2nd Quarterly Report

Mona Monkey Reintroduction Project

Internal Report, January – March 2008

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Introduction

During the second quarter after the release of 3 mona monkeys (*Cercopithecus mona*), CERCOPAN's research team has carried on the monitoring of the group on a daily basis, following the monkeys from dawn to dusk and sampling the behaviour by focal and scan sampling methods (Altmann, 1974).

This report presents an analysis of activity budget, habitat occupation and diet for the 2nd quarter, compared to the results from the 1st quarter that extended from November 2007 to the middle of January 2008. Information concerning group movements and medical treatments are provided and discussed.

General

For this second quarter of post-release monitoring extending from the 26th of January to the 31st of March 2008, we have followed the mona monkeys every day without any exception (91 days of observation).

Every day, the group is monitored from 6 am to 7 pm. Data sampling consists 15 min interval scan sampling (48 to 50 scan per day) and 10 min continuous individual focal sampling every hour (120 min per day)..

The two monkeys that are equipped with a radio collar still wear their respective collars, and both are still transmitting.

Home-range size and day length range:

From the end of December 2007 to the middle of March 2008, the group established their home-range about 200m from the central point they occupied the 2 first months (November-December). This location corresponds to a lowland swamp forest where a stream constitutes the core of the mona's home-range. This stream is still flowing during dry season, and the group follows it to explore and find new fruiting places. We have observed the group following this stream several times, foraging on invertebrates (mainly insects) and then

returning to their sleeping site. During these 3 months, one main sleeping site was used and largely exploited for different species of fruits produced by large trees (*Uapaca heulotii*; *Parkia bicolour*; *Pycnanthius angolensis*; unknown species of climbers).

The size of the home-range later reached 8 ha and the group was travelling total distance between 700 and 1000m per day, most of the time generally circling the area of their main sleeping site and returning to it in the evening. The main fruiting trees are more spatially dispersed than they were during November and December, resulting in longer movements between feeding locations.

Food provisioning:

From the beginning of January to the middle of March, we provided food once per day every 2 days, keeping a random feeding time. This randomisation prevented the monas becoming conditioned to associating the arrival of food with humans. The food supplied consisted of bananas and/or papaya.

The provisioning complements all the fruits and other food that the mona can find in the forest. During this quarter, we sampled 7 types of fruits that were produced in large quantities by trees and climbers. When a new fruiting tree or place is found, the monas come back regularly every day to each feeding spot, but they never stay several hours on the same tree. Longer times spent in the same crown by one or several individuals have been observed when the monkeys were feeding on leaves of *Parkia bicolor*, a very large tree (>100cm Diameter at Breast Height), and whose crown extends up to 20m. This species of tree is common into the Core Area and the mona guenons feed on fruits, flowers and leaves of this species. The group can also find diverse species of shrubs bearing small quantities of fruits while they forage on the lower levels of the forest.

Activity budget:

A comparison of activity budgets for the group between the first quarter and second quarter of post-release is shown in figure 1.

The considered categories of activity are resting, travel (movements between two points without feeding bouts), feeding (process, chew, swallow, look for and manipulate food items), socializing (affiliative and agonistic intra-group interactions) and others (vigilance, calls and out of view). To analyse activity budgets, we calculated proportions based on the

number of time-points records for each activity divided by the total number of activity records.

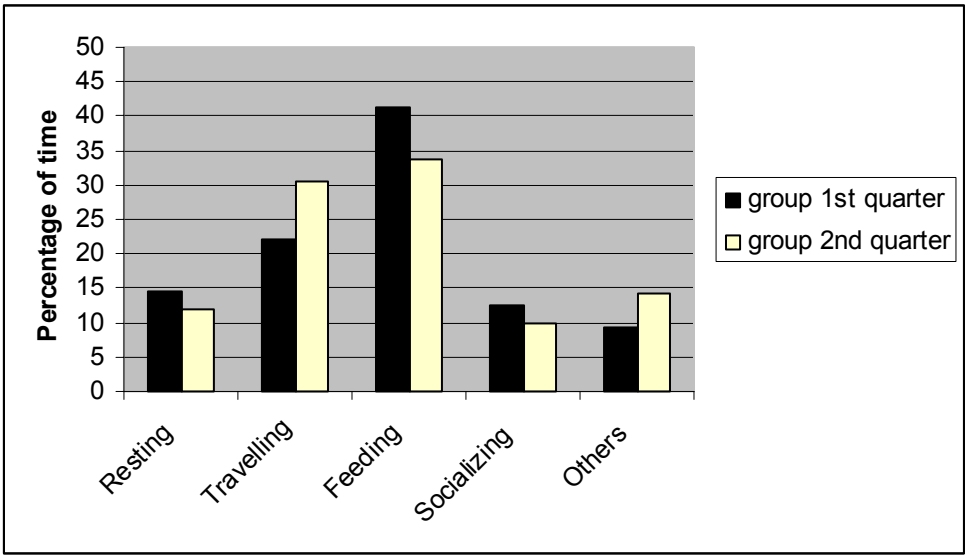

Fig 1: Activity budgets in percentage of time spent in different categories of activity for the release group.

For both quarters, the main activity on the group scale corresponds to the feeding time, but we can observe a decrease of the time spent feeding and foraging between the first and second quarter (41.4 % vs. 33.63 %). The second main activity is the travelling time for both quarter, increasing slightly in the second quarter (22.05 % first quarter vs. 30.45 % second quarter). This corresponds with a decrease in other activities (e.g. resting and socializing) which decreased slightly in the second quarter (14.55 % vs. 11.90 % for resting activity; 12.64 % vs. 9.86 % for socializing activity).

The vigilance behaviour is included in the category “others”, and there is a significant increase in the time spent in the vigilance behaviour by the overall group during the second quarter: 3.51 % of the total sampled time in the first quarter against 7.82 % of the total sampled time during the second quarter, accounting for the increase in this category of behaviour in the second quarter.

To conclude, during the second quarter of post-release, the group of monas has spent more time travelling and for anti-predation behaviour, less time feeding, resting and socializing. The vigilance behaviour that we consider corresponds to any behaviour of alert, when an individual is looking around before starting a movement, when an individual stares at the surroundings and for any alarm calls.

Habitat use

We recorded the forest stratum occupied by each individual on each activity record, allowing us to analyse the habitat use and forest level occupation patterns. The categories used are 0: ground; 1: shrubs and sapling layer; 2: understory layer; 3: canopy; 4: emergent. The results for the second quarter of study are given in figure 2.

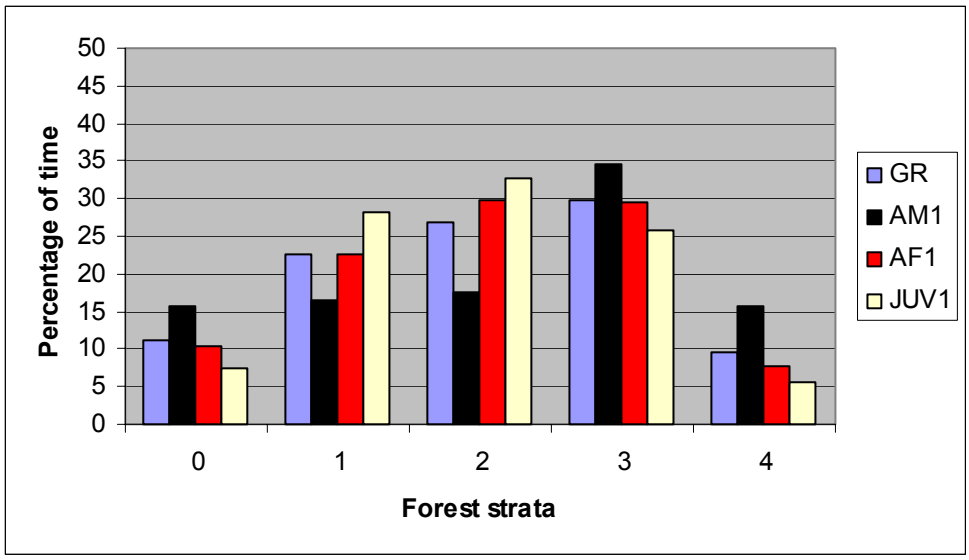

Fig 2: Percentage of time spent in the different forest stratum by the released individuals. GR: group; AM1: adult male 1; AF1: adult female 1; JUV1: juvenile 1

When the overall group pattern is analyzed, we can note that the canopy (strata 3) is the main strata where the group spend its time, followed by the understory layer (strata 2) and the lower level before the ground (strata 1). No large differences between the occupation of these 3 layers can be noticed, and the vertical occupation pattern is quite similar to what was found during the first quarter (1: 22.17 % of time first quarter vs. 22.57 % second quarter; 2: 30.25 % vs. 26.88 %; 3: 29.91 % vs. 30.62 %; 4: 10.97 vs. 9.55). The main differences between first and second quarter lie on the occupation of the ground level. We can see that the group has spent more time on the ground level during the second quarter, reducing then the time in the understory layer and emergent trees (5.95 % of time spent on the ground first quarter against 11.1 % of time during the second quarter).

Inter-sexual differences arise as it was shown during the first quarter. The male spent more time in the ground, canopy and emergent trees than the females, probably because of physiological constraints and because of the social role of the male. Indeed, because of his

larger size than the females, the male cannot stand for a long time on the brush and understory layers mostly constituted by thin branches and lianas. When the male goes down from the higher levels, he uses the ground, in contrast to the smaller females which more easily use thin branches in the lower levels (4 to 5m). The male spends more time in the crown of these large emergent trees for observation and social activities, looking at the surroundings and emitting alarm calls if a predator approaches. The role of the males in this anti-predation strategy is well known and spread among primates species (Bitty & McGraw, 2007). Anti-predation behaviour is also observed more often when the individuals approach from the ground level. They often interrupt their movements to look around and supervise the surroundings. We can comfortably assume that the longer time spent in vigilance activity is linked to more time spend on the ground. Another relationship that can be assumed exists between the increase of time spent travelling and the increase of time spent on the lower levels, since it has been often observed that the group is travelling fast between feeding places using the ground or the first liana layer between 1 and 5m.

Diet:

Diet composition is studied by recording the type of food item that is processed, ingested or manipulated, this for each activity record corresponding to a feeding activity. The next table presents the relative proportion of the main categories of food in the diet of the released monkeys, during the first and second quarter.

	Fruits/Seeds	Leaves	Invertebrates	Provisioned food	Other
1st quarter:	28.31%	8.35%	57.73%	4.7%	0.88%
2nd quarter:	40.84%	12.31%	42.21%	2.6%	2.03%

Table 1: Relative proportion of time spent feeding each category of food for the first and second quarter of study.

The main food category during the 3 first months was invertebrates (insects, cocoons, caterpillars, spiders…). This category is still an important resource during the second part of the study, but the amount of time spent feeding on it has sensibly decreased in favour to the time spent feeding on fruits and seeds. The participation of leaves and flowers (others category) has increased, mainly due to the production of new leaves and flowers by *Parkia bicolour* species that bear a large amount of food available for the monkeys. The decrease of time spent feeding on the provisioned food (4.7% against 2.6%) is due to the reduction in the rhythm of provisioning as explained above.

The high relevance on insects and arthropods confirms what was seen by Tashiro (2006) on *Cercopithecus mitis* and *Cercopithecus lhoesti* in the Kalinzu forest, with more than 50% of the feeding time devoted to invertebrates. The high importance of fruits in the mona's diet is similar to what is known on other guenon species, which are generally characterized as primarily frugivorous species (Chapman & al.,2002; Gautier-Hion, 1980; McGraw, 2002).

The increase of time spent feeding on fruits and reduction of time spent feeding and foraging on insects can be related to the decrease of time spent feeding in the activity budget, since fruits are generally available in large quantities on a small patch, and the monas don't need to spend a lot of time into these patches to get a reasonable amount of high-energetic food. On the contrary, feeding a lot of insects is time consuming since the preys are always scattered and cryptic, resulting in longer foraging efforts by the monkeys. Another factor explaining the increase of fruits into the diet is the reduction of the provisioned food that is constituted by bananas, rich in carbohydrates. However, the number of fruiting species is higher during the second quarter than it was during the first quarter, and we could observe the group moving from one patch to another regularly during the day, and following the same

ways to reach these patches. Contrary to the first quarter, most of the large trees exploited by the monas are spaced, since only 3 large trees on the same spot were exploited during the first months. The longer distances between food patches can explain the increase of time spent travelling by the group. On the other hand, we also can make an inverse relationship between time spent travelling and amount of food available. As shown in other primates species (Chapman & al., 2002; Passamani, 1998; Vasey, 2005), we can expect more time devoted to the travel since more high-energy food is available (fruits). It seems to be the case for the group of mona since the increase of fruits into the diet occurs in the same time than the increase of time spent travelling, and these 2 increases are the main changes (with vigilance behaviour) between the first and second quarters.

The variation in the diet observed between the 2 periods of the study emphasizes the dietary flexibility and adaptative ability shown by the monas, and confirmed on other related species (Bourlière, 1985).

Update

On the 12th of March 2008, the group has suffered from an eagle attack, when a bird that came to perch close to the monkeys. The group reacted with alarm calls and they took refuge down close to the ground, protected by the vegetation. No monkey was directly attacked (ie mobbed or predated), so neither injury nor death occurred, but it seems the monkeys were extremely shocked by this event, since they spent the entire day in the same place, not moving a lot, which is atypical of their behaviour so far. We even could observe the male shaking and being extremely quiet during this day.

Two days after, on the 14th of March, the group started to move very fast on the west side of the forest to finally reach the open-topped mangabey enclosure, which houses a group of semi free- ranging mangabeys. During this day, the monas followed the edge of the enclosure to finally stop at the 2 satellite enclosures housing 2 groups of captive monas, future release candidates, kept there as part of the rehabilitation process (ie close proximity to a natural habitat). All CERCOPAN team did the best to prevent the released monas reach the area where the captive monas are housed. We used negative reinforcement by threat and display – although this succeeded in moving them away in the short term, they continued to return. We used provisioned food bananas to attract the group back inside the forest, with variable success. It didn't work at all in the morning, but the trial we did afternoon succeeded to attract them close to their usual sleeping site. However, they returned in less than one hour

to the mangabey enclosure, finally settling to sleep close to the captive monas. The following day we tried, unsuccessfully, to attract them by baiting with food.

Since we observed that the group would not move away from the captive mona area, we decided to dart the released monas and to transfer them into the forest to a new site.
The choice of the new site was based on distance criterions. We needed a location enough far from the boundaries of the forest and as far as possible from an extreme point of the previous home-range, since the monkeys are able to use geographical clues to find their way.

Discussion

One of the main hypotheses to explain why the released monas have been attracted to these cages is that they were attracted to the captive food source, and possibly couldn't find enough food where they were before. Consequently, we provided to the group on their new location a permanent feeding platform that was alimented every day with 3kg of bananas. We worked out to be able to have constant and permanent food on the table, this corresponding to an *ad libitum* feeding. The difference compared to the feeding process we applied before is that we were feeding the monkeys anywhere they were moving, without permanent feeding station. The aim of this feeding station was to make this area attractive to the monas. It was working perfectly for 17 days. The monkeys became accustomed to coming back regularly to the feeding platform, to move around during the day and to come back to sleep close to the feeding station. During this time, they could find the same species of fruits they were feeding on before they came to the satellite cages. However, after 17 days on this location, the group suddenly moved very fast on the canopy to the West and return to the satellite cages in less than 30minutes, from an area which was more than 1000m distant from the satellite cages.

Their return again to the enclosure raises the question: why did they return when they we were being fed consistently and daily? It seems that the first hypothesis of attraction to food is rejected for the following reasons:

1. If the lack of food was the reason why they came to the captive monas, they should have come to them earlier in the season, soon after food provisioning was first reduced (beginning of January). In the middle of January, the released group reached a point in their home-range from where the captive mangabeys and monas vocalizations could be easily heard. This suggests that the released group knew the location of the captive monkeys since this time, but they didn't attempt to return to the area until the middle of March, several weeks later.

2. The activity budget analyzed (see above) and the examination of the diet show interesting arguments against the food attraction hypothesis. We could see that the group reduced the time spent feeding and increased the proportion of fruits in their diet, indicating that natural high-energy food was more available during this second quarter than during the first quarter of post-release. Feeding on fruits is less time consuming than foraging and feeding on invertebrates, and the group is able to decrease its foraging effort and to devote more time for travelling between food patches. Indeed, travelling time increased during the second period of study.
3. The strategy of using food as bait to attract the monas back into the forest didn't work and they were not attracted away from satellite cages towards an easy food source during the time they were there. They also did not attempt to enter areas of food storage while at the satellite enclosures.

An alternative hypothesis to explain why the released monas moved to the area of the captive monas after 4.5 months is social. The following observations support this hypothesis:

1. Between January and March, the group met several times a group of putty-nosed guenons (*Cercopithecus nictitans*). These encounters were more frequent in this place than it was during the first months because of the home-range overlap between these 2 groups. There were no agonistic encounters, no display behaviour or aggression between the members of each species. The female mona tried several times to join this wild group, moving fast into their direction and making a lot of contact calls, followed by the juvenile – guenon species often form mixed species associations in the wild, and this may have been the purpose of the group attempting to join the putty nosed group in a non aggressive manner. Contact calls from the putty-nosed females were heard. The monas did not join this group because the unhabituated putty nosed monkeys fled when the observers (research assistants) approached, despite not being hunted for over 10 years of protection. Guenons are cryptic monkeys and not easy to habituate (Matsuda, 2007), so that the wild group, although decreasing their 'fleeing distance', still moved away when they detected the presence of human observers.
2. When the released group was up to the satellite cages, a lot of social interactions with the captive monkeys took place. We could observe the released juvenile playing and grooming a lot with the others captive juveniles, and the male receiving grooming from the captive females. The released juvenile has been observed playing only twice

while this individual was inside the forest, and that was lone play without interaction with another member of the group.

3. During the time the group was relocated to a new location, before returning back a second time to the cages, we also observed a strong tendency to join a wild group of putty-nosed guenons, especially in the early morning. We had to use the radio telemetry system several times to find the group that moved very fast in the morning. We found them mixed with wild putty-nosed until these latter fled when human observers were detected.

Mixed-species associations are common among Guenons species (Cords, 1990a; Eckert & Zuberbühler, 2004; Gartlan & Struhsaker, 1972; Wolters & Zuberbühler, 2003). It has been shown that anti-predator advantages occur for both species that associate without increasing inter-specific feeding competition (Wolters & Zuberbühler, 2003). In this context, Diana monkeys (*Cercopithecus diana*) associate with Campbell's monkeys and each species take advantage of the anti-predator abilities of each other to exploit additional levels of the forest, and to reduce their vigilance behaviour inside these forest strata which they do not use in the absence of the other species. It has also been shown by play-back experiments that species are able to understand the semantic content of alarm calls from another species (Zuberbühler, 2000). Guenons also join primates from other genera such as the primarily terrestrial red capped mangabeys (*Cercocebus torquatus*); this allows an essentially arboreal species to exploit and increase foraging efforts in the lower strata (Bitty & McGraw, 2007).

Another element is demonstrated by the analysis of activity budget where we can see that the time devoted to the vigilance behaviour has increased during the second period of the study (3.51 % of the total sampled time from November to mid-January; 7.82 % of the total sampled time from mid-January to mid-March). Since the monas were moving more and spent more time on the ground level, they had to be in alert more often than when they occupy higher levels.

All these elements in addition to references from the literature suggest that the released group may have been attracted by the others monas for increased ability to detect predators (anti predator behaviour) and for social reasons. The original return to the enclosure area occurred 2 days after the group suffered from an eagle attack in which the male appeared to be seriously shocked. When they were fed *ad libitum* after their transfer into a new place, they tried to mix with a wild group several times. They demonstrated that they could easily return to the enclosure in less than one hour, probably because they could see a tree or visual clue to orientate and find their way. The day they returned to the enclosure, they started to follow a

putty-nosed group on the west and suddenly moved straight to the West to reach the enclosure area.

Evidence seems to strongly suggest that the release group is currently too small to meet their social needs, and possibly to assure their defence against predation. Three individuals is substantially below average group size for a group of guenons, particularly when there are few other guenons with which to associate easily in a mixed group. Guenons live in one male-multi female groups, and usually every individual contributes to the vigilance behaviour. Dilution and confusion of predator effects are well known explanation as to why species live in groups. To be able to reduce the predation pressure, adding more eyes for vigilance and more individuals that can spread if a predator threats is very advantageous.

Conclusion

The analysis of activity budgets, habitat use and diet of the release group has shown patterns of behaviour similar to what was found on other related species, in particular the tendency to mix with another species due to the small size of the group.

At the present time, following the information we learned from analysis of these events, we have re-captured and removed the release group from the area of the satellite enclosures, into their original release enclosure (see map). We are building a second, smaller temporary release enclosure close to the original enclosure where we plan to house 2 captive monas who are currently in the satellite cages as future release candidates, and who have cleared all quarantine and screening procedures. If agreement to release is given, we will give some overlapping time of proximity between the 2 groups and then we expect that the release group will stay close to this new enclosure housing 2 conspecifics. We expect that the presence of these conspecifics (one juvenile and one 4 year-old female) should help the group to feel more confident and to reduce the risk of predation, as well to increase the social interaction. Grooming and socializing are known to reduce tension inside the group but also to reinforce group bonds. The level of socializing observed in the release group (about 10% of the time) is in the lower side of the range of others related species (Clutton-Brock & Harvey, 1977). Moreover, other reintroduction projects have used captive individuals to reinforce site fidelity for reintroduced individuals.

We anticipate that releasing these 2 monas as soon as possible, in order that they can form a larger release group with the original 3 monas and alleviate the perceived problem of

small group size, will assist the future success of the reintroduction of mona monkeys in Iko Esai forest.

Medical and health summary

From January to March, the monkeys continue to appear healthy, and no monkey has been injured or suffered from any obvious disease.

The first time we had to transfer the group into the new location in the forest (25th of March), we used Medetomidine (40ug/kg of body weight) and Ketamine (5mg/kg of body weight) anaesthetics. The adult male received 0.4 and 0.2 ml of Medetomidine and 0.4 and 0.2 ml of Ketamine. The adult female received 0.2 ml of Medetomidine and 0.2 + 0.3 ml of Ketamine. The juvenile received 0.1 ml of Medetomidine and 0.1 ml of Ketamine. The adult female and the juvenile were also treated with 0.2ml of Ivomectine, and the adult male received 0.4 ml, as a precautionary anthelmintic to treat for parasites,.

The second time the group was transferred into the release enclosure (17th of April), the adult male was anesthetised with 0.3ml of Medetomidine and 0.3ml of Ketamine. The adult female received 0.15ml of Medetomidine and 0.2ml of Ketamine, and the juvenile was treated with 0.05 ml of Ketamine.

Their respective weights were: adult male 5.3 kg, adult female 2.5 kg and juvenile female 1.5 kg, which are in the normal range of weights for this species (CERCOPAN data, unpublished; Glenn 2002.). Their overall condition was good.

References

Altmann J, 1974. Observational study of sampling methods. Behavior 49: 227-267

Bitty E. A, McGraw W.S. 2007. Locomotion and habitat use of Stampflii's Putty-Nosed monkey (*Cercopithecus nictitans stampflii*) in the Taï National Park, Ivory Coast. American Journal Of Physiological Anthropology 134: 383-391

Bourlière F, 1985. Primates communities: their structure and role in tropical ecosystems. Int. J. Prim. 6:1-26

Chapman CA, Chapman IJ, Cords M, Gathua JM, Gautier-Hion A, Lambert JE, Rode K, Tutin CEG, White LJT, 2002. Variation in he diets of cercopithecus species: differencies within forests, among forests, and across species. In: Glenn ME, Cords M (eds) The Guenons: diversity and adaptation in African monkeys. Kluwer Academic/Plenum, New York, NY, pp 325-350

Clutton-Brock TH, and Harvey PH, 1977. Species differences in feeding and ranging behaviour in Primates. In: Primate ecology, Clutton-Brock & Harvey eds, NY Academic, pp 557-589

Cords, M. (1990a). Mixed-species association of east African guenons: General patterns of specific examples? Am. J. Primatol. 21, p. 101-114.

Eckerdt W., Zuberbühler K., 2004. Cooperation and competition in two forest monkeys. Behav. Ecol. 15: 400-411

Gartlan J.S., Struhsaker T.T., 1972. Polyspecific associations and niche separation of rain forest Anthropoids in Cameroon, West Africa. J. Zool., Lond. 168: 221-266

Gautier-Hion A, 1980. Seasonal variations of diet related to species and sex in a community of *Cercopithecus* monkeys. The Journal of Animal Ecology 49 (1): 237-269

Matsuda RG, 2007. Behaviour and ecology of the mona monkey in the seasonally dry Lama forest, Republic of Bénin.PhD Dissertation, University of New York

McGraw W.S. 2002. Diversity of guenon positional behaviour. In: Glenn M.E, Cords M., editors. The Guenons: diversity and adaptation in African monkeys. New York: Academic/Plenum. P 113-131, 2002

Passamani M. 1998. Activity budget of Geoffroy's Marmoset (*Callithrix geoffroyi*) in Atlantic forest in southeastern Brazil. American Journal of Primatology 46: 333-340, 1998

Tashiro Y, 2006. Frequent insectivory by two guenons (*Cercopithecus lhoesti* and *Cercopithecus mitis*) in the kalinzu forest, Uganda. Primates, 47: 170-173

Vasey N. 2005. Activity budgets and activity rhythms in Red Ruffed Lemurs (*Varieca rubra*) on the Masoala peninsula, Madagascar: seasonality and reproductive energetics. American Journal of Primatology, 66 (1) 23-44, 2005

Wolters S, Zuberbühler K, 2003. Mixed-species associations of Diana and Campbell's monkeys: the costs and benefits of a forest phenomenon. Behaviour 140: 371-385

Zuberbühler, K. (2000). Interspecic semantic communication in two forest monkeys. — Proc. R. Soc. Lond. B 267, p. 713-718.

Appendix: map of CERCOPAN field site indicating relevant locations