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Introduction

1.1 Background

The Eastern Arc forests of Kenya and Tanzania are a remnant of a once continuous mosaic of unique forest that stretched from the Kenya-Somalia border, to the border of Tanzania and Mozambique (Clarke, 2000). Internationally recognised, this forest system is one of the 25 global biodiversity hotspots and listed as one of 11 'priority' regions for international conservation investment (Myers et al 2000). These unique and diminishing forest habitats support high levels of endemism and important populations of species that have wide-ranging, but fragmented distributions, therefore remaining vulnerable. Tanzania's Eastern Arc Mountains are renowned for their communities of endemic amphibians, reptiles and mammals. The coastal forests of Kenya form the northern fringe of the Eastern Arc forests, however much less is known about the floral and faunal diversity of these areas.

The coastal forests of Shimoni (located on the southern tip of coastal Kenya) form a thin strip of 'coral rag forest', officially labelled as the 'Northern Zanzibar-Inhambane Floristic region'. This forest zone is found along the coastal areas of Kenya, Tanzania and Somalia, and is formed on ancient coral reef exposed by falling sea levels, leaving limestone rock and shallow soils. In conjunction with relatively high salinity levels and coastal climatic influences, the plant community and the structure of the forest are adapted to the substrate and favour shallow root systems, which reduce stability. This makes these forest habitats highly susceptible to erosion processes and hence at risk from the influences of deforestation in the wider Shimoni area. The specialised flora that is found in these habitats supports and sustains rare and endemic species which are of particular interest to biological conservation, and sustainable livelihoods through responsible tourism. Coastal forests continue to be under threat due to human population growth, agricultural expansion and tourist development, therefore increasing the need for a stringent management plan to be enforced, to conserve the remaining forest areas within this region (Anderson et al. 2007b).

1.1.2 Study Area

Primary research is conducted in Shimoni forest (east) on the southeast of the Shimoni peninsula, positioned between Shimoni village to the west (04º64'900"S, 39º38'600"E) and the coast of the Indian Ocean to the south and east (04º64'300"S, 39º40'300"E), (Figure 1). The forest is locally known as *'Mbuyu Tundu'*, and will hereafter be referred to as 'Shimoni forest (east)'. Since (2011) three additional transects have been cut in the forest west of Shimoni village. This area will be referred to as 'Shimoni forest (west)'.

Shimoni forest represents an important fragment of Kenya's unique and indigenous coastal forest. Currently used for resource extraction and the clearing of land for farming, the area is threatened by the continuing development of Shimoni village, particularly on coastal land plots. More recently, the increase in charcoal production within Shimoni forest (east) has resulted in the clearing of large areas of what previously was untouched forest.

This area of forest was selected for biological research primarily because it represents a valuable area for biodiversity and in particular supports an important population of the Angola Black-and-White Colobus (*Colobus angolensis palliatus*), a flagship species for this region. Anderson et al., (2007) highlighted Shimoni forest to be one of the key habitats for this species, sustaining its second largest population in Kenya. Discussions with community-based organisations in Shimoni village highlighted the importance of the forest to the wider community. In particular, firstly the 'Shimoni Youth Conservation Project' and later the 'Friends of Shimoni Forest', have been keen to seek protection and promote sustainable management. As a result, GVI have developed the terrestrial research programme to support local stakeholders. On a more practical level, the forest is readily accessible and GVI are logistically able to support long-term and wide ranging biodiversity surveys and monitoring of the area.

Figure 1. Survey transects on the Shimoni peninsula with Shimoni village in the middle on the coast and forest on both the East and West sides. Transects are numbered (1-6) from South to North.

2 Aims

The aims of the terrestrial research programme are to monitor primate community dynamics, densities, distribution, habitat use and time budgets, with particular interest in *C. a. palliatus*. These surveys are complemented and quantified by the monitoring of habitat variation through analysis of

floral composition, seasonal change and human disturbance. Vegetation surveys are utilized to assess floristic diversity, canopy height, canopy cover and seasonality of fruits and flowers. Disturbance surveys document resource consumption, including extraction of poles and timber as well as other forms of anthropogenic activity. Monitoring of floral regeneration in relation to disturbance levels can be used to assess forest recovery rates. Butterfly surveys are used to examine forest diversity and the effects of disturbance on the butterfly community. Bird diversity and habitat use is also carried out to assess resource competition between certain avian and primate species, and to gain a species list for the area. Biodiversity is additionally monitored by the recording of casual observations, used to assess and gauge species richness and the presence of other rare and endangered plants and animals. Research has also been undertaken in forest located within KWS Shimoni headquarters.

The eventual aim of this research is to gain community management through support of the local Shimoni community. A community-based organisation was established in 2007, 'Friends of Shimoni Forest', and its main objectives are conservation of biodiversity, indigenous afforestation, and continued forest research. If effective community management status is obtained, research can be used to suggest management protocols whereby resource use is acceptable at specified levels, and re-plantation initiatives are utilised to ensure the long-term sustainability of forest resources for both the human and wildlife communities. Additional forms of income may also be derived from the forest through responsible tourism; the Angola Black-and-White Colobus is a charismatic and beautiful primate species. Guided tours through the forest would provide a source of sustainable revenue to supplement the successful community fund initiatives of the Shimoni Slave Cave Committee, and create awareness among the wider population.

Anderson (2007) highlighted the importance of the Shimoni coastal forest as key habitat for the future of the Angola Black-and-White Colobus conservation initiatives, holding potentially the second largest population of this species in Kenya. This makes the forest not only of local importance, but of national and international importance in stemming the declining population numbers of this primate in Kenya.

As research continues GVI is currently seeking to re-evaluate research programs in cooperation with KWS and local communities. New goals and aims are to be implemented after presentation of the new KWS 10-year management plan.

3 Methods

3.1 Line Transect Sampling

The overall methodology for the terrestrial research programme is structured around a transect grid system utilising east-west straight line transects (Figure 1). Parallel transects are spaced at 200-metre intervals, facilitating a 100 metre survey distance either side of each transect. This follows the Tropical Ecology, Assessment and Monitoring (TEAM) Initiative, Primate Monitoring Protocol (Lacher 2005).

The Shimoni forests contains nine transects; transect 1 on the East side of Shimoni, the furthest south, runs approximately 100 metres from the coastal edge. Transect 1 on the West side of Shimoni, runs approximately 1000 meters from the coastal edge. Transects are divided into 50-metre sections to enable the survey data to be categorised accurately, and facilitate distribution mapping. A north-south 'spine' is used to ensure the 200m separation between parallel transects and to aid access. Table 1 summarises the total number of sections and lengths of each transect and Figure 1 shows all transects on a satellite photograph. The total survey area for Shimoni Forest (east) is 1.568 km^2 (156.8 ha). The survey area for Shimoni Forest (west) has been estimated at 1.02 km^2 (102 ha).

Table 1. Summary of transects in the Shimoni area.

Forest	Transect	Sections	Length (m)
Shimoni forest (East)	1	17	850
Shimoni forest (East)	2	30	1500
Shimoni forest (East)	3	31	1550
Shimoni forest (East)	4	32	1600
Shimoni forest (East)	5	42	2100
Shimoni forest (East)	6	46	2300
	Subtotal	**198**	**9900**
Shimoni forest (West)	1	34	1700
Shimoni forest (West)	2	34	1700
Shimoni forest (West)	3	39	1950
	Subtotal	**107**	**5350**
	Total	**305**	**15250**

3.2 Primate Community Survey

Three species of anthropoid coexist in the survey area: the Angola Black-and-White Colobus monkey *(Colobus angolensis palliatus),* the Syke's monkey *(Cercopithecus mitis albogularis),* and the Yellow baboon *(Papio cynocephalus).* The primate community surveys are based on distance sampling methods, utilising two nominated observers whilst additional members of the team ensure they do not draw attention to primates un-detected by the observers. This maintains consistency of effort, to enable the quantifiable analysis of data used in estimating primate densities (Buckland et al 2001).

Primate surveys are conducted along one transect at a time (and only once during each expedition) during the mornings, when primates are more likely to be active and easily detected. When groups of primates are spotted, the sighting distance (distance from the observer to the first detected individual) and the sighting angle from the transect line to the primate (to the first detected individual) are estimated. All observers were tested at a distance estimation accuracy of 90%. The sighting distance and sighting angle is then taken to the geometric centre of the group once all individuals have been identified. If it is not possible to record this to an acceptable level of accuracy in-situ, perpendicular distance is calibrated from the first animal seen to the centre of the group by Whitesides et al., (1988) standard correction method using the below equation:

$$P' = P\left(1 + \frac{r_j}{S}\right)$$

Where: P' = Perpendicular distance from the transect line to the centre of the group.

P = Perpendicular distance from the transect line to the first detected ind.

r_i = Half the mean group spread.

S = Sighting distance (distance from observer to first detected ind.)

Population size and density were calculated using the program DISTANCE 6.0 (Thomas et al 2006). Distance sampling requires a number of assumptions to be met, including the random distribution of the surveyed objects. In order to meet this assumption for social species such as primates, groups rather than individuals are recorded; therefore sightings of solitary individuals were not included in distance sampling analysis (however were included in the complete group counts). It is also necessary to be confident that any group positioned 0 metres from the transect line has a 100% probability of detection (Buckland et al 2001). Since the species surveyed in this study are not particularly cryptic, and often freeze rather than flee when approached, it is unlikely that such groups would go undetected; hence this assumption can be upheld with confidence.

For each sighting, species, group size and demography were determined, spending up to 30 minutes with the group. Sex and age class is most easily recognized in *C. a. palliatus*; 0-3 months (white infant), 3-6 months (grey juvenile), >6 months (black and white adult). Small individuals with adult colouration in close association with an adult were classed as sub-adults. Sub adults were not sexed as this could not be done with confidence; gender may be deliberately obscured, to reduce intolerance of adult males towards young males (Estes, 1997). Age classes were selected on the basis of pelt colouration enabling confidence in accurate categorisation rather than attempting to estimate using relative body size. Sex was only determined in adults, with males distinguishable by a clear white stripe from buttocks to genitalia which is absent in females. Age classes and sexes were not assumed in *C. m. albogularis* and *P. cynocephalus* (except where young were seen attached to an adult), as this could not be confidently quantified.

Sighting quality was recorded and ranked as follows; 1 - group count incomplete, 2 - group count complete but demographics incomplete, 3 - count and demographics complete. A 0 sighting quality was not used in the analysis, but provided information on any particular cryptic species present. Group spread of primates was recorded where possible, to estimate a mean group spread for the species sampled. In addition, tree species in which the primates were sighted was recorded when possible, providing information on species preference, thus gaining information on habitat preference and distribution in relation to floral composition of the forest.

3.3 Colobus travel pattern studies

We have started an attempt to document *C.a.palliatus* path sequences and use of consecutive feeding and resting sites in order to address a series of questions regarding average range and daily travel distance for the focal individuals. Consecutive periods of study will enable us to calculate

average and range of area for the focal individuals calculated as minimum convex polygon (MCP) and a normal distribution kernel method. Average and daily use of primary feeding trees are being noted and eventually path lengths to recourses will be calculated.

The current methodology is being adapted to suit colobus studies and based on Pavelka (2005). Behavioural data on colobus activity budget, social interactions, and ranging behaviour will be collected on focal animals with identification number using a 2-min instantaneous time sampling technique (Altmann, 1974).

There are some slight adaptations to the protocol described in paragraph 3.3.4. Feeding is defined as handling and ingesting plant material where as foraging is localized movement in the crown of a feeding tree for the specific goal of encountering a food resource. Travelling is movement between the crowns of trees or within the crown of a tree that is not directly food related where resting is a period of inactivity. Social interactions are being recorded and limited to physical contact and grooming. Other behaviour is logged for later reference.

During all data collecting periods, a team of at least two researchers is in the forest. One researcher is responsible for collecting behavioural data and the other researcher is responsible for marking every tree visited by the focal animal. These trees are scored as travel trees, feeding trees, and/or resting trees.

When travelling between feeding and resting sites, colobus tend to move in a single line progression (Fashing 2007 for *Colobus guereza*) and therefore, we, for now, assume that the path taken by the focal animal was similar to the path taken by other group members. The first animal sighted on a given morning will be selected as the focal animal and followed continuously. On those occasions when the focal animal is lost from view for a period of ≥ 4 min, the next animal sighted becomes the focal animal. Colobus are followed continuously for as long as possible per day for as many days as possible, with a minimum of five hours a day, for 10 days. We use the period to illustrate and explain short-term travel patterns, ranging, and patch choice in our Colobus study group.

A trail system and map of the study group's home range will be constructed using a GPS combined with a sketch map. The locations and sequential use of trees will be plotted daily on a field map. For this trees are marked with an Identification number as feeding, resting, foraging, or travelling tree. Distances and angles between trees are measured and locations of the trees are determined using GPS and sketch maps. This might enable us to record the spatial position of individual colobus in relation to mapped points within their small home range. Daily path lengths will be calculated by measuring the straight-line distance between sequential feeding, resting, foraging, and travelling trees directly off the field map and summed.

In order to determine the spatial distribution of major feeding and resting sites, a grid divided into 25 m × 25 m squares will be overlaid on thefield map. We then tally the number of major feeding and

resting trees located in each of the N quadrates. In addition, we tally the number of times the focal animal enters each quadrate in order to determine patterns of habitat utilization, ranging, and the degree to which individual path segments between major feeding and resting sites were reused during the same day, reused on different days, or whether Colobus revisited major feeding sites using a variety of different travel routes. A route segment will be defined as a travel path in which the same three or more contiguous quadrates were visited and revisited in sequence (i.e., A–B–C=C–B–A). We also identify the order in which major feeding and resting trees were visited over the course of each day, and compared this with the most efficient tree sequences (in terms of minimizing travel distance) to visit these sites. An index of circuitry (actual distance/most efficient route distance) can be calculated to determine the degree to which Colobus travel patterns were consistent with taking the most efficient route to visit all trees on a daily itinerary.

3.4 Primate Behavioural Surveys

Behavioural surveys of *C. a. palliatus* are used primarily to investigate time budgets. However, habitat use, group structure, and group interactions are also derived from the data collected. Through habituation and the identification of group territories, these surveys will also support the development of tourism initiatives to gain sustainable income from the forest wildlife.

Continuous, focal individual sampling is adopted in order to establish *C. a. palliatus* time budgets. Time budgets can be used to establish conditions and constraints under which animals are living. The most suitable conditions promote greater carrying capacities and hence higher densities (Fimbel et al 2001), as well as less vulnerability to changes in habitat condition. Time budgets can also be used in examining predator pressures by analysing the relative time spent being vigilant. This data will then be used to compare between individuals, groups, forest types, and at different levels of disturbance.

Focal individuals are surveyed in ten-minute blocks, measuring behaviours which are broken into states and events. States are measured in real-time durations, as opposed to events which are recorded only as frequencies logged within each ten-minute time block. States represent behaviours of longer durations, for example feeding, sleeping, resting, etc. Events represent shorter, instantaneous behaviours, for example scratching, yawning, and urinating. Some tactile signals and postures are included in this survey for use in the analysis of group interactions. These include stiff-legs display, which has been identified as an agonistic display between territorial males (Estes 1991). At the end of each time block, a scan sample is conducted to identify the overall group state (>50% of the group); this is used in the analysis and discussion of the circumstances under which different individual behaviours occur and if certain behaviours occur simultaneously.

States and events are categorised under strict parameters, and outlined in an ethogram which is used to ensure consistency between observers and comparability between surveys.

Surveys are conducted at all times of the daylight hours in order to measure a representative portion of time budgets throughout the day. Data recording is only initiated after a period of at least 10 minutes to reduce bias caused by the arrival of the observers. If the focal individual moves out of view and observers are unable to confidently identify the same individual upon reappearing, the survey is ended. There is no set survey time limit.

3.5 Bird Point Counts

Bird species diversity, abundance and density are estimated through the use of bird point counts. East Africa represents one of 218 worldwide *Endemic Bird Areas,* (Stattersfield et al 1998) and birds are important components of forest ecosystems as well as indicators of habitat disturbance. Many bird species are dependent on readily available stocks of fruits, flowers and seeds, and the presence or absence of seasonal birds indicates the seasonality of these forest commodities. Birds such as large raptors also represent the only known predators of primate species in the area, and are most likely only predators of young.

Point count surveys are conducted at various times of the day, as different species are most active at varying times. Surveys are done along the transect lines at 100 metre intervals. The point count is delineated by transect sections. Odd or even transect numbers are sampled, leaving two sections between recordings, therefore avoiding double counts. Number and species of birds seen are recorded in ten minute blocks. A five minute settle-down period of silence precedes each recording period. Each survey lasts for 30 minutes, or three survey blocks.

From June 2010 onwards point count surveys have expanded to, and been done mainly in, off-transect locations.

3.6 Canopy Surveys

Canopy cover is recorded in order to enable analysis of seasonal change and to describe the forest profile. This is in turn used to complement primate and other faunal distribution surveys. Estimations of the canopy cover are recorded every 10 metres of each 50 meter section, enabling five recordings to be averaged for the section. Cover is recorded by looking straight up through inverted binoculars, estimating the percentage of the area blocked by tree canopy foliage and branches, to the nearest 5%.

Canopy height is also recorded at the same points as the cover estimation. The height is found by taking the angle from the person recording to the highest point of the canopy, from a known distance away. The eye height of the person recording is also measured. Basic trigonometry is then used to calculate canopy height.

3.7 Butterfly Community Survey

Butterflies (Order: Lepidoptera) offer an excellent indicator taxon of plant species diversity, habitat diversity and disturbance levels. Butterfly canopy traps and butterfly sweep nets are utilised. The traps are baited with mashed banana that has been allowed to ferment for at least 3 days. Traps are baited and left for approximately 24 hours before checking, and ten canopy traps are used simultaneously on each trapping day. Traps are placed at the same height for a given period. The height varies between ground (0-1m), understory (1-5m), and mid-canopy (5-10m). Photographs of each individual are taken for identification using Larsen (1996). Butterfly sweep nets are used at varying points along all transects. Sweep netting is done using three nets in the same area for 20 minutes. This adds up to an hour of effort per session. All specimens caught are photographed for identification using Larsen (1996).

In Expedition 121 sweep-netting was done only in off-transect locations.

3.8 Disturbance

Disturbance surveys are vital for assessing the levels of anthropogenic disturbance and destruction that are rife in the forest. The local communities utilise the resources in the forest for many things, including wood for canoes, fish traps, and domestic fuel. Plants are also used for traditional medicines and remedies. In the last few years however, there has been a massive increase in deforestation for commercial timber and charcoal. The scale and rate of this deforestation is entirely unsustainable and it has been estimated that between 2006 and 2009 (Jan-Sept) 1.8% of our research area was lost to deforestation. Our survey area only covers a portion of the forest as a whole, suggesting the actual area of the forest lost is far greater. For disturbance surveys, a 10 metre wide strip (5 metres either side of the transect) is surveyed, and all human disturbance is recorded. This includes poles (stumps with a diameter between 5 and 15 cm), timber (stumps with a diameter greater than 15cm), pitsaws, charcoal pits, fires, snares and clearings.

3.9 Casual Observations

During all observer time in the forest, records are also made of other fauna observed and identified in the field, noting time, species, location, habitat, group size and other applicable notes. Indirect observations of animals such as tracks, dung or feathers are also recorded as indicators of presence. Where possible unknown species are photographed with detailed descriptions recorded, for later identification.

Even if not during Expedition 121, during previous expeditions dedicated observations have been performed. This involves team members spreading out over an area and sitting quietly and still for a period of several hours. This has proved to be an excellent survey for the sighting of cryptic and shy animals that are rarely seen for any length of time. Because the animals are generally unaware of your presence, it is possible to see them at exceptionally close distances and for extended periods of time. It also allows one to observe the animal's normal behaviour, such as feeding or foraging, instead of fleeing which is the most commonly recorded behaviour of the shy animals. Examples of the animals sighted during dedicated observations include the Suni, the Zanj elephant shrew and a number of bird species.

3.10 Hornbill survey

The survey is very similar in design and methodology to that of primate community as described in paragraph 3.3.2. Two nominated observers walk a specified transect line. When a hornbill species that is not in flight is sighted it is identified and sexed. The distance and angle to the first individual is taken as well as the distance and angle to the geo-centre of the group. Its position within the canopy is recorded, as is a brief description of the tree. Hornbills in general build their nests in large trees (50+cm DBH). We will try and assess the population density of hornbills as a whole. Due to insufficient time and manpower, this survey was not completed on the majority of transects this expedition.

3.11 Digital Herbarium

An electronic herbarium is used to catalogue plant and tree species present within the coastal forests surrounding Shimoni. The aims of this project are to ease repeated identification of specific species as well as to initially establish species presence and abundance, as prior knowledge and research is limited. We are currently in the process of collecting as many samples as possible for record. Leaf, flower, fruit and bark samples are taken and photographed with a ruler present for scale. Other measurements such as height and diameter of sample are also recorded. Once back from the field all information and photographs for each individual sample are separated into corresponding computer files for use in identification using field guides and other literature

(Palgrave 1977, Beentje 1994, Dharani, 2002.). However, no new additions were done during the period January-March 2012.

3.12 Pitfall Traps

Pitfall traps have been used occasionally to trap small animals, such as insects, arachnids, reptiles and amphibians. A hole is dug in the ground and a bucket is sunk into it deep enough so the rim is level with the soil surface, as a raised edge will deflect many animals around the hole. A 'drift fence' barrier is set up between traps to direct foraging animals towards the traps, increasing the traps' success rate. Animals that enter the traps are unable to escape; they are photographed then released and identified later to get a better understanding of the species diversity in the area, the main focus being arachnid populations. Currently no traps have been placed in the forest.

3.13 Arachnid Identification

Little is known of the arachnid diversity in the Shimoni coastal forest area. Continuously throughout the expedition an arachnid species list has been created to identify animals seen in Shimoni forest, pitfall traps, and in the village. Pictures were taken of all arachnid species found, which were later identified and added to a spreadsheet. In order to identify the species found, internet resources and literature (Filmer 1991) were used. Even though no new species were identified during Expedition 121, this is an ongoing project that will continue in future expeditions.

3.14 Mangrove Surveys

To assess diversity, health and changes to this ecosystem around Shimoni, and set a baseline for further studies, mangrove straight line transect surveys are carried out irregularly. The used method is based on a point-centre-quart-count adapted from Mitchell (2007). Surveys are done at low tide. Individuals walk along straight line set marked transects perpendicular to the coastline. At 10-metre intervals they stop to record distance to the closest tree within each quarter formed by an imaginary line perpendicular to the transect. In addition we record the tree species and diameter of trunk for each of the four trees at every 10-metre point. Percentage and height of canopy coverage is recorded only at the centre-point, thus once every 10 metres. Trees with a diameter at breast height (DBH) under 5 cm, or trees with no leaves more then 1.5 m above the base of the stem are ignored. In addition, human disturbance is recorded as a tally within a ten meter radius for each 10-metre centre-point.

3.15 Fruit and Flower Survey

Fruits and flowers are surveyed in an effort to measure tree species seasonality, and the distribution of fruits and flowers throughout the survey area. Many forest animals rely on fruits and flowers as vital food sources; most significantly for the aims of this project, they are vital dietary components of the primates found in the Shimoni forests.

Fruits and flowers are identified along the transect lines, recording vegetation within 10m of the transect line. Trees in fruit or flower are identified by the aid of a field identification sheet, composed in collaboration with a local botanist, and the Diameter at Breast Height (DBH) recorded in order to assess age structure. For all fruits and flowers that are seen, a sample of the fruit or flower and its leaves is taken and put into a herbarium where it will be pressed and dried. A comprehensive collection of dried specimens will then be sent to a local botanist for identification. The samples will then be used for future in-situ identification. Samples, photographs, and detailed descriptions of all specimens are taken.

As research questions, objectives and goals with regard to floral surveys were not clear, fruit and flower surveys were not conducted during this expedition. Another type of survey focused on flora is described in 3.6.

3.16 Moth diversity

In order to collect data on moth diversity moths were opportunistically collected. Throughout the quarter individuals were photographed and identified using the African Moths database (www.africanmoths.com). Moths were often attracted using a fluorescent light 25 Watt light bulb positioned at the top of a white plastered wall, or by a 160 Watt ML-lamp positioned in low-cut shrub in front of a vertically positioned 2.5 by 3 meter white sheet about 25m from the GVI base in Shimoni village. The GVI base is located where the village and a small, $3*10^{-2}$ km^2, forest patch meet. No moth data was collected this expedition.

4 Results

4.1 Primate Community Survey

Primate community and distance sampling was completed at least once across all transect sections within Shimoni forest east and west. Table 2 summarises the primate groups encountered this expedition.

Table 2. Summary of total counts observed during primate community surveys on the East and West sides of Shimoni.

	Peters's Angola Black-and-White Colobus (C. a. palliatus)	*Sykes (C. m. albogularis)*	*Yellow baboon (P. cynocephalus)*
Area surveyed (metres)	15250	15250	15250
Number of groups	36	6	0
Number of individuals	110	24	0
No. Individuals per Group	3.06 ± 1.93	4.00 ± 3.22	0

Using the population estimation program 'Distance 6.0' (Thomas et al 2006), the total *C. a. palliatus* population estimate for Shimoni forest (east) is 158 and for Shimoni forest (west) is 138. The input data does include sightings of solitary individuals. The Shimoni forest (east) survey area consists of 6 transects, extending for 9900 metres, with a total forest area estimated at 156.8 Ha. The Shimoni forest (west) survey area consists of 3 transects, extending for 5350 metres, with a total forest area estimated at 102.0 Ha. The forest area for Shimoni forest (west) was estimated based on area surveyed, not the entire forested area. For all observational data the truncation distance has been set at 70 metres, as it has been shown over previous expeditions that the majority of sightings occur within a perpendicular distance of 70 metres, and the majority of individual outliers occur at distances greater than 70 metres. Tables 3 and 4 show the populations, densities, and mean cluster sizes of *C. a. palliatus* as calculated using 'Distance 6.0'.

Table 3. *DISTANCE* sampling analysis results for primate community surveys on the East side conducted in January – March 2012.

	January-March 2012 (East)			
	Value	SE (±)	95% confidence interval	
D (Ha)	1.01	0.38	0.45	2.23
N	158	60	71	349
mean cluster size	2.96	0.42	2.21	3.96

Table 4. *DISTANCE* sampling analysis results for primate community surveys on the West side conducted in January – March 2012.

	January-March 2012 (West)			
	Value	SE (±)	95% confidence interval	
D (Ha)	1.35	0.76	0.31	5.98
N	138	77	31	610
mean cluster size	3.25	0.49	2.33	4.53

4.2 Colobus travel pattern studies

4.5 hours of data has been collected on one habituated groups of *C.a.palliatus* consisting of two males, three females, male sub-adult and one white infant; and a semi-habituated group of 9 individuals. No analysis of this data has been performed as there is not enough to draw any sound conclusions.

4.3 Primate Behavioural Survey

A total of 9.2 hours of behavioural surveys were conducted on seven groups of *C. a. palliatus*. Due to the exact home ranges of the troops not being known, it is possible that this is an overestimation of the number of different troops. Figure 2 summarizes the total time budgets for all individuals. A maximum of 20 individuals were observed. Both adult males and females were studied, as well as sub-adults and juveniles. All of the common behaviours were recorded including feeding, resting, sleeping, staring and alert. Aggressive encounters were not observed during this survey (either between or within groups).

Staring behaviour is recorded when the subject under survey is intently staring at the observer. This behaviour is caused by human presence and is used to prevent inaccurate recording of vigilance (alert) behaviour. Staring behaviour also provides a measure of the effect of human presence on the subjects.

C.a. palliatus spent most of their time resting (69%), feeding (14%), and staring (8%). Other behaviours such as grooming (4%), alert (1%), sleeping (1%), travelling (1%) and playing (1%) were observed less frequently.

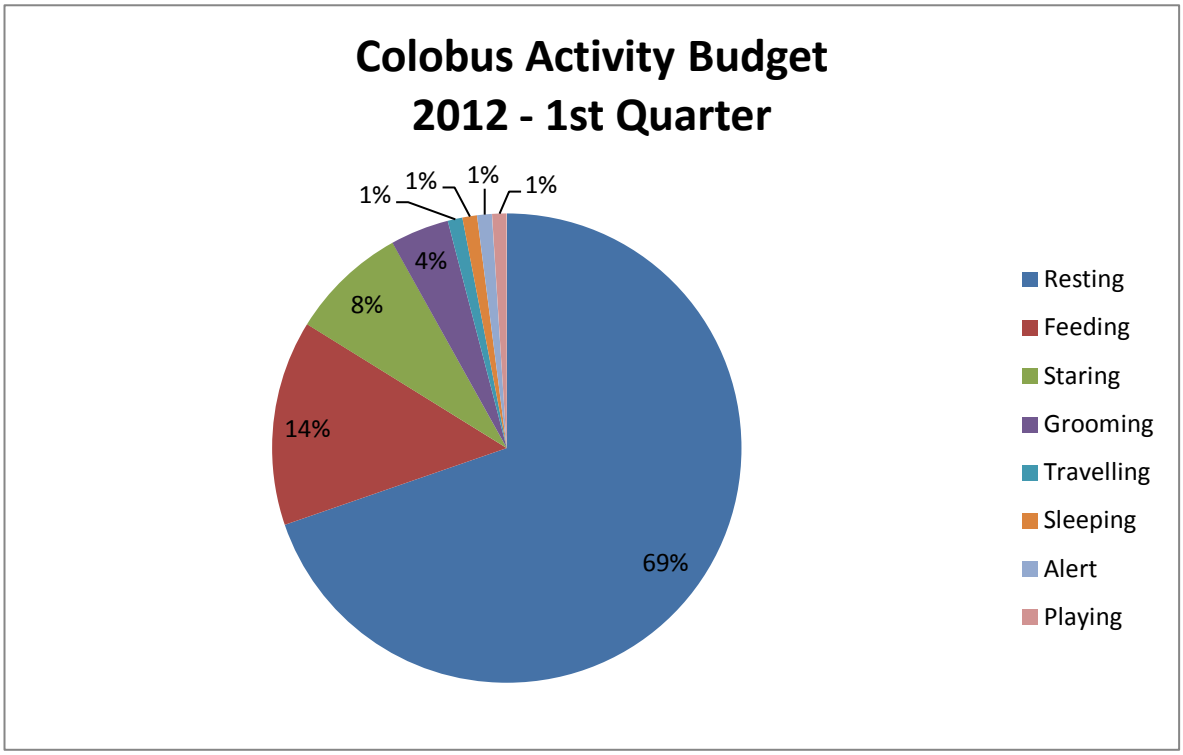

Figure 3-2. Chart displaying the activity budget of *C. a. palliatus* in the survey area from January – March 2012.

Events recorded are listed in Table 5. The most common event observed was scratching, followed by contact between two individuals. Other events were observed much less frequently. Neither antagonistic encounters nor copulation were witnessed during these surveys. There were also no stiff leg displays or teeth displays observed.

Table 5. Frequencies of events seen during primate behavioural surveys performed during the period from January – March 2012.

Frequency of behaviours			
Urination	1	Contact	10
Defecation	2	Exchange	0
Yawn	0	Arousal	0
Teeth Display	0	Copulation	0
Vocalising	0	Masturbation	0
Scratching	78	Shaking	1

4.4 Bird Point Counts

Bird point counts were conducted between the hours of 7:35 and 15:30. A total time of 20.5 hours

of survey time was undertaken. 548 individuals were seen, belonging to 61 different positively identified species. The locations for the surveys ranged from the back of the house, the Reef Hotel, the coastal shelf, the edge of the forest and several other spots in and around Shimoni. Swifts (*Apus spp.)*, swallows *(Hirundo spp.)*, common bulbuls (*Pyconotus barbatus*), black kites *(Milvus migrans),* weavers *(Ploceus cucullatus and P. bicolour),* black-and-white mannikins *(Lonchura bicolor),* and fork-tailed drongos (*Dicrurus adsimilis*), were among the most abundant species.

4.5 Canopy Surveys

Canopy cover was recorded every ten metres across all transect sections both in Shimoni East and West. The average canopy cover for one section varied from 1% to 85% in Shimoni East, and from 11% to 84% in Shimoni West. The total average canopy cover for Shimoni forest this quarter was 38.68% (SD=17.95%). However, canopy surveys were not performed on transect 1 west (sections 23-34), transect 5 east (sections 26-32), and the negative part of transect 3 east. The average canopy height for the surveyed area was 9.79m (SD=3.92).

Figure 3 shows the development of average canopy cover in Shimoni forest between October 2006 and March 2012.

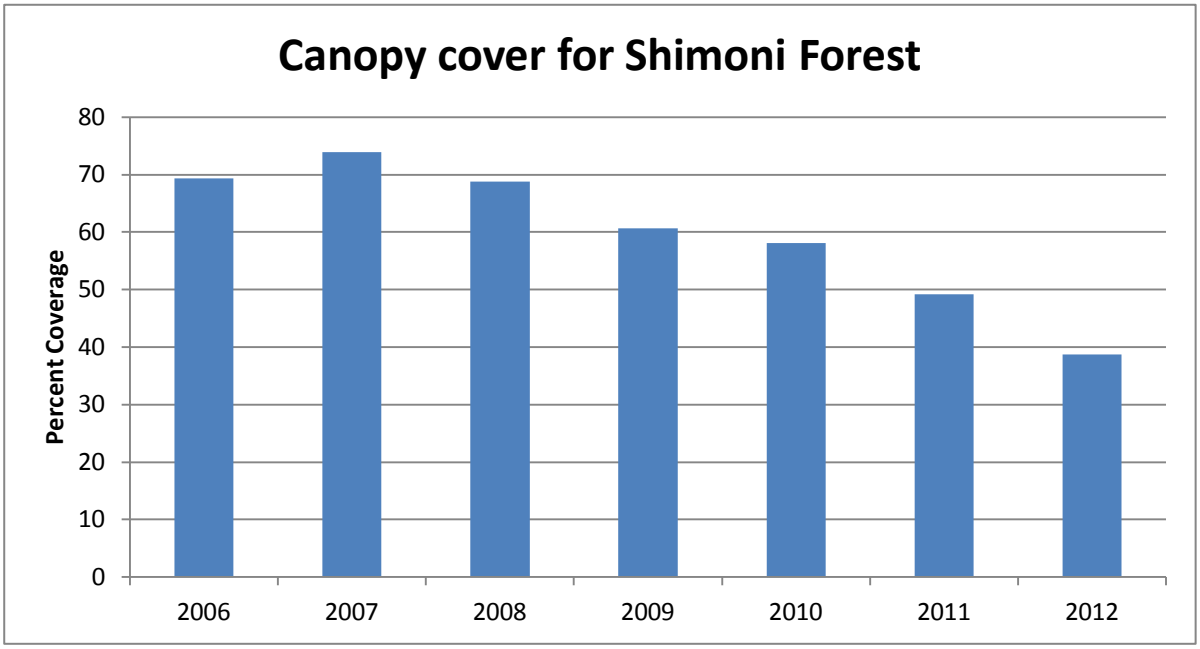

Figure 3. Comparison of average canopy cover from October 2006 (Expedition 064) to March 2012 (Expedition 121).

4.6 Butterfly Community Survey

4.6.1 Butterfly Traps

A total of 40 butterfly traps were placed and baited during Expedition 121. We captured and identified a total of 40 butterflies, belonging to 10 different species. Table 6 summarises the species trapped and their frequencies.

Table 3-6. Butterfly species trapped.

Species	Number of Individuals
Bicyclus safitza safitza	9
Charaxes brutus	9
Charaxes candiope candiope	4
Charaxes hansali baringana	1
Charaxes jahlusa kenyensis	1
Charaxes varanes vologeses	7
Colotis daira jacksoni	1
Euxanthe wakefieldi	4
Hypolimnas misippus	2
Melanitis leda	2
Grand Total	**40**

4.6.2 Butterfly Sweep Nets

Sweep netting was done at varying locations throughout the Shimoni peninsula. Attempts were made to utilise sweep netting in as many different types of forest habitat (e.g. clearings, mature forest etc) as possible. A total of 30 hours worth of effort were completed. In total 96 individuals were caught and identified, representing a total of 24 species, shown in Table 7.

Table 3-7. Butterfly species swept.

Species	Number of Individuals
Acraea acrita	6
Acraea eponina eponina	3
Acraea pudorella	4
Acraea ventura	1
Belenois aurota aurota	14
Belenois zochalia agrippinides	3
Byblia anvatara acheloia	3
Byblia ilithyia	18
Catopsilia florella	4
Charaxes brutus	1
Colotis eucharis evarne	1
Colotis phisadia rothschildi	1
Danaus chrysippus (albinus and *dorippus)*	7

Graphium Angolaus Angolaus	1
Graphium antheus	4
Graphium leonidas leonidas	1
Graphium porthaon mackiei	2
Hypolimnas misippus	2
Junonia natalica natalica	3
Junonia oenone oenone	11
Papilio dardanus tibullus	1
Papilio demodocus demodocus	3
Papilio hornimani	1
Tirumala petiverana	1
Grand Total	**96**

4.7 Disturbance

Disturbance surveys were conducted along all three transects in Shimoni forest West and all six in East, with the exception of the negative part of transect three. A total of 31 hours and 2 minutes was spent conducting the surveys. Table 8 and Figure 4 summarise the findings in comparison to the results of previous expeditions.

Table 8. Table showing the results of the anthropogenic disturbance surveys for expeditions 94 – 121.

	Pole (old)	Pole (new)	Timber (old)	Timber (new)	Charcoal (old)	Charcoal (new)	Clearing	Snare	Fire	Firewood
094	578	48	103	5	5	1	38	3	19	2
101	560	51	340	28	9	21	38	7	1	40
102	356	34	92	6	10	1	57	2	3	10
103	370	72	162	18	13	5	45	2	27	29
104	413	63	249	27	12	5	24	2	37	19
111	466	41	215	21	17	4	27	1	121	67
112	213	15	161	9	11	1	16	3	50	19
113	1271	160	480	37	13	8	12	0	87	28
114	2118	101	604	67	42	13	40	0	111	49
121	3178	102	1208	91	44	22	31	2	151	43

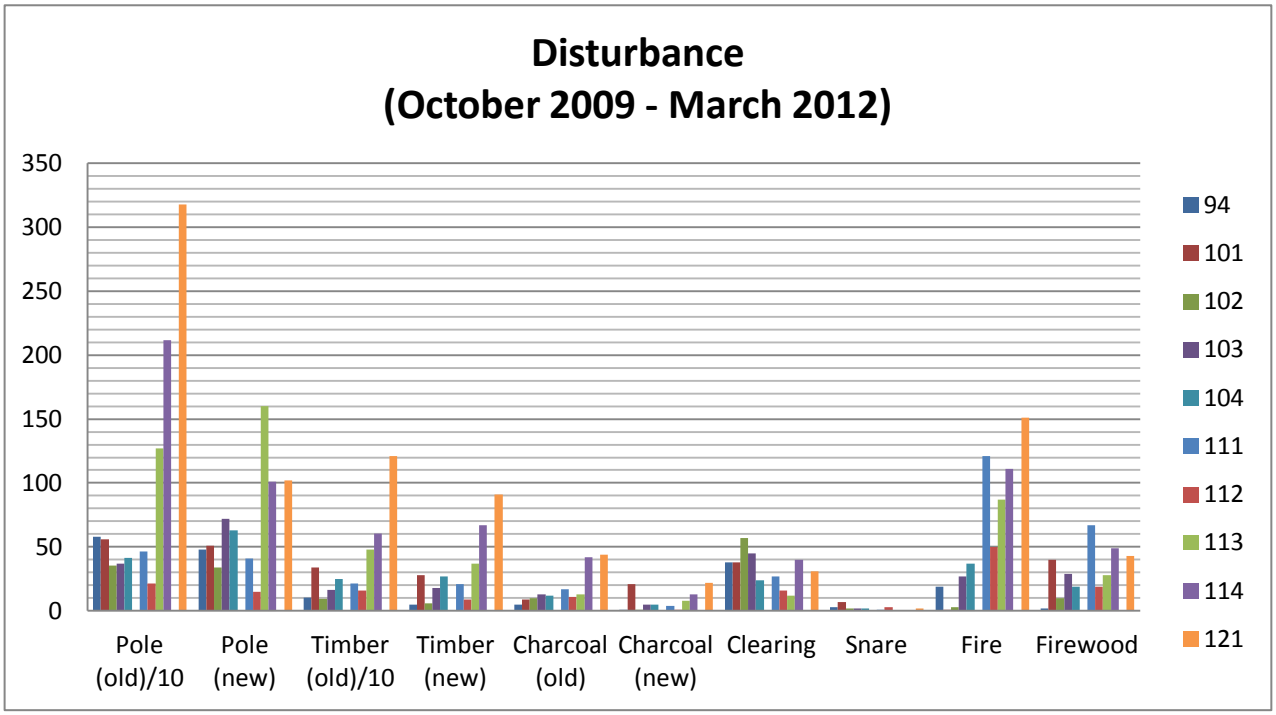

Figure 4. Graph showing disturbance surveys for expeditions 94 - 121.

4.8 Casual observations

A total of 401 hours was spent in the field during this expedition in Shimoni forest. There were 1350 sightings, accounting for 3540 individuals from 96 different species. Table 3-9 shows the number of sightings of each species during casual observations during Expedition 121.

Table 3-9. Table showing the species sighted during casual observations during the period January – March 2012.

Common Name	Count
<Other - See Notes>	10
<Unidentified - See Notes>	12
African Black-headed oriole	1
African Fish Eagle	16
African Golden Oriole	12
African Goshawk	4
African Green Pigeon	7
African Harrier-Hawk	1
African Pied Wagtail	4
Angola Black-and-White Colobus	223
Ashy Flycatcher	8
Black Backed PuffbackAngola Black-and-White Colobus	2
Black Egret	2
Black Kite	33
Black-and-White Mannikin	4
Black-Bellied Starling	11
Black-Headed Weaver	23
Broadbilled Roller	7
Brown-Breasted Barbet	4
Brown-Headed Parrot	22

Brown-Hooded Kingfisher	35
Bushbuck	1
Collared Sunbird	22
Common Bulbul	91
Common Tern	1
Coral Rag Skink	1
Crowned Hornbill	64
Dark-backed Weaver	29
Dimorphic Egret	3
Dwarf Galago	2
Eastern Bearded Robin	2
Emerald-Spotted Wood Dove	1
Ethiopian Swallow	2
Eurasian Golden Oriole	7
Eurasian Nightjar	1
Eurasian Swift	1
Forest Batis	1
Fork-Tailed Drongo	105
Great Plated Lizard	6
Great Sparrowhawk	2
Greater Galago	14
Green Barbet	3
Green Wood Hoopoe	7
Grey Plover	1
Grey-backed Camaroptera	1
Hadada Ibis	3
Harvey's Duiker	6
Helmeted Guineafowl	1

Lesser Striped Swallow	12
Lilac-Breasted Roller	1
Little Sparrowhawk	5
Little Swift	24
Lizard Buzzard	1
Martial Eagle	1
Mombasa Woodpecker	1
Narina Trogon	1
Nile Monitor Lizard	1
Nubian Woodpecker	2
Olive Sunbird	2
Palm-Nut Vulture	14
Parrot-Billed Sparrow	6
Peter's Twinspot	7
Pied Crow	11
Pied Kingfisher	5
Plain-Backed Sunbird	6
Purple Banded Sunbird	5
Red Bellied Coast Squirrel	52
Retz's Helmet Shrike	10
Ring-Necked Dove	4
Sacred Ibis	1
Silvery-Cheeked Hornbill	47
Snouted Night Adder	1
Sooty Gull	3
Southern-banded Snake Eagle	1
Speckled lipped Skink	1
Speckled Mousebird	14

Speckled Sand Snake	2
Striated Heron	1
Striped Kingfisher	4
Striped Skink	1
Suni	17
Sykes monkey	163
Tambourine Dove	1
Trumpeter Hornbill	1
Whimbrel	1
White- Throated Bee Eater	8
White-Browed Coucal	6
White-Rumped Swift	1

Wire-Tailed Swallow	1
Wood Sandpiper	1
Woolly-Necked Stork	8
Yellow Baboon	24
Yellow Bellied Greenbul	1
Yellow Headed Dwarf Gecko	4
Yellow-Fronted Canary	3
Yellow-Rumped Tinkerbird	1
Zanj Elephant Shrew	8
Zanj Sun Squirrel	35
Grand Total	**1350**

4.9 Hornbill survey

The hornbill community survey was conducted on only transect 1 in Shimoni east this quarter. No hornbills were seen.

4.10 Digital Herbarium

At present 21 plant species have been catalogued in an electronic file; 15 of these have been identified. Although no new species were added during this quarter, we aim to expand this database throughout future expeditions.

4.11 Pitfall Traps

We did not work with Pitfall traps during Expedition 121. Previously caught species include an unidentified white toothed shrew (*Crocidurinae spp.*) a Rusty Thick Tail Scorpion (*Babycurus jacksoni*), several forest crickets (*Nemobius sylvestris?*), Brauns toad (*Bufo braunii*) and a range of unidentified invertebrates.

4.12 Arachnid Identification

Currently the spider catalogue has a record of 16 identified arachnids (Table 10), without new additions during Expedition 121.

Table 3-10. Summary of identified arachnids found in the Shimoni area.

Common name	Genus	Species	Family	Subfamily	Order	Suborder
Black-legged Nephila	Nephila	fenestrata	Nephilidae		Araneae	Araneomorphae
Red-legged Nephila	Nephila	inaurata	Nephilidae		Araneae	Araneomorphae
Tailess whip scorpion/ Whip spider	Damon	annulatipes	Phrynichidae		Amblypygi	
Funnel-web spider			Agelenidae		Araneae	Araneomorphae
Kite Spider	Gasteracantha	falcicornis	Araneidae	Gasteracanthinae	Araneae	Araneomorphae
Golden lynx spider	Oxyopes	jacksoni	Oxyopidae		Araneae	Araneomorphae
Crab Spider			Thomisidae	Thomisinae	Araneae	Araneomorphae
Huntsman	Palystes		Sparassidae		Araneae	Araneomorphae
Long-spinnered bark spider	Hersilia		Hersiliidae		Araneae	Araneomorphae
Burrowing Wolf Spider	Geolycosa		Lycosidae		Araneae	Araneomorphae
Wall Crab Spider	Selenops		Selenopidae		Araneae	Araneomorphae
Spiny-legged sac spider	Rhaeboctesis		Liocranidae		Araneae	Araneomorphae
Harvestman					Opiliones	Palpitores
Prowling sac spider	Cheiracanthium	furculatum	Miturgidae		Araneae	Araneomorphae
Rusty thick tailed scorpion	Babycurus	jacksoni	Buthidae		Scorpiones	
Box Kite Spider	Isoxya		Araneidae	Gasteracanthinae	Araneae	Araneomorphae

4.12 Mangrove surveys

This expedition the first survey of the third mangrove transect was completed. The final 110m of the transect were sampled, bringing the total length of transect 3 to 910m. The collected data has not been further explored.

5 Discussion

5.1 Primate Community Survey

The population and density estimates for *C. a. palliatus* for the past six years are shown in Figures 5 and 6. Unless otherwise noted, these estimations are based on the results of four quarterly surveys each year. The large error obtained and the relatively small number of data sets make it difficult to deduce any trends in population or density.

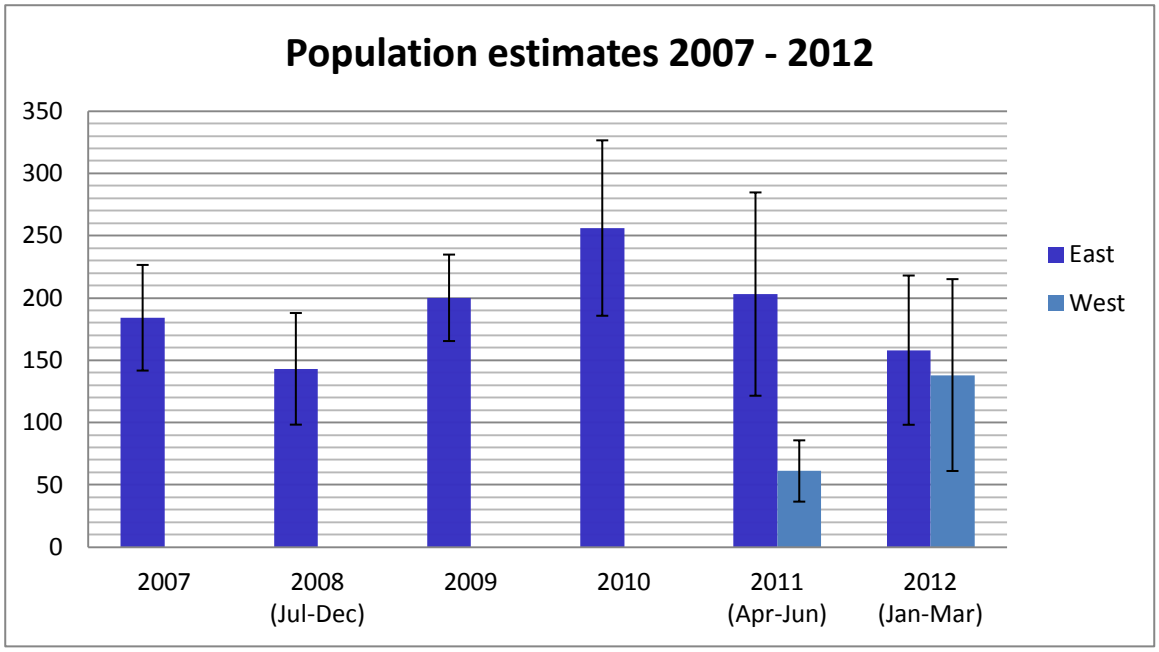

Figure 5. The population estimates for *C. a. palliatus* based on census in Shimoni forest.

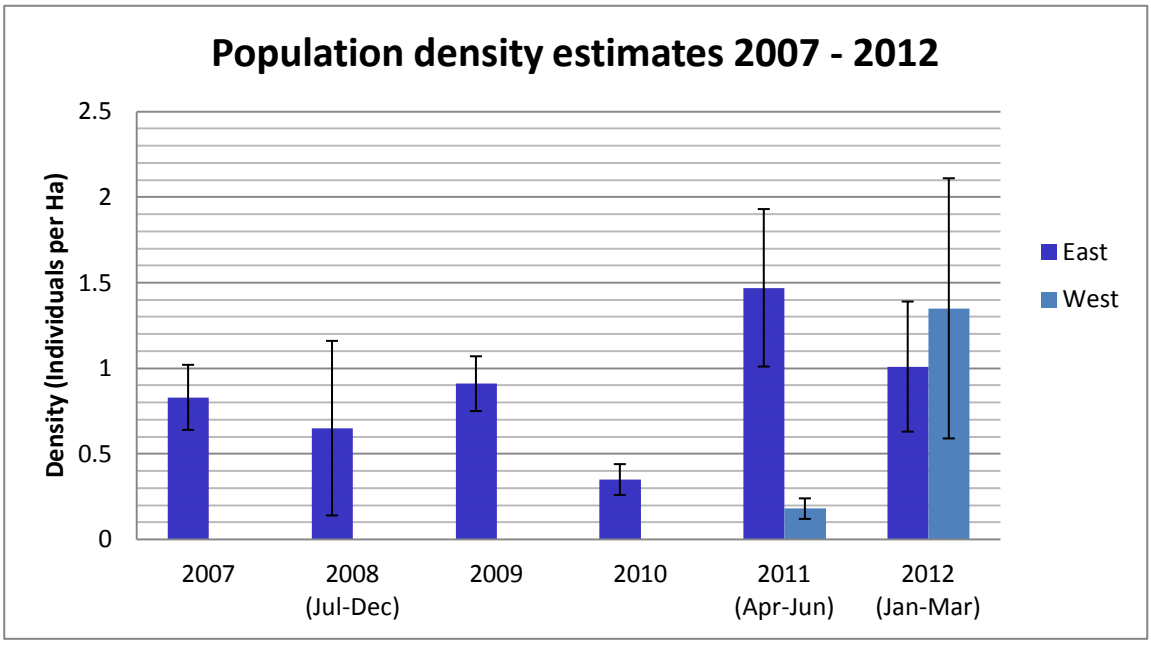

Figure 6. The population density estimates for *C. a. palliatus* based on census in Shimoni forest.

The data from previous primate community surveys have produced estimations of population and density with significant errors, which devalue the results. The primary reason for this is the relatively small amount of effort (or number of metres walked). In an attempt to compensate for this, population estimates were based on four repeated surveys. This has been done for 2007, 2008, 2009, 2010, and 2011. Tables 11, 12, and 13 show the results from these yearly estimations. It can be seen from the tables below that the errors produced are much greater in years with fewer data sets. This highlights the need for more data sets.

Table 11. *C. a. palliatus* population estimates for Shimoni forest (east and west).

Population						
Year	Location	Value	SE (±)	% error	95% Confidence Interval	
2007	East	184	42	22.83%	110	306
2008 (Jul-Dec)	East	143	45	31.47%	73	282
2009	East	200	35	17.50%	139	288
2010	East	256	70	27.34%	139	468
2011 (Apr-Jun)	East	203	82	40.39%	92	448
2011 (Apr-Jun)	West	61	25	40.98%	27	140
2012 (Jan-Mar)	East	158	60	37.97%	71	349
2012 (Jan-Mar)	West	138	77	55.80%	31	610

Table 12. *C. a. palliatus* population density estimates for Shimoni forest (east and west).

Population Density (Individuals per hectare)						
Year	Location	Value	SE (±)	% error	95% Confidence Interval	
2007	East	0.83	0.19	22.89%	0.50	1.39
2008 (Jul-Dec)	East	0.65	0.51	78.46%		
2009	East	0.91	0.16	17.58%	0.16	0.33
2010	East	0.35	0.09	25.71%	0.19	0.63
2011 (Apr-Jun)	East	1.47	0.46	31.29%	0.52	2.53
2011 (Apr-Jun)	West	0.18	0.06	33.33%	0.08	0.38
2012 (Jan-Mar)	East	1.01	0.38	37.62%	0.45	2.23
2012 (Jan-Mar)	West	1.35	0.76	56.30%	0.31	5.98

Table 3-13. C. a. palliatus mean cluster size estimates for Shimoni forest (east and west).

Mean Cluster Size						
Year	Location	Value	SE (±)	% error	95% Confidence Interval	
2007	East	4.28	0.31	7.24%		
2008 (Jul-Dec)	East	3.85	0.36	9.35%		
2009	East	3.53	0.20	5.67%		
2010	East	3.35	0.25	7.46%	2.88	3.90
2011 (Apr-Jun)	East	4.32	0.83	19.21%	2.88	6.49
2011 (Apr-Jun)	West	2.67	0.50	18.73%	1.74	4.09
2012 (Jan-Mar)	East	2.96	0.42	14.19%	2.21	3.96
2012 (Jan-Mar)	West	3.25	0.49	15.08%	2.33	4.53

The values obtained for mean cluster size are significantly below the average group size of 6 obtained by a national survey (Anderson et al. 2007a). This may be due in part to the inclusion of solitary individuals in the analysis. It may also result from the difficulty of detecting all individuals in a group in a densely canopied forest. Of the 36 sightings of *C. a. palliatus*, 9 received a sighting quality of 1 (group count incomplete). It can be reasoned that our population estimate is also low due to these incomplete group counts. Furthermore, this expedition no troop of baboons was observed during the Primate Community surveys, and only six groups of Sykes monkeys. Nevertheless, there are numerous sightings of these two species in the Casual Observations data. This indicates that the Distance Sampling methodology in dense forests can easily underestimate the population sizes of primate species, and either an increased effort or a change in the methodology is needed. We should also take this into account for our Colobus population estimations. The validity of this survey method in general is questionable since the surveys are by definition spread out over a longer time-span, rather than conducted simultaneously on all transects. Future work will focus on obtaining more accurate group counts, as well as group characterisation to determine the composition of groups. Use of GPS and related software will allow us to better define home ranges for Colobus troops. This, along with an increase in knowledge of local flora, should allow us to derive more information on habitat preference, leading to more sound scientific bases for conservation.

It is still beyond doubt that this relatively small forest holds a large, viable population of *C. a. palliatus,* which Anderson (2007b) highlights as one of the largest and most important populations of this species in Kenya. This forest is an indigenous forest patch, with a variety of rare and endangered endemic plant and animal species. Increases in deforestation and human settlement

continue to pose significant threats to the *C. a. palliatus* population in the form of habitat loss. The high population of *C. a. palliatus* residing within the Shimoni forest, and the high number of endemic plant and animal species, renders the conservation and protection of the forest of major local, national and international importance.

5.2 Colobus travel pattern studies

Travel patterns for the Angola Black-and-white Colobus (*Colobus angolensis spp.*) have not been previously studied and such data is very much needed. The development of an effective methodology in itself would be valuable for other research programmes and possibly for our partner programme in Kakamega.

As a last remark, it would be interesting to revise the travel pattern data form, in order to obtain data consistent with the Primate Behaviour surveys, increasing considerably the amount of data available for behavioural analysis and its reliability.

5.3 Primate Behaviour Survey

Colobines have large, four-chambered, polygastric stomachs, permitting fermentation by anaerobic cellulytic bacteria (Struhsaker & Leland, 1974). This ruminant-like digestion allows them to exploit leaf diets generally unavailable to other primates. Most species show a greater preference for young leaves that are higher in protein, and are found high up in the canopy. This may indicate why this species is found there, i.e. due to the food availability rather than as a consequence of competition from other anthropoid species or shyness to human presence. However, an adaptation for mature, tough leaves would enable this species to live in high densities, as food competition becomes relatively low and foraging time reduced. Smaller groups as seen within the study area (average group size calculated at 2.96 for east and 3.25 for west for Expedition 121, with the maximum number ever observed in this forest being 13) deplete food sources less quickly and therefore can afford to remain in one area for long periods (Fimbel et al. 2001). Mature leaves require effective detoxification (Kay & Davis 1994), and a high amount of energy is devoted to digestion, relating to large amounts of time spent resting.

In the last week of November 2011, an article was accepted by the *Journal of African Primatology* titled “Activity budgets of the Angola Black-and-white Colobus (*C. a. palliatus*) in East African Coastal forests” (Wijtten et al, 2011, unpublished). This paper does not include data from the last two expeditions, and therefore will be used for comparison purposes (Figure 7). Resting was the most frequently recorded behaviour in expedition 121, in total making up 69% of the entire observation time. This is an increase from last expedition’s figure of 50% and larger than the figure

of 61.78% for the past 4 ½ years (Wijtten 2011, in press). Feeding was the next most frequently observed behaviour (14%). This concurs with the findings of the last two expeditions (12% in 114, and 15% in 113), but is significantly less than the findings of Wijtten (2011, in press), which recorded 21.07% of time devoted to feeding during the period from February 2007 to August 2011. This could correspond to the availability of food due to the amount of rainfall. Drier periods decrease food availability and the abundance of young nutritious leaves. Also, a higher dependence on mature leaves involves longer digestion periods (Kay & Davis 1994), so one might expect to see larger amounts of time spent resting.

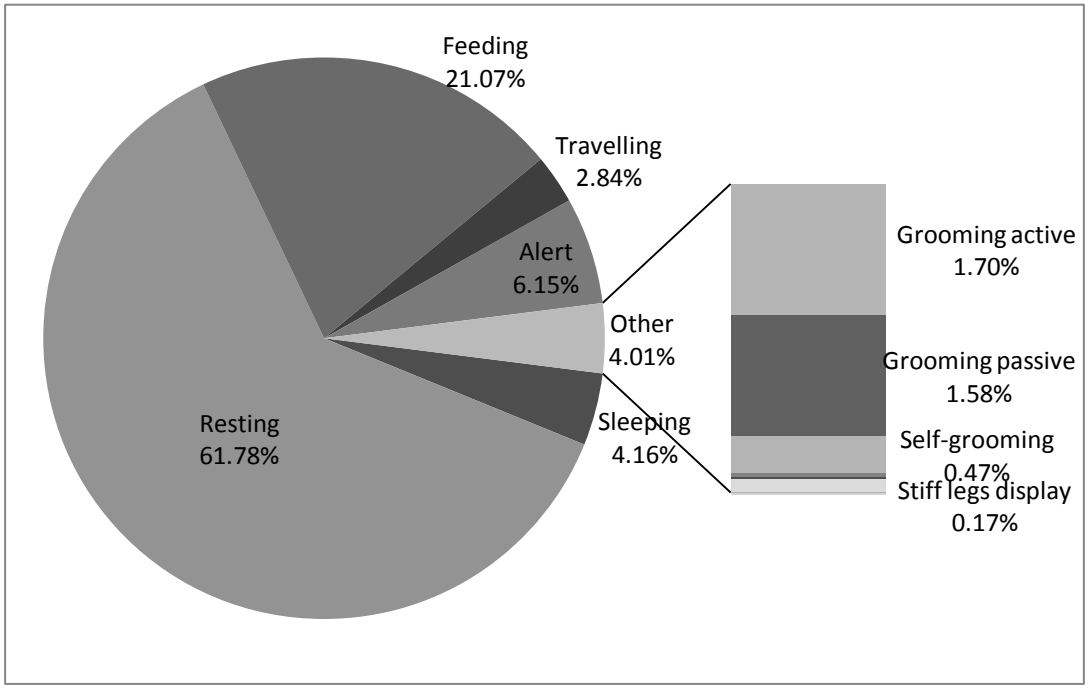

Figure 7. Chart displaying the activity budget of *C. a. palliatus* in the survey area between February 2007 and August 2011.

There was a decrease this quarter in the amount of time spent staring at humans, from 17% to 8%. Travel time also continued to decrease, from 4% to 1%, down from 36% in Expedition 113. Both of these decreases could be effects of habituation of the groups. Logically, fleeing behaviour will decrease in habituated and semi-habituated groups. No aggressive behaviour was witnessed between or within groups this expedition which highlights how relations within troops of Colobus are peaceful and close, and reflects the placid dispositions of leaf eating monkeys (Estes 1991).

Grooming behaviours normally occur within the resting periods, early in the morning or late evening (Estes, 1997). When grooming has been observed in previous expeditions, females were the groomers more often than males. This is expected as within *C. a. palliatus,* males emigrate and

females remain within their natal groups. Individuals that are related show higher levels of grooming towards each other than towards unrelated individuals (Struhsaker & Leland, 1974). However, this expedition most grooming was classified as “self-grooming”, with only three instances of active grooming noted. Of those three instances, one was by a male, one was by a female, and one was by an adult of undetermined sex.

Three primate groups can now be confidently recognized, therefore allowing comparison between group behavior, home range and composition. Data of this type will yield interesting results for the populations residing within the forest. This will require more data collection, as the amount currently held will probably not be sufficient. This reinforces the need to continue primate behaviour surveys in the following expeditions.

We will continue to perform behavioural surveys, expanding our efforts to the forest patches more westward, and start looking into opportunities to expand ecological and behavioural studies with regard to group movement and life-history. Performing these studies in conjunction with primate community and group characterisation studies will provide us with more comprehensive data concerning habitat use by colobus groups of varying composition.

5.4 Bird Point Counts

The total number of species in our bird list currently goes up to 184 species. Previous visits from Birdlife International ornithologists have only identified 117 different species within the Shimoni forest (east). Several bird species identified within this forest are listed on the IUCN Red List of Threatened Species. The Amani sunbird (*Hedydipna pallidigaster*) and spotted ground-thrush (*Zoothera guttata*) are listed as endangered; Fischer’s Turaco (*Tauraco fischeri*), the plain-backed sunbird (*Anthreptes reichenowi*), the martial eagle (*Polemaetus bellicosus*), and the southern banded snake-eagle (*Circaetus fasciolatus*) are classified as near threatened. The Uluguru violet-backed sunbird is also listed as locally threatened. Four of these species were sighted during either bird point counts or during casual observations this expedition (Table 14). There have been sightings of the other species in past expeditions. This shows that Shimoni forest is a viable habitat for these species.

Species	Number of individuals seen during bird point counts	Number of individuals seen during casual observations
Amani sunbird	3	0
Plain-backed sunbird	4	16
Martial eagle	0	2
Southern banded snake-eagle	0	1

Table 14. Sightings of threatened bird species in Shimoni forest during expedition 121.

Casual observations are also increasing the species list. Due to difficulties imposed by the visual constraints of a forest environment, bird song identification has led to an increase in successful species identification. Moreover, expanding research to off-transect sites allows us to include a multitude of water birds and to explore the west side of Shimoni peninsula, which has more savannah-type vegetation.

Ross' Turaco has been reported regularly in the area. Accurate confirmation of these sightings would mean a large range extension for the species, but we have had no sighting of this species yet.

As a result of our efforts over the years, Birdlife International and their local partner Nature Kenya have expressed interest in declaring the surroundings of Shimoni an 'Important Bird Area'. Such a status might very well aid future conservation effort and increase global interest for the area. The request is currently under consideration.

5.5 Canopy Surveys

Canopy surveys continue to provide valuable data on seasonality of canopy density in support of primate surveys. Decrease in canopy cover is alarming and quite possibly reflecting the ongoing destruction and degradation of the forest. Such drastic and sudden changes often result in great ecological changes that directly affect wildlife and biodiversity in general.

5.6 Butterfly Community Survey

The sweep netting surveys continue to provide information on the butterfly populations in all areas of the forest. Not only does the mobility of the sweep nets provide a chance to survey areas of the forest that the traps do not cover, but they also allow species to be caught that would not ordinarily go into the traps, such as the smaller, weaker flyers.

While the diversity of butterflies captured indicates a healthy diversity in the local flora, more quantitative data might provide more reliable information regarding the abundance of each species' associated plants. A modification of the survey methods should be considered for future expeditions.

5.7 Disturbance

The results from this expedition's disturbance surveys continue to cause alarm. The most concerning set of results are those of charcoal pits, clearings and fires or burnt areas of vegetation. A new charcoal pit is one that is in the process of burning when recorded, or is considered to have completed the burning process within a day or two. These results demonstrate that charcoal burning continues to be utilised as a form of resource use. No charcoal pits were observed before September 2007, however new charcoal pits have been observed during nearly every successive expedition. The period of January-March 2012 resulted in 22 new charcoal pits being discovered and 44 old pits (highest number since 2007). These figures combined with the increasing size and scale of the pits themselves is cause for concern. The numbers of poles and timber also continue to increase, from 2219 poles and 671 timber (old and new) in expedition 114 to 3280 poles and 1299 timber in expedition 121. Although there is currently no indication of a drop in *C. a. palliatus* population numbers, Anderson (2007) showed a negative correlation between *C. a. palliatus* density and forest size. Especially at current rates, habitat loss from increased deforestation and human settlement might very likely cause a significant threat to *C. a. palliatus.*

GVI has again recorded a significant number of large clearings. New clearings are developing both along the road and within the forest - a cause for concern. One significant new clearing along transect 3 in Shimoni East has burnt an area of roughly 300m by 150m of forest to the ground. The land is already being converted to farmland. Several other clearings of about 50m by 50m seem to exist for the purpose of harvesting timbers, poles, or charcoal. If the level of disturbance seen along the transects were to be extrapolated outward away from the transects, one could assume a severe level of disturbance throughout the forest as a whole. It is however possible that our transects are providing a means for local timber harvesters and charcoal burners to access the forest to a greater extent than would be possible without our presence. This requires further investigation to examine the distribution of disturbance activities in relation to our transects.

The coastal plots along the South side of the peninsula see the most development. Within less than a year an area of roughly 2200m by 200m, or 44 hectares, representing critical and unique habitat within the Shimoni area, for several confirmed internationally protected species has been destroyed. The identity of the developers is not entirely clear. On behalf of FSF, GVI is trying to establish lines of communication between the local community and the developers. Hopefully this will result in the

concerns of the community being relayed to these developers, and will allow for requests and advice to be given, so as to stop illegal activities and reduce the negative impact of the development.

Due to the continued destruction of the forest, it is vital that disturbance surveys are continued and possibly even extended in the future.

5.8 Casual Observations

Casual observations continue to yield results, as there have been a multitude of sightings throughout the January-March period. These sightings include a diversity of primates, other mammals, birds, and reptiles. There continue to be sightings of unidentified species (mammals, reptiles and birds), as well as recordings of species not recorded in any other survey, which highlights the importance of continuing this survey.

5.9 Hornbill survey

Hornbills remain a potential flagship species. The lack of enough sightings and the impossibility to perform a Distance analysis suggest that a revision of the methodology should be considered. An increase in the effort would be a good starting point, for instance, including hornbill community in all survey days and dedicated observations, allowing identification not only from visual observations but also from vocalizations.

5.10 Digital Herbarium

The digital herbarium has proven useful in several instances. An expansion would be beneficial.

5.11 Pitfall Traps

Pitfall traps have proven to be beneficial in expanding the registered biodiversity for the Shimoni area. The method often proves invaluable when collecting data on invertebrates, small mammals such as shrews or mice, amphibians and smaller snakes. As placing traps requires extensive resources and man-power the method is unlikely to provide quantitative results. An alternative should be considered, in order to obtain valid quantitative and qualitative data of small terrestrial animals.

5.12 Arachnid Identification

As arachnids provide a limited but interesting group of invertebrates, our catalogue might be a step up to further invertebrate studies and provide a reference for arachnid studies. A continued and consistent effort is needed in the future to build on the existing database.

5.13 Mangrove surveys

The south-side of the mangrove area east of Shimoni seems to know a lower level of disturbance compared to the more northern areas, possibly as a result of accessibility. Some indication of mangrove degradation caused by global warming related effects was found at the outer, ocean side, edge of the Southern-most transects.

The ecological significance of mangrove forests is well understood. Mangrove forests provide a number of ecological services including prevention of erosion, biodiversity value, water filtration, and sediment and waste trapping. The health of the Shimoni mangrove forest is not properly understood as yet and thus the surveys will continue into the future. The continued occurrence of unidentified species (mammals, reptiles and birds) in the mangrove forest further highlights the importance of continuing this survey.

5.14 Fruit and flower survey

No Fruit and Flower survey was performed during Expedition 121. However, comprehensive knowledge of fruits and flowers would be highly valuable as a complement of the butterfly, bird and primate surveys. We shall continue building up this database.

5.15 Moth survey

Moths are very much underrepresented in current Lepidoptera literature for East Africa. The moth discovery curve is inclining and further work will provide valuable insights in diversity, seasonality and possibly abundance.

6 Summary, Recommendations and Future Work

As human disturbance in the form of forest clearance and charcoal pits have continued to increase within the past three months, an assessment of *C. a. palliatus* home range, in relation to distribution and levels of disturbance would be valuable to assess the impact on the population. This would require dedicating a large amount of time to specific troop identification, which has already been started with the Travel Pattern Surveys. However, a larger effort is necessary. Disturbance surveys

will continue being carried out in both Shimoni East and West forest. Within expedition 114 a forest degradation report has been distributed.

Trapping of butterflies using the canopy traps will be continued in Shimoni East and West and in the indicator plots. There is scope to increase the number of traps within the survey area, which would enable the monitoring of different habitat types, such as in different indicator plots.

Casual observations continue to reveal greater faunal diversity. Although some of the large terrestrial mammals have been identified, it is thought more species are yet to be spotted. Night/dusk walks will continue hopefully, revealing a greater diversity of nocturnal or shy species, e.g genets and civets (*Viverridae spp.*), and aardvarks *(Orycteropus afer).* Crepuscular animals are not being recorded due to the absence of any dawn surveys. These should be undertaken in future. Bat and bird mist netting and harp trapping would provide a record of bat and bird species within the forest. This could potentially increase the species list although the risk of disease transmission should be considered in survey design. Bird surveys will be continued as the species list is still increasing. Calculating the relative abundance of existing species and the variation during different seasons and through different habitats will be beneficial. We have begun a new bird survey that assesses the diversity of waders we have on our coastal shores. This survey has led to the addition of new species and should be continued with an increase in effort. This could open up a variety of possible studies including reviewing migratory traits in waders and their diversity, which will in turn further boost our current species list. Very little research has been done on waders within the Shimoni area so this survey will prove very beneficial.

With the help of a botanist, the species list for vegetation that fruit or flower is increasing and a substantial herbarium collection is within sight. With aid of the botanist, more plant species can be identified and a density estimation of these species presence in the forest obtained. Continuing to expand the herbarium catalogue is considered vital.

Global Vision International is working very closely with the community-based organization Friends of Shimoni Forest (FSF), who promote forest conservation, promote environmental education and support community initiatives. This expedition, the different achievements include:

- Computer lessons: Capacity building is an important part of what GVI aims to provide. Both the FSF organisation as a whole AND the individuals within it have benefited greatly from these lessons. The skills they have learnt are essential and transferrable and the FSF guys have enjoyed the lessons thoroughly.

- Land proposal: This expedition, FSF (with the assistance of GVI) assembled a proposal for the local council. FSF has applied for 104 Acres of forest for conservation purposes. We are eagerly awaiting a response from the council.
- Tourist trail: To ensure that the skills and knowledge of the FSF tour guides are maintained many GVI volunteers have participated in and evaluated the FSF “Tourist Trail”. This exercise is to ensure that they can offer an enjoyable, educational experience to tourists, which is essential if they are to grow.
- Information Banda: Negotiations between FSF and GVI are underway regarding the erection of an FSF information banda. This would provide an opportunity for other local business to benefit from FSF’s tourist traffic.
- Collaboration: FSF and the local boat tour operators have shown interest in collaborating to help Shimoni’s eco-tourism industry grow. GVI’s involvement with the KMMPA and similarly our relationship with FSF has helped to facilitate this collaboration.

Charcoal is one of the greatest threats facing Shimoni forest at present. Currently FSF and GVI are supporting the Shimoni Environmental Association, which is doing weekly workshops on alternative charcoal from Shimoni primary. This expedition, members of the GVI forest program have been assisting the Shimoni Environmental Association (SEA) in developing an environmentally friendly charcoal alternative in an effort to save Shimoni forests. Throughout the last 10 weeks GVI has continue to build good relationships with this organisation and its members so that our common goals can be achieved. Our achievements include:

1) We have succeeded in formulating a recipe for the briquettes that will be able to compete with charcoal as an energy source. This was a lengthy process of trial and error but we now believe we have the right ingredients to pursue large scale manufacture of briquettes.
2) Provided funds through the carbon offset program that will allow the SEA to produce charcoal briquettes more quickly and efficiently.
3) Provided a means to encourage charcoal burners back into the SEA. The future purchase of a posho mill will present alternative income streams i.e. briquettes and maize flour.
4) Developed a logo and flyer to accompany free samples of the product. This will allow SEA to approach major charcoal consumers i.e. hotels and restaurants, in an organised and professional manner.
5) Collaborated with a similar project in Diani to increase both our knowledge and potential customer base.

Although we are now aware of the population status of *C. a. palliatus* will still remain our focal study species, Habitat affiliation is known to a certain degree but open to further study. We are still discovering new species every expedition, however species discovery curves are levelling-off. Fauna has been catalogued with the exception of invertebrates, nocturnal species, bats, a range of small mammals and a range of flora. Cataloguing the remainder of the species would require the use of different survey techniques but mainly basic materials such as field-guides, traps and recorders. Natural resource use and anthropogenic impact has been studied and is, to a large extent, known for the area. Awareness and capacity for community based conservation is being raised and built by continuous support of several local groups, projects and environmental education.

Because of the drastic change in our research area, when comparing it to 2007, approximately 50% of the coastal forest has disappeared and destruction rates are increasing. A shift in focus and goals is evidently becoming needed.

Research focus will shift from biodiversity assessment to shorter period single species or species group ecology studies, and long-term continuous studies related to anthropogenic impact, degradation and regeneration. As previously stated *C. a. palliatus* will continue to be our main focal species.

Publishing and communication of findings, online, peer-reviewed or popular scientific thereby legitimating research, presence and creating awareness will be a constant target.

Long term goals with include continuing with *C.a.palliatus* ecology and behaviour studies. Yearly Primate census of Shimoni Peninsula will continue, feeding ecology, group size, home-range, social structure, association with other primates and predation with other primates will all continue to be surveyed.

We also want to gain more knowledge of the satellite forest camps in Kwale District, including kibuyuni Dam, Mkenda river crocodile population monitoring and Kwale district forest patches biodiversity.

With regards to Shimoni forest it’s crucial to carry out degradation and regeneration studies. Flora and fauna regeneration after clearing, fire, and logging is something we are very eager to initiate. We are also looking into the carbon sequestration potential with biomass studies.

We are also hoping to start up some short term ecological research projects. The Zanj elephant shrew is still an elusive creature, although we now have a greater grasp of its general distribution, we still are unclear of population. Thus we hope to gain a wider knowledge this expedition.

The Zanj sun squirrel (*Heliosciurus undulatus*) is another species that has rarely been studied, and we are planning to learn more about the ecology of this squirrel, either through distribution or behaviour.

Mangroves are extremely important to our coastal forest and hold a vast bio diverse habitat. Through stress indication surveys we can obtain a better awareness of the degradation that the mangroves are being subjected too.

We have recently become, much more aware of the bush babies in our forest, originally we believed there to be only one species, the Greater galago *(Otolemur garnetii)* now however we have discovered that the much rarer Dwarf galago *(Galago senegalensis)* also resides in this area in high densities. With this new information we hope to discover more about the Galago distribution and density, through more night surveys and spotlighting activities.

Other suggested long term goals are listed below

1. Dissemination of data acquired from 2006-now thereby establishing our presence in the Area on a broader level, warrant significance and legitimacy of past and current ecological research, and aid our partners in science based conservation management. This can be done by:
    a. Submitting a number of peer reviewed publications
        i. *Colobus angolensis palliatus* activity budgets (Target: African Primatology), already accepted.
        ii. *C.a.palliatus* habitat extension; mangrove-type (Target: To be determined)
        iii. General biodiversity for one of the last remaining coastal forests in Kenya (Target: Journal of Coastal Research).
        iv. *Rhynchocyon petersi* (Zanj elephant shrew) presence, density and habitat description. (contribution 2011 Symposium on small mammals in Africa, Arusha), already presented.
    b. Online publication of existing reports and findings
        i. Continuous GVI Blog and, when allowed, a Flickr account with selection of forest pictures.
        ii. End of expo reports from 2007-now.

c. Involving third parties and research professionals in current research
    i. National Museums of Kenya (NMK), for confirmation of new species for the area or Kenya, and collection of unidentified species.
    ii. November 2010: L. Pozzi, University of New York, taxonomical status of Greater and Lesser (Dwarf) Galago at the Kenyan coast.
    iii. Dr. J. Kairo, Specialized in Mangroves, in particular for the Kenyan South-Coast.
    iv. Dr. T. Butynski, Y. De Jong, Authority on East African Biodiversity, with specialization on Primates.
    v. Dr. A. Pearcy, Specialized in crocodile management and ecology.
    vi. Collaboration with Colobus Trust Diani, already begun with regards to alternative charcoal.
    vii. Involvement in national primate conservation working group for Kenya.
    viii. Dr. J. Fahr, bat specialist interested in collaboration on *E. helvum* counts.

2. Active protection of coastal forest trough community development
    a. Continuous support of Friends of Shimoni Forest:
        i. Management structure.
        ii. Training.
        iii. Funding.
        iv. Tourist trail development.
    b. Promotion of alternative charcoal production:
        i. Support of existing alternative charcoal group.
        ii. Further promotion of new group formation.
        iii. Acquisition of a posho mill in order to enhance, accelerate and improve the briquette production.
    c. Environmental education:
        i. Adult environmental education (weekly).
        ii. Wildlife club (weekly).
    d. Shimoni village Forest Scout programme to prevent illegal practices:
        i. Support and training of forest scout programme management and communication.
        ii. Funding.
        iii. Assessment of possibility to acquire and protect small forest patches or corridors.
    e. Supporting ongoing reforestation efforts in Shimoni.

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