due to low occurrence. For the same reasons the behaviours out of sight and drinking were included in the behaviour “other”.

3. RESULTS

3.1. Differences between morning and afternoon periods

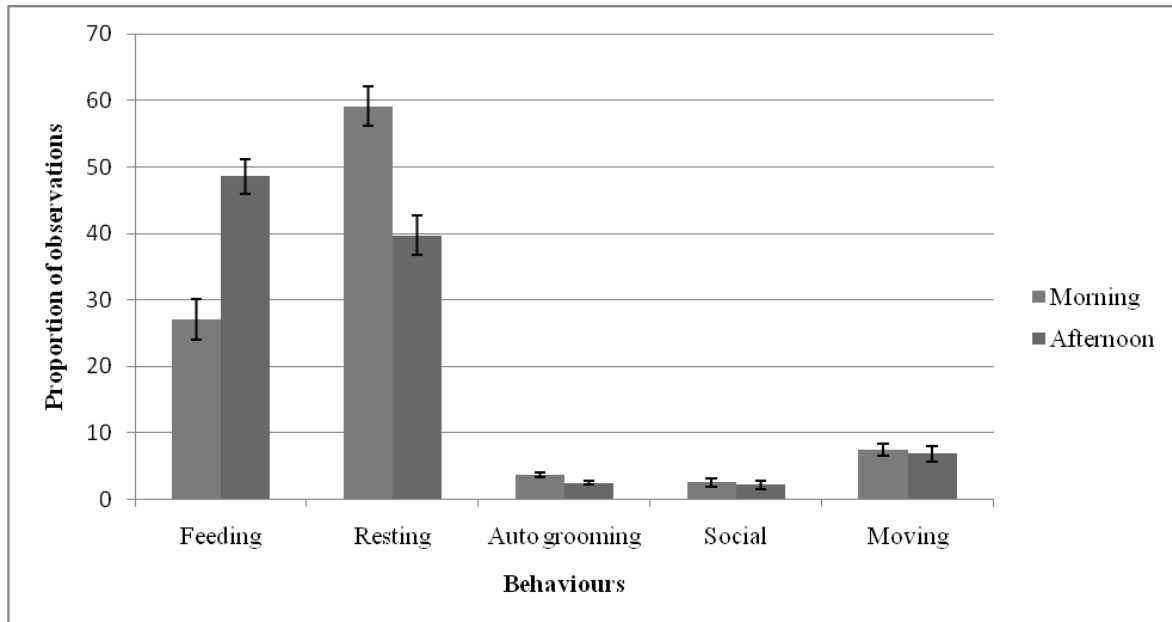


Figure 1. Proportion of observation spent on different behaviours during morning and afternoon periods. Other behaviours are not included.

Figure 1 illustrates higher foraging activities in the afternoon compared to morning periods ($P < 0.001$; $F = 29.38$; $DF = 1$). The monkeys spent more time resting ($P < 0.001$; $F = 21.17$; $DF = 1$) and auto grooming ($P = 0.018$; $F = 6.36$; $DF = 1$) in the morning compared to the afternoon periods. There were no significant differences in proportion of observations spent on social behaviours and moving.

3.2. Differences between males and females

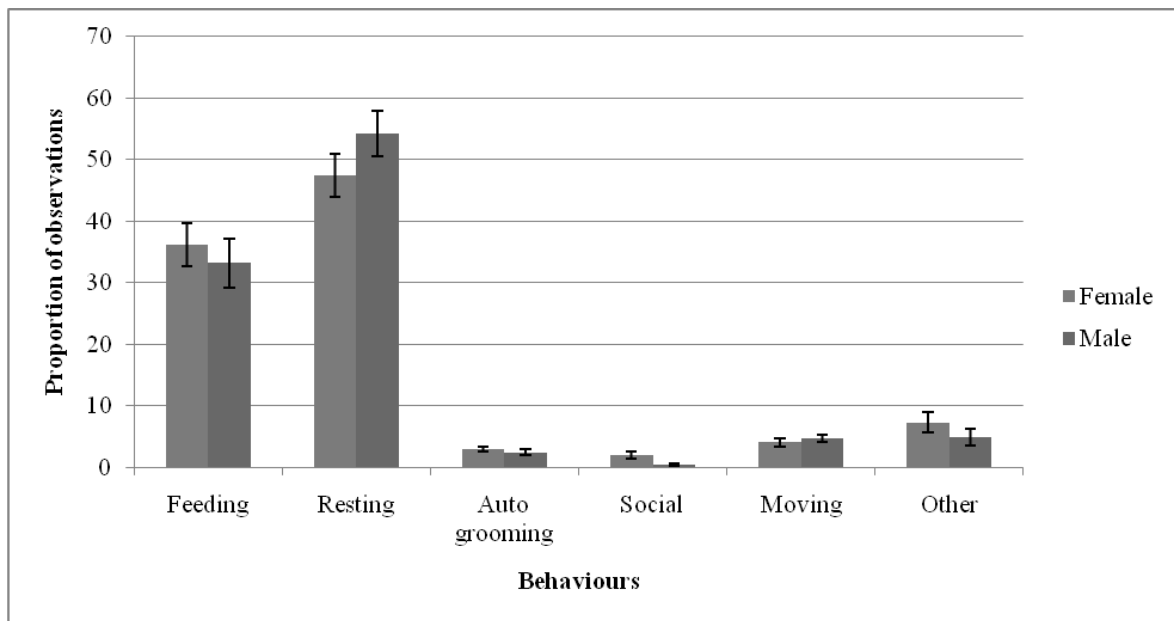


Figure 2. Proportion of observation spent on different behaviours by males and females.

The results displayed in figure 2 show a higher proportion of social behaviours in females compared to males ($P = 0.009$; $F = 7.26$; $DF = 1$). Figure 2 also illustrates that there were no statistical differences in proportion of any other recorded behaviour between sexes.

4. DISCUSSION

4.1. Differences between morning and afternoon periods

The population of *C. a. palliatus* observed in this study displayed significant differences between the morning and afternoon periods in the behaviours feeding, resting and auto grooming. A variation in timing of behaviours throughout the day is normal in primates. The characteristic pattern is that the proportion of feeding is greater in the morning followed by a large proportion of resting and grooming over the midday period. The variations in behavioural activities in primates are highly affected by the ambient temperature (Hill et al., 2004). When temperatures are high the animals need to either seek shelter or reduce thermally costly behaviours to minimize their heat load (Korstjens et al., 2010). A way to do this is to rest during the hotter hours of the day and to feed during the colder (Korstjens et al., 2010). The daytime temperatures during the observation period in this study were not registered and it is therefore difficult to say whether the morning period was colder or warmer than the afternoon period or vice versa.

Even if the ambient temperature was measured there is still difficult to predict the monkeys' behaviours since the monkeys might respond to their perceived temperature and not to the actual air temperature (Hill et al., 2004).

There is a possibility that *C. a. palliatus* in this area perceived the morning temperature as higher than the afternoon temperature and therefore demonstrated a higher proportion spent on resting in the morning compared with the afternoon. This variation in perceived temperature between the morning and afternoon periods can explain the large differences in resting behaviour. The results indicate that *C. a. palliatus* in this area rest more during the warmer temperatures, in agreement with McGraw (1998). In the cited study, three species of colobines showed a clear preference for resting during the hottest periods of the day. In McGraw (1998) the hottest period was during midday and no comparison was conducted between morning and afternoon.

The differences in auto grooming, in the present study, may be explained by the proportion of observations spent on resting. *C. a. palliatus* in this study frequently groomed themselves while resting (Buskas, personal observations). In some other studies, auto grooming is defined as a resting behaviour (e.g. Korstjens et al., 2002; Todd et al., 2008). The higher proportion of observations spent on auto grooming in the morning would therefore be clarified by the higher proportion spent on resting in the morning.

The higher proportion spent on feeding in the afternoon may also be explained by the temperature. The animals need to minimize their heat load during the warmer hours (Korstjens et al., 2010) and this would explicate why the thermally costly behaviour feeding was higher during the afternoon period, which might have been perceived as cooler than the morning. The differences in the proportion of observations spent on feeding between morning and afternoon may also be a part of *C. a. palliatus* strategy to avoid predators. Colobines balance their activities for several reasons and predator avoidance is one of them (Stanford, 2001). The variation in feeding and resting may well be a reflection of their predators' behaviours. In a study by Teichroeb et al. (2003) the competition over resources between troops are discussed and resource competition may have influenced the monkey troops in this study. The higher proportion of observations spent on feeding in the afternoon might be a result of competition over favorable food sources between these troops and other troops in the same area. The season and the area may also have influenced

the monkeys' behaviours. Colobine diet can vary between different seasons (Saj & Sicotte, 2007) and between different areas (Daegling & McGraw, 2001). Since there are no published results on the monkeys in this area and their variation in behaviour, there is a possibility that this variation may be a result of season and area. The higher proportion of feeding in the afternoon, and resting in the morning, can possibly be normal for the monkeys in this area during this season.

No differences between morning and afternoon period's proportion spent on social was found. Moving in colobines is mostly associated with foraging purposes and the monkeys have been recorded travelling and later on arrive to a food tree and continue to feed (Anderson et al., 2007c). It is therefore interesting that there was no significant difference in moving and no likeness between the proportions in feeding and moving.

4.2. Differences between males and females

Regarding the monkeys' sex, there were no differences in the proportion of observations found in the behaviours feeding, resting, auto grooming, moving and other behaviours. The variation in male and female feeding behaviour is believed to mainly be a result of pregnancy and lactation (Dasilva, 1992; Teichroeb et al., 2003). None of the females in this study were lactating (Buskas, personal observations) and the pregnancy statuses were unknown (A. Donaldson, personal communication, April 1, 2011). The fact that perhaps no female was pregnant and none was lactating can be the reason for lack of variation in female and male proportions of feeding. In a study on *C. vellerosus*, females fed more than the males in the large troops but not in the small troop (Teichroeb et al., 2003). The small troop in the study of Teichroeb et al. (2003) consisted of 7-8 individuals, much like the ones observed in the present study. Teichroeb et al. (2003) discuss that this difference in behaviour between the group sizes may be due to food competition only existing in larger troops. The non significant differences in the present study may therefore possibly be due to the small number of individuals in the groups and the absence of intergroup feeding competition. The study by Teichroeb et al. (2003) was conducted in Ghana between August and November. The seasonal and area variations between the present study and the one by Teichroeb et al. (2003) may explain the absence of differences in feeding budgets between sexes in this study.

Teichroeb et al. (2003) found a difference in resting behaviour between the two sexes; the males tended to rest more than the females in larger troops but no variation between the sexes was found in the small troop. In a study on *C. a. ruwenzorii* by Fashing et al. (2007) the same result as in the study of Teichroeb et al. (2003) was found. There were no significant variation between the sexes in this study and these results are in agreement with the findings on small groups by Teichroeb et al. (2003). To my knowledge, there are no other records of gender differences in resting in colobus monkeys and the findings in the studies by Teichroeb et al. (2003) and Fashing et al. (2007) may well be the results of a coincidence.

There was no significant difference found in auto grooming and this may be due to fact that there was no variation in resting between the sexes. As mentioned above, the colobines frequently groomed themselves while resting (Buskas, personal observations). Auto grooming is sometimes defined as a resting behaviour (e.g. Korstjens et al., 2002; Todd et al., 2008). The insignificant difference in moving between males and females in this study are in agreement with the findings in the study by Teichroeb et al. (2003) but not with the results in Fashing et al. (2007). Fashing et al. (2007) observed more moving in females

than in males. The variation in results between the finding of Fashing et al. (2007), of Teichroeb et al. (2003) and this study may be the result from species-dependent variations since all of these studies involve different subspecies.

There was a significant difference in social behaviour between the two sexes. This difference may be due to the fact that allo grooming is one of the behaviours summarized in the behaviour social. Allo grooming is mostly performed by females (Horwich & Wurman, 1978; Fashing, 2001; Fashing et al., 2007) and the grooming is most often directed to another female or a young (Horwich & Wurman, 1978).

I have not found any study observing the variation in moving between sexes in colobines.

4.3. Evaluation of the method

There are several possible sources of error in this study. The method chosen for observing the behaviours of *C. a. palliatus* in this study was focal sampling with instantaneous recording. This bachelor report is a part of a master's project and the method is therefore designed as a pilot study to fit the master project's study design. Instantaneous recording is suitable when recording behaviours that can occur or not occur at any instant in time, for example position and locomotor activity. The method is not as useful when recording behaviours that seldom occur and behaviours with short duration, such as social behaviours etc. (Martin & Bateson, 2007). The method worked well when observing behaviours such as feeding, resting and moving because of the fact that these behaviours are frequently performed. The reason why the method worked so well on those behaviours may also be because of the hours chosen for observing. The observation took place during the *C. a. palliatus* most active feeding periods to fit the master project's study design. The hours of observing only reflects a small part of the day and the results are therefore not representative for the animals' whole activity budget. However, to see whether there were any differences between morning and afternoon periods and between sexes, the method is suitable. When it comes to the social behaviours of *C. a. palliatus* it is always difficult to get good data because the behaviours are not frequently performed and occurs at a low level throughout the day (Teichroeb et al., 2003). With instantaneous recording there are possibilities that several bouts of behaviours are not registered, especially when it comes to social behaviours. With the short intervals of one minute used in this study, there is still a possibility that a larger proportion of the social behaviours performed by the animals are included in the results. For more certainty about the social behaviours, a different method should have been used.

The focal animals in the study were selected randomly but depending on the visibility. According to Teichroeb et al. (2005), it is difficult to recognize individuals, and the possibility for some animals to be selected as focal animal more often than others are very large. The visibility of the monkeys and the fact that the focal animals were changed after every 15 minutes interval, made it possible for an animal to be selected twice or more in a row. The chance of a few individuals representing the whole group needs to be taken in consideration but despite this, the method is suitable for observing these monkeys. During the monkeys' active times there are a lot of movements in the troop and it is almost impossible to see what every animal is doing. It is therefore possible that a large part of the recorded behaviours will be out of sight. The air temperatures during the observations were not recorded and the weather conditions were only confirmed twice a day, one time in the

morning and one time in the afternoon. To know whether the temperature or the weather is affecting the monkeys' behaviour those measurements should have been conducted.

4.4. Reflections

This study is conducted as a pilot study for a master's project with hoping of being published. Even though this paper will not be published the data from the behavioural observations are useful for the non-profit organization The Colobus Trust. The Colobus Trust is working for the protection and conservation of the forests of Diani Beach, using *C. a. palliatus* as a flagship species. The behavioural data will help the organization to better understand the monkey's time budget and hopefully get a deeper understanding of the monkey's behaviours. Hopefully this paper, or only the behavioural data, is of such usefulness for The Colobus Trust that it will be used in the protection and conservation of the *C. a. palliatus* habitat. There is also a chance that The Colobus Trust will find this paper as an allure and perhaps cooperate with scientist to find out more about the *C. a. palliatus* behaviour.

I would like to see more research on *C. a. palliatus* behaviour, especially in Diani Beach. Since their habitat in Diani is threatened by deforestation and fragmentation, research on this particular population might save them from going extinct in this habitat. It would be interesting to perform similar studies, like the present one, on this population during a longer duration and during different seasons. The new information might give a more accurate result and also tell if the findings in this study are representative for the population or just coincidence. I would like to see more research on this population and on their habitat utilization. This information can very well be used in the conservation and protection of the forests of Diani Beach. Saving the *C. a. palliatus* habitat will also save the home for many other species in the area.

5. CONCLUSION

The results of this study indicates that there is a difference in the proportions of observations spent on the behaviours feeding, resting and auto grooming between morning and afternoon periods. The significant differences in the performances in these behaviours may be a result of ambient temperature, predatory avoidance, competition over resources or season and area.

The results also show that there are no significant differences in the proportions of observations spent on feeding, resting, auto grooming, moving and other behaviours between males and females. The outcomes from these behaviours may be effects from season and groupsize. The higher proportion of social in females than in males may be due to allo grooming among females.

The method used during this study is, with a few corrections, suitable when studying *C. a. palliatus* in the forests of Diani Beach, Kenya.

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