Investigating mammalian species richness and vegetation structure in the Arabuko-Sokoke Forest, Kenya, using reconnaissance walk techniques.

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Summary

1) The mammalian and plant community of the Arabuko-Sokoke Forest, Kenya was investigated using reconnaissance walk techniques and quadrat sampling. Correlations between animal and plant species were examined in each of the two main forest types, namely Cynometra forest and Brachystegia woodland.

2) A total of seventeen different animal and eighty-two plant species were recorded. Correlations were found between the plant and animal species within the Cynometra but not within the Brachystegia woodland.

3) Further analyses revealed significant differences between the structural components of the two forest types and a north/south divide within each forest habitat, giving a total of four separate regions in terms of the vegetation.

4) Ivlev’s electivity index found that aardvark, porcupine and caracal showed positive preference for northern Cynometra and strong avoidance of the other three habitats while bushbuck, genet, civet and baboon actively selected Brachystegia and avoided Cynometra.

5) The conclusions drawn on habitat preferences and presence/absence data will aid the Arabuko-Sokoke Forest Management Team and the Kenyan Wildlife Service in their continued work to preserve and maintain the Forest.

Keywords: Ivlev’s electivity index; recce walks; species richness; vegetation sampling
**Introduction**

In order to effectively manage and preserve an area of any habitat, a comprehensive survey must be conducted to develop knowledge of the populations of animals and plants within that habitat, and any relationships existing between the two (Fitzherbert *et al*, 2006). Line transect surveys are one method employed to obtain such information. Direct or indirect signs of animal presence are used according to the habitat type of the study site. Direct methods involve counts of animals sighted and allow estimations of the population dynamics. Seasonal repeats of such assessments can provide a population history, which can be maintained and used for future research. However in forest or woody areas, where visibility is low, this method can be impractical and potentially biased (White & Edwards, 2000). Indirect methods involve counts of any physical signs of an animal presence, for example faecal counts, spoor tracking and nest counts. Although these generally do not allow for estimation of population sex and age structure, they do still provide a good assessment of species abundance (Buckland *et al*, 1993).

Walsh & White (1999) developed a method described as reconnaissance or ‘recce’ walks which involve following the line of least resistance through a forest at a constant compass bearing. This method allows researchers to work in smaller teams, travel faster and to minimise their impact on the forest. However this technique cannot be used to estimate species abundance in a particular area. By following existing paths through the forest the data is potentially biased, as it will not provide a representative survey of vegetation types within the area or the numbers of animals present (White & Edwards, 2000). To assess presence / absence and species richness data, the process allows for a larger area of habitat to be examined within the same time frame. If abundance analyses are needed, a combination of recce walks and comparative line transect data collection in the
same area would be required. This will enable a quantifiable correlation between recce walk data and animal densities (White & Edwards, 2000). Vegetation analyses are very important in a forest environment as they define the very nature of the ecosystem. Tropical forests contain a large diversity of plant species, which in turn provide a large variety of habitat and food material for the mammals within them. The first step in any vegetation analyses is to conduct an inventory of the species present within the study area. An inventory can provide a record of the plant species found in the region, estimates of abundance and an idea of the favoured habitat of each species. Quantitative studies (i.e. a numerical description of a habitat’s composition) like this are beneficial in that they 1) provide biological information on the botanical structure and uniqueness of an area; 2) provide a basis for vegetative classification and mapping studies and 3) provide a foundation for further ecological research for example, food plants constituting an animal’s diet (Archaux, Berges & Chevalier, 2007).

It is a general assumption that mammal species richness is related to the vegetation structure of the environment (Martinoli et al, 2006). Most studies conducted in this area have involved rodents although conflicting conclusions have been drawn (Medellin, 1994; Caro, 2002; Ecke et al, 2002; Fitzherbert et al, 2006). During studies undertaken in northern Sweden, Ecke et al (2002) reported that tall vegetation cover (shrub layer) and the structural heterogeneity of the forest floor layer positively influenced rodent species richness. Caro (2002), looking at species richness inside and outside the Katavi National Park in Tanzania, contradicted these findings and found no significant effects of canopy, shrub or leaf litter on rodent diversity. Surprisingly, greater species richness was found outside the Park rather than inside it although Caro reached no definite conclusion as to why this should be so.
Ecke et al. (2002) also noted that clear cutting during forest management appeared to promote an increase in rodent diversity. Similar results have been found in forest management areas in British Columbia, Canada (Sullivan & Sullivan, 2001). Presently within the ASF there is a population of African savannah elephants, originally thought to have come from Tsavo East National Park and prevented from returning by the increasing human population (Kombe, W., pers.comm.). Almost one hundred of these elephants now inhabit the forest (ASFMP, 2002) and their daily movements and feeding habits have a large impact on the structural composition of the various vegetation zones. Although this study is not focusing on the disturbance caused by these large mammals, their presence and influence on the vegetation cannot be overlooked.

The purpose of this study was to develop a greater understanding of the vegetative make-up of the Arabuko-Sokoke Forest, Kenya, through quantifiable data collection and to investigate potential correlations with the various mammalian species present in the various floral zones. Some of these species are yet to be studied in any detail so this work will also provide preliminary data on the more elusive species inhabiting the forest.

**Materials and Methods**

*The study site*

The Arabuko-Sokoke forest (ASF), situated within the Kilifi and Malindi districts, Kenya (S 03°20', E 39°50'), is the largest remaining fragment of the indigenous coastal forest that once stretched along the East African coast from southern Somalia, through Kenya and Tanzania, to northern Mozambique. The ASF covers approximately 41,600ha within the Kilifi and Malindi districts of Kenya, about 120 miles north of Mombasa. 5935ha in the northern region was designated
a Nature Reserve in 1979 (ASFMP, 2002). There are three main forest types within the ASF: *Cynometra* forest or thicket, *Brachystegia* woodland and Mixed Forest (Fig. 1).

The forest types of concern for this work are the *Cynometra* forest and *Brachystegia* woodland. The *Cynometra* is a thick, tangled forest type consisting predominantly of *Cynometra webberi* and *Manilkara sulcuta* with an important population of endangered *Brachylaena huillensis* (KIFCON, 1995). This population was once abundant within this forest type but has suffered from extended extraction for carvings and timber. Underlying Jurassic sediments cause the soils to have a distinct red colour with a low phosphorus content and low fertility (Blackett, 1994).

The *Brachystegia* woodland has a higher and more open canopy, dominated by *Brachystegia spiciformis*, with many grass-covered clearings (KIFCON, 1995). The deep, loose, light coloured sands have poor fertility and allow rapid percolation, with little water being retained to promote plant growth (Britton & Zimmerman, 1979). The dividing line between the two soil types is very distinct and is reflected in the abrupt vegetation change from *Cynometra* to *Brachystegia* forest. The base of the plateau also has a number of seasonal pools that dry out during the dry season. The Sokoke swamp is the only permanent water source, located on the northeastern edge of the forest.

Rainfall has a bimodal pattern, with a monsoon season from April to June and a second period of rainfall during November and December. Annual average rainfall varies from less than 600mm in the northwestern areas to over 1000mm in the east. Temperatures generally remain high with a daily mean of 25°C while the proximity of the coast ensures high humidity throughout the year. The western area of the forest is plateau, reaching heights of 60-160m above sea level, and begins
to descend to the flat coastal plain (45m above sea level) in the east of the forest on roughly a SW-NE line (KIFCON, 1995).

Agriculture in the area surrounding the forest is becoming more and more intensive with maize cultivations, as the human population in the area continues to grow. Encircling villages and crop plantations sets the ASF boundaries. The human / wildlife conflict in the area continues to increase as crops are regularly raided by the forest fauna, predominantly elephants and primates.

Field methods

A comprehensive overview of recce walk techniques is given in White & Edwards (2000). A key element in the method design is ensuring equal coverage probability of the study region to reduce any bias in the resulting data. An example of poor design would be the placement of walks along the contour lines of a region rather than perpendicular to them. This would lead to low precision in the resulting data if altitude has any effect on the species richness of the region (Marques et al, 2001). Recce walks, as with line transects, can be established using a random stratified sampling procedure (Plumptre & Reynolds, 1994; Hirzel & Guisan, 2002). Eight strata were identified within the parameters of the study (Table 1). Regardless of stratum size, eight 500m long recce lines were walked within each stratum, with starting positions chosen at random, making a total of 64 walks throughout the study period. Hirzel & Guisan (2002) showed that equal-stratified sampling is an effective method in model predictions of presence/absence data. Their paper provides an evaluation of optimum sampling strategies for habitat suitability modelling and presence/absence predictions.

The initial data set collected on the walk, were any animal sightings, tracks or other indirect signs of animal presence, such as dung or pathways. All signs within a metre on either side of the walk were recorded. On the return walk
vegetation analyses were conducted. Each 500m walk was divided into 5 sections of 100m and at the centre of each 100m, a 10m² quadrat was staked out. On walks conducted in the forest strata, the quadrats were situated on the central line of the walk to get a representative example for the whole walk (Fig. 2). Quadrats completed on road recce walks were measured out 10m into the forest on alternating sides of the road (Fig. 3). This ensured that any edge effect exhibited by the vegetation directly adjacent to the road could be disregarded. Within each quadrat, canopy height and density (on a graded scale), substrate type and depth and understorey density (estimated average distance between adjacent shrub or tree base) were recorded. In addition, the total number of each species of tree and shrub within the quadrat was identified and noted. The start and end point of each recce walk was marked using a hand-held GPS system (Garmin e-Trak®).

Three people were required to complete the walks effectively: a local guide and tracker, with years of experience in identifying the plant and animal species of the forest, to create a path through the vegetation; one researcher recording all direct and indirect signs of animals with the aid of the guide and another researcher monitoring the direction and length of the line of walk. In many parts of the forest, the GPS failed to accurately record distance due to the dense canopy cover. Therefore all distances were measured by the pacing of the same individual with regular checks with a tape measure to ensure accuracy.

Statistical analysis

To test the null hypothesis (H₀) of no difference between the two habitat types, the 2-sample t-test was performed using Minitab® (2007). Possible differences between the north and south sections of the same forest type will also be investigated using this test. Spearman ranked correlation was used to examine
any associations between total animal and plant species number within each forest type and any relationships between the five vegetation variables.

Ivlev's electivity index (Jacobs, 1974) was used to investigate habitat selection by the small and medium mammals of the forest, using the indirect counts and observations recorded on the recce walks. The electivity index, $E_i$, for habitat $i$ is calculated by the equation $E_i = (u_i - a_i) / (u_i + a_i)$ where $u_i$ is the proportion of species observations in habitat $i$ (the habitat utilised by that particular species), and $a_i$ is the proportion of habitat $i$ available within the study area.

Ordinal logistic regression examines the relationship between one or more predictor or ‘cause’ variables and a response. In this case, the effect of the five quantified vegetation variables on the number of animal signs found was examined using this technique. Another advantage of this type of regression analysis is that it allows for some of the data to be in category form, thus reducing the influence of human error during estimates (Dytham, 2006).

**Results**

*Species richness*

In total, evidence of 17 different species of small to medium mammals were recorded on the 64 recce walks located within the *Cynometra* forest and *Brachystegia* woodland of the ASF (Table 2). Evidence of large mammal presence (elephant, buffalo and hippo) were recorded but not used in any data analysis. In addition, a total of 82 different tree and shrub species were identified. The Spearman rank correlation showed the total number of recorded animal species was not significantly correlated with the total number of plant species ($r_s = -0.091$, $p>0.05$). However, on closer inspection, there is a strong negative correlation between the animal and plant species number within the *Cynometra* ($r_s = -0.419$, $p<0.05$).
p<0.05). No relationship was discovered between the animal and plant species of the *Brachystegia* woodland ($r_s=0.140$, $p>0.05$). The combination of the latter two results balance out to reveal an overall result of no significant correlation.

A 2-sample t-test was used to show no significant difference between the total number of animal species recorded in either of the forest classes ($t=-0.22$, $p>0.05$, $df=61$). However, plant species richness was considerably different, with *Brachystegia* woodland containing more species per 100m$^2$ than the *Cynometra* forest ($t=-4.89$, $p<0.001$, $df=61$).

**Forest structural diversity**

The 2-sample t-test revealed significant differences between means of the vegetation variables in the two forest types: canopy height ($t=-14.21$, $p<0.001$, $df=54$), canopy density ($t=4.04$, $p<0.001$, $df=59$), understory density ($t=-16.10$, $p<0.001$, $df=34$) and leaf litter depth ($t=3.95$, $p<0.001$, $df=52$). Grass was rare in the *Cynometra* and was only present at the borders of the forest types and occasionally in isolated areas where a large tree had fallen. The Spearman ranked correlation performed on the five vegetation variables found significant relationships between all except canopy height and leaf litter depth, although the two are still linked indirectly (Table 3).

No significant differences were found between road and forest walks. Analysis of differences between the north and south regions of the forest were surprising. Although canopy height (*Cynometra*: $t=-0.07$, $p>0.05$, $df=24$; *Brachystegia*: $t=0.85$, $p>0.05$, $df=25$) for both habitats showed no significant difference between the north and south, canopy density in the *Brachystegia* woodland was significantly denser in the south ($t=-3.34$, $p<0.01$, $df=27$) while there was no difference in the means of north and south in the *Cynometra* forest ($t=-1.38$, $p>0.05$, $df=28$). For understory density and leaf litter depth there was a
significant variation in the north and south means for the *Cynometra* forest. The
understorey vegetation was less dense in the southern region (t = -2.30, p < 0.05, 
df = 25) and leaf litter was found to be consistently deeper in the south (t = -2.47,  
p < 0.05, df = 27). Within the *Brachystegia* woodland, leaf litter depth (t = 0.25,  
p > 0.05, df = 29) and understorey density (t = 0.44, p > 0.05, df = 25) were not found to  
be significantly different so the null hypothesis was accepted in this case.

*Habitat usage*

The community of mammals within the ASF did not inhabit the different  
forest types randomly, but appeared to show strong avoidance for some regions of  
the forest and positively select others (Fig. 4). The southern areas of the  
*Cynometra* forest were avoided by all species with the exception of suni  
(*Neotragus moschatus*) and Four-toed Elephant Shrew (*Petrodromus tetradactylus*), at least during the study period. Bushbuck (*Tragelaphus scriptus*),  
Blotched genet (*Genetta tigrina*), African civet (*Civettictis civetta*), various  
mongoose species and Yellow baboon (*Papio cynocephalus*) appear to choose  
*Brachystegia* woodland over *Cynometra* forest as their preferred habitat while  
caracal (*Felis caracal*), aardvark (*Orycteropus afer*) and porcupine (*Hystrix cristata*)  
actively avoided it. These latter three also avoided the southern *Cynometra* and  
were the only species to positively select only the northern *Cynometra* region. No  
species used all regions of the forest and all avoided at least one of the four study  
areas.

Ordinal logistic regression on the categorised data found various  
relationships between the animal species richness and vegetation variables. There  
were no correlations found between any of the variables and occurrence of  
bushbuck, bushpig (*Potamochoerus larvatus*), caracal and Golden-rumped  
Elephant Shrew (*Rhynchocyon chrysopygus*) while there was insufficient data on
the Syke’s monkey (*Cercopithecus mitis*) to conduct an analysis and form any conclusions. Understorey density had a strong effect on the occurrence of suni (*z* = 3.30, *p* < 0.001) and duiker species as a whole (*z* = 2.99, *p* < 0.01). Canopy density, and thus the amount of light reaching the forest floor, affects the presence of genet (*z* = -2.73, *p* < 0.01), civet (*z* = -2.83, *p* < 0.01), aardvark (*z* = 2.73, *p* < 0.01) and various species of mongoose (*z* = -3.45, *p* < 0.01). Leaf litter depth had an effect on four of the 17 species examined: total duiker species (*z* = 3.30, *p* < 0.01), four-toed elephant shrew (*z* = -2.11, *p* < 0.05), porcupine (*z* = 2.10, *p* < 0.05) and mongoose spp (*z* = 3.01, *p* < 0.01).

**Discussion**

*Species richness and habitat use*

The results of this study show significant relationships between the forest structure and small antelope, smaller carnivores, aardvark, porcupine and mongoose spp. The prevalence of suni and duiker species is closely affected by understorey density. Being a prey species, they are more likely to inhabit areas where there is most cover. Their size allows easy movement through dense vegetation and food plants are more accessible. Surprisingly, bushbuck data did not reflect these results and no relationship was found. This species is much larger and would have difficulty moving through the understorey of the *Cynometra*. Initial observations suggested that bushbuck preferred the more open *Brachystegia* woodland. The same is true of the caracal. Although only observed in the *Cynometra* the regression does not support any link between the occurrence of caracal and forest structure. However, further analysis using Ivlev’s electivity index revealed a habitat preference for both species. Bushbuck did, in fact, actively select *Brachystegia* over *Cynometra* while caracal highly favoured the northern
*Cynometra*. As a carnivore, the caracal would be expected to occupy an area with access to its main prey i.e. small antelope. Its absence from the other three habitat regions are probably a result of secondary factors such as avoidance of humans. Tourists and butterfly farmers are regular visitors to the northern *Brachystegia* while local people daily enter the forest further south. The busy main road running directly through the southern *Cynometra* from Sokoke field station to Dida will also have an effect.

Bushpigs are omnivores and as such, are able to exploit a wide variety of food resources. However, they also actively avoided the southern *Cynometra* although to a lesser degree than bushbuck or caracal. This could also be a result of human disturbance.

The four-toed elephant shrew presence was found to have an association with leaf litter depth, which supports Ecke *et al*’s findings and opposes those of Caro. This would presume an inclination towards both regions of the *Cynometra*, which was in fact the case, however the index also shows a preference for the southern *Brachystegia*. Vegetation sampling showed that this area often had a substantial leaf litter layer in stark contrast to its northern counterpart. The reason for the association is elusive and may not be the result of a direct association. Perhaps the leaf litter increases the chances of locating fallen seeds and berries, missed by other species. Oddly no such relationship was found between any vegetation variable and the golden-rumped elephant shrew. This species constructs dome-like nests using the leaf litter from the forest floor so an association with leaf litter depth would have been expected. Despite this, regular sightings of these unusual rodents were obtained in both forest types and the electivity index showed a positive reaction to all except the southern *Cynometra*. Reduced presence could be due, in part, to the hunting and trapping pressure within this region.
Of the three primate species, the yellow baboon was the only one on which enough data was collected for analyses. Syke’s monkey was recorded only five times while Black-faced Vervet monkeys were only observed once during the study period. However baboon presence was unrelated to vegetation structure. Baboons are extremely resourceful and are capable of exploiting many different habitats. They would have little difficulty locating food in both forest types. With no predators and the shelter and protection the troop provides, they can utilize any habitat within the ASF with no restriction. Despite this, the electivity index shows that baboons actively chose *Brachystegia* and tended to avoid *Cynometra* forest. Practically, the *Cynometra* is difficult for an animal of any size to move through, with the notable exception of elephants. The troop also relies on sight as well as sound to maintain contact. The open *Brachystegia* with its higher, stronger canopy allow the troop to wander further when foraging while still remaining within sight of con-specifics. Young members of the troop would be at risk from predators such as caracal and possibly the larger birds of prey, so the open canopy and understorey allow for early detection of any possible threat.

Both genet and civet had a strong statistical relationship with understorey density. These species are generalist hunters with a diet consisting of small mammals, reptiles, birds, eggs and insects (Nowak, 1999). Thick understorey would allow them to stay concealed while hunting small mammals and birds. However, further analysis showed that they also prefer the less dense *Brachystegia*. It is possible that their diet is more insectivorous in the ASF than is perhaps normal in other parts of their range. There is a large species of burrowing cricket in the forest, which was regularly found by researchers, usually dug up and partially consumed. Evidence around the diggings pointed to genet, baboon and occasionally humans to be the culprits. Although mammalian prey is present in the
Brachystegia woodland, the abundance of such large insects may reduce the animal's need to hunt for mammals.

Two of the three species to strongly avoid the Brachystegia were the aardvark and porcupine (the third being the caracal). The primary reason for the distribution of the aardvark within the ASF is a viable food resource. Aardvark feed predominantly on termites, which construct vast shelters using the surrounding soil. The red Jurassic soils of the Cynometra are a perfect substrate for these edifices while the lighter, sandier soil of the Brachystegia is not suitable for this purpose. Logically aardvarks would be most prevalent in areas of high termite density. Porcupines also had a negative response to both regions of the Brachystegia and showed a strong avoidance of the southern Cynometra. Being primarily nocturnal, it is likely that the frequent human activity in the area repel such a reclusive species.

The negative correlation between total plant and animal species in the Cynometra forest is possibly a reflection of tree and shrub classification. Habitat use by small mammals is strongly influenced by factors that affect their food and shelter resources (Ecke, 2002). There is an abundance of small berry and seed bearing species with no large fruit bearers, with the exception of Landolphia. Therefore only folivores and seed predators have a viable food source. The lack of a variety of food resources will greatly reduce the number of different mammalian species that can exploit that habitat. Hawkins & Pausas (2004) concluded that plant and animal species richness only correlate in their similar reaction to environmental variables. These results disagree with this conclusion, as the various relationships found during this study are unlikely to be a result of climatic differences due to the relatively small size of the study area. The greater number of plant species in the Brachystegia woodland can be attributed to the lesser amount of interspecific competition for space and light. The soils of both forest types have
low fertility (Blackett, 1994; Britton & Zimmerman, 1979), however the red clay-like soil of the *Cynometra* has a higher water capacity allowing many fast-growing species of lianas to flourish which further restricts the light reaching the forest floor. These species will suffocate the young plants of other slower-growing, less hardy species.

**Habitat diversity**

The five quantified forest variables are all directly or indirectly correlated with each other. Therefore any relationships found between animal species presence and any of the variables is due to the forest structure as a whole. Roads and tracks within both types of forest had no impact on the forest structure beyond 5-10m into the undergrowth. The sampling technique used accounted for and eliminated the minimal edge effect of the road. It was due to this method design that no significant difference was found between road and forest vegetation.

The difference between the means of the northern and southern regions of canopy density within the *Brachystegia* could be a result of varying soil fertility. Increased soil richness, if present, and the proximity of the Kararacha swamp in the center of this area may contribute to the increased productivity of the tree and shrubs. The same rationale could explain the wider understorey density and deeper leaf litter of the southern *Cynometra*. More fertile conditions would encourage sapling growth, thus reducing the suffocating effect of the lianas that tend to restrict growth in the northern *Cynometra*.

**Data collection**

The animal species data used for the ordinal regression are counts of direct and indirect signs found along the recce walk. Due to the possibility of misidentifying or overlooking signs, the data was assigned categories. Estimations
of any variable are often prone to bias, especially in studies where two or more people are working independently of each other. Plant species lists can overlook or misidentify specimens and do not always take into account seasonal, spatial or annual variations (Lepš & Hadincová, 1992; Scott & Hallam, 2006). Animal spoor can also be misinterpreted or overlooked. These issues are a particular problem if transects are to be repeated.

Archaux, Berges & Chevalier (2006) recommended large, single use quadrats for vegetation monitoring. For forests they concluded that 10m² quadrats were the optimal size as they obtain a good relative sample while remaining practical in thick vegetation. This author agrees with these findings. Where human judgement is used to measure any indices, there will invariably be error. It is highly likely that over or under-estimation of a vegetation variable, namely canopy height and density, or misidentification of a plant species or animal sign occurred. However by averaging quadrat data over the entire recce walk, it is hoped that the effect of any errors will be reduced. Additionally, with respect to the five variables, it was more important to the study for the data to be representative of the differences between Cynometra and Brachystegia, north and south, so errors will have had little effect on the overall conclusion.

The resident elephants of the ASF have a large impact on the vegetation during their daily movements. Trees and shrubs are regularly uprooted and paths forced through the understorey layer. The fallen trees create a gap in the canopy allowing more light to reach the forest floor and encourage growth. Increased deadwood promotes the proliferation of invertebrates, a major food source for many of the forest’s smaller mammals. Previous studies have shown that measured amounts of disturbance to a forest’s structure can have a positive effect on species richness (Ben-Shahar, 1993; Sullivan & Sullivan, 2001; Ecke, 2002) and the ASF elephants may be performing a similar function. By promoting
understorey growth and indirectly encouraging a rich food source, they are benefiting the wildlife of the forest. Of course, there are matters of human: elephant conflict to consider but these are not discussed by this paper.

There is no doubt that the ASF is a globally important biodiversity hotspot and as such needs to be preserved and understood. Regular sampling of all taxa will provide clues to the status and vulnerability of the forest. Is species richness and abundance declining, remaining at a constant level or on the increase? Techniques such as the capture-mark-recapture method would be of particular use to answer this question, especially when considering the more elusive species of the forest. Is the human encroachment, elephant presence or another external factor having an impact on any species richness trends? Is the vegetation structure and make-up changing with time and in what way? Answers to questions such as these will aid the ASF Management Team in the planning and implementation of future conservation strategies.

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References


Fig. 1: Forest types of the Arabuko-Sokoke Forest, Kenya (ASFMP, 2002).

Fig. 2: Forest recce walk design.
Table 1: Species observed in the study area.

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<td>C. mitis</td>
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Fig. 3: Forest recce walk design.

Fig. 4: Ivlev’s electivity index. Negative values indicate habitat avoidance. Positive values indicate active habitat selection.
Table 1: Eight strata identified for sampling.

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<th>Scientific name</th>
<th>Common name</th>
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<td>Petrodromus tetractylus</td>
<td>Four-toed elephant shrew</td>
<td>Least concern</td>
</tr>
<tr>
<td>Rhynchocyon chrysopygus</td>
<td>Golden-rumped elephant shrew</td>
<td>Endangered</td>
</tr>
<tr>
<td>Tragelaphus scriptus</td>
<td>Bushbuck</td>
<td>Lower risk</td>
</tr>
<tr>
<td>Potamochoerus larvatus</td>
<td>Bushpig</td>
<td>Lower risk</td>
</tr>
<tr>
<td>Felis caracal</td>
<td>Caracal</td>
<td>Least concern</td>
</tr>
<tr>
<td>Genetta tigrina</td>
<td>Blotched genet</td>
<td>Lower risk</td>
</tr>
<tr>
<td>Civettictis civetta</td>
<td>African civet</td>
<td>Lower risk</td>
</tr>
<tr>
<td>Orycteropus afer</td>
<td>Aardvark</td>
<td>Least concern</td>
</tr>
<tr>
<td>Hystrix cristata</td>
<td>Crested porcupine</td>
<td>Least concern</td>
</tr>
<tr>
<td>Various</td>
<td>Mongoose spp</td>
<td>Various</td>
</tr>
<tr>
<td>Papio cynocephalus</td>
<td>Yellow baboon</td>
<td>Lower risk</td>
</tr>
<tr>
<td>Cercopithecus mitis</td>
<td>Syke's monkey</td>
<td>Lower risk</td>
</tr>
</tbody>
</table>

Table 2: Identification and IUCN classification of the seventeen animal species recorded within the ASF. *as of 29th August 2007.

<table>
<thead>
<tr>
<th>Canopy height (m)</th>
<th>Canopy density (%)</th>
<th>Understorey density (m)</th>
<th>Grass height (cm)</th>
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<tbody>
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Table 3: Spearman ranked correlation matrix of vegetation variables of the combined forest types. Top line is the test statistic ($r_s$), bottom line is the p-value (p<0.05 is significant).