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*Habituation, capture and relocation of Sykes monkeys (*Cercopithecus mitis albotorquatus*) on the coast of Kenya*

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Abstract

*The objective of this project was to collect scientific data to assist in the development of guidelines for the humane relocation of threatened and endangered arboreal non-human primate species. A troop of 31 Lowland Sykes monkeys (*Cercopithecus mitis albotorquatus*) was habituated to fruit bait for capture in a village and relocation to a previously selected suitable site in a protected forest reserve approximately 30 km away. Sixty-five percent (n = 20) of the animals were captured and relocated. This subgroup comprised one adult male, eight adult females, two subadult females, three juvenile males, four juvenile females and two infant males. Although the relocated group originated from one single group, post-translocation telemetry signals demonstrated that it split into two groups, which established themselves approximately 2–4 km apart in their new territory; the adult male eventually became solitary. The factors of importance for the successful capture and relocation of forest primates were found to include: proper understanding of troop home-range utilisation and of social bond organisation within the troop, method and period of habituation, method of release, suitability of the new habitat with respect to the ecological niche requirements of the species in question, and the period of post-relocation monitoring.*

Keywords: *animal welfare,* Cercopithecus mitis albotorquatus, *conservation, release, relocation, Sykes monkeys*

Introduction

Habitat destruction and the over-exploitation of animals by the rapidly increasing human population in primate source countries is a worldwide concern. As a result of environment disturbance, some populations of wild non-human primates are at risk of extinction in their dwindling natural ecosystems, necessitating relocation from vulnerable areas to suitable protected habitats. This procedure is relevant in Kenya, where the growing human population expands geographically into the home-ranges of endangered arboreal primate species at a very fast rate.

Capturing and maintaining wild primates in captivity is known to be stressful to the animals (Johnson *et al* 1973; Else 1985; Suleman 1998), and often results in high morbidity and mortality (Uno *et al* 1989; Suleman *et al* 1995, 1999, 2001; Tarara *et al* 1995). Consequently, a conservation strategy protocol for the humane capture, relocation and release of a primate species that is relatively abundant in the wild is vital prior to the application of the protocol to endangered primate species. Capture and release should be undertaken with minimal risks of mortality and of weakening group cohesiveness after release.

In 1984, three troops of wild-ranging baboons in Kenya were successfully translocated a distance of 120 km (Strum & Southwick 1986). Baboons are very adaptable (Strum 1987) and opportunistic terrestrial primates (Altmann & Altmann 1970; Strum 1975; Barton 1989). Most primate species, however, are arboreal. Although the baboon translocation provides an important model for primate translocation, the translocation of an arboreal species is the next necessary step. All of Kenya's endangered primates are arboreal, for example the De'Brazza monkey (*Cercopithecus neglectcus*, Schlegel), which is locally endangered (Karere *et al* 1997). The Tana River red colobus (*Procolobus rufomitratus*, Peters) and the Tana River crested mangabey (*Cercocebus galeritus galeritus*, Peters), both endemic to the lower Tana River, have been classified as endangered in the International Union for the Conservation of Nature and Natural Resources (IUCN) red list of threatened species (http://www.redlist.org). Additionally, populations of these endangered primates have continued to decline over the years. It has been proposed that relocation is probably the only solution for the future survival of the remaining populations of these endangered arboreal primate species (Karere *et al* 1997; Suleman *et al* 2001).

The main aim of the present study was to collect data to assist in the development of a protocol that could be applied to future relocation programmes for endangered forest primate species. A troop of Lowland Sykes monkeys (*Cercopithecus mitis albotorquatus*) was used for this purpose.

Project study sites and animals

This project took place in two locations in eastern Kenya: Watamu and the Arabuko Sokoke Forest Reserve (ASFR).

Watamu

Watamu is a tourist town on the coast of Kenya (Figure 1). The local residents grow cereals and fruits on fairly small plots in the area around the town. The vegetation in Watamu consists of relic patches of semi-deciduous forest on coral rag that once covered most of the Kenyan coast (Stoinski 1995). Approximately seven groups of Sykes monkeys occupy a residential area along the 5 km coastal strip of Watamu town. Much of the forest in this area has been cleared for domestic establishments, resulting in two small forest patches that are separated by inhabited plots with varying amounts of vegetation. Sykes monkeys in the Watamu area are increasingly threatened by loss of habitat and they are perhaps no longer a viable population. As a result, over the years they have begun to raid crops, fruit and garbage pits, and they are considered an agricultural pest by local farmers. The increasing conflict between the residents and the Sykes monkeys has made the monkeys cautious. Although Sykes monkeys are not endangered, local hoteliers did not want them destroyed, and offered to provide some logistic support for the translocation of one group that ranged within the hotels' premises. The aim was to reduce the number of Sykes monkeys, even though it was understood to be a temporary measure because of the high chances of other neighbouring groups coming in to occupy the area previously occupied by the translocated group. Sykes monkeys are arboreal, hence the idea arose to expand the project to include other research objectives, with the aim of gathering data to assist in the development of a protocol that could be applied to future relocation programs for threatened and endangered forest primate species.

Arabuko Sokoke Forest Reserve (ASFR)

The site chosen for relocation was the ASFR, which covers an area of 372 km^2 and is the largest surviving indigenous forest on the coast of Kenya (Figure 1). It is a key site for the global survival of at least six bird species, five butterfly species and three mammal species, and rare plants are distributed in all parts of the forest reserve. The reserve is located approximately 30 km from Watamu and is situated between latitudes 3º30'S to 3º10'S and longitudes 39º50'S to 39º40'E (Mwangi 1992). It is believed that the forest patches remaining in Watamu were once part of this forest. The forest has three distinct habitats: *Afzelia* forest, *Brachystegia* woodland and *Cynometra* forest (Figure 1):

Afzelia forest

Afzelia or mixed forest is a semi-deciduous forest and covers approximately 52 km^2. This habitat type is situated on the eastern boundaries of the reserve on sandy soil and has tangles of underbrush of shrubs and small trees. It is structurally similar to parts of the *Cynometra* woodland. The canopy height is between 10–30 m (Britton & Zimmerman 1979; Kelsey & Langton 1984).

Brachystegia woodland

This is open woodland, dominated by *Brachystegia spiciformes* up to 18 m high, and covers an area of 67 km^2. *Brachystegia* woodland forms a belt running from the southern to the northern parts of the forest. The canopy cover rarely exceeds 50%. A diverse shrub layer grows where there is adequate sunlight. The ground cover is of varying densities and includes knee-high grasses and moderate herbaceous cover (Britton & Zimmerman 1979).

Cynometra forest

This forest habitat consists of three structures: *Cynometra* woodland, intermediate *Cynometra* and *Cynometra* thicket, and encompasses a total area of 253 km^2. *Cynometra* woodland is largely dominated by *Cynometra webberi* (Kelsey & Langton 1984). Mature trees reach 15 m in height (Wairungi *et al* 1993), while the underbrush contains small trees, shrubs, lianas, vines and dense tangle (Kelsey & Langton 1984). The intermediate *Cynometra* is similar to the *Cynometra* woodland but with fewer mature trees and a shorter canopy height, averaging 7–8 m (Wairungi *et al* 1993). The *Cynometra* thicket is a low and dense shrub habitat. It consists of *Cynometra webberi* that is shorter and structurally forms bush shrubs rather than tree canopy. The height ranges from 3–5 m and very few tall trees are found within this habitat.

The fact that Sykes monkeys already existed in the *Cynometra* forest habitat indicated that this was a suitable release site for the Sykes group targeted for relocation from Watamu.

Animals

The Lowland Sykes monkey is a subspecies of *Cercopithecus mitis*, which is widely distributed in Kenya (Eley 1989). Like its counterparts, this subspecies is arboreal and diurnal, and inhabits coastal forests in the eastern parts of Africa, from Somalia to South Africa (Tappen 1960). *C. mitis* are generally highly frugivorous and live in social groupings (one-male and multi-female groups) typical of forest guenons (Tsingalia & Rowell 1984; Cords & Rowell 1986; Butynski 1990). At puberty, males leave their natal groups and subsequently become solitary or join all-male groups (Cords 1987a).

A troop of 31 Lowland Sykes monkeys was identified and studied in its original habitat in Watamu. The justifications for relocating these monkeys to the protected ASFR, approximately 30 km away, were:

1. The increasing concern regarding conflicts between the primates and local residents as a result of the destruction of food crops and fruits.

2. Sykes monkeys are a forest species and not particularly specialised either in their foraging or social behaviour (Cords 1987b; Butynski 1990); their adaptability makes them good candidates for relocation.

3. Sykes monkeys are relatively abundant in Kenya (Eley 1989), and thus they are a suitable species from which to gather scientific data for the future conservation of endangered forest primate species.

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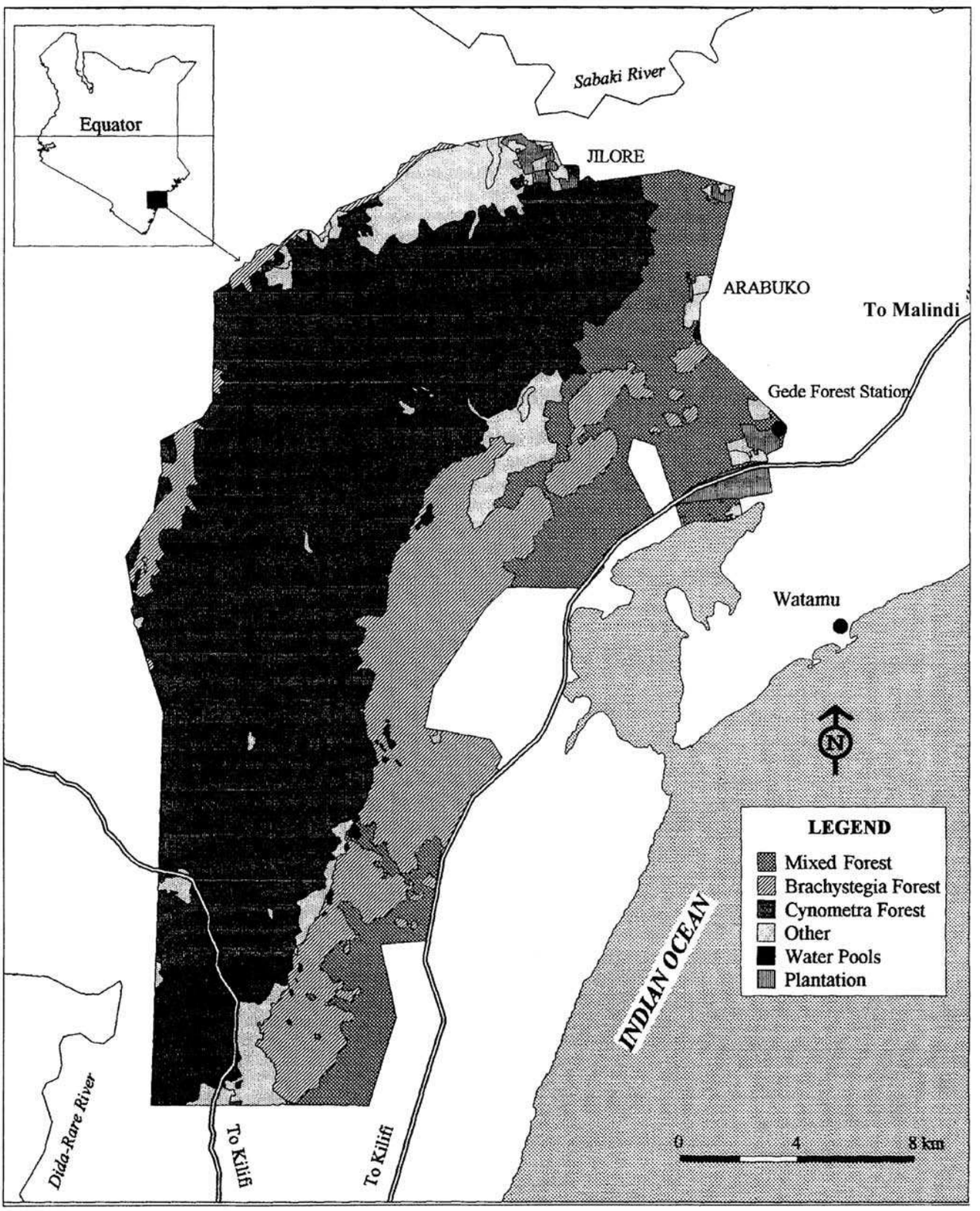
Figure 1



A map of the Arabuko Sokoke Forest Reserve showing vegetation types. Inset is a map of Kenya indicating the position of the forest.

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Project phases

Prior to the start of the project, a study and relocation permit were obtained from the Kenya Wildlife Service (KWS). One condition for the approval of the permits was adherence to the IUCN/Species Survival Commission guidelines for reintroduction (IUCN/SSC Reintroduction Specialist Group 1995).

In order to fully understand and follow the proceedings of this project, this paper outlines the six phases of the project in the following order:

1. Socio-ecological study of the Sykes monkeys in Watamu
2. Survey of Sykes monkeys and habitat in the ASFR
3. Habituation of the targeted Sykes group to aid capture
4. Capture in Watamu
5. Relocation to the ASFR
6. Post-translocation monitoring in the ASFR

The objective(s), methods and outcome of each phase are discussed in turn to provide a clearer sequence of events.

Phase 1: Socio-ecological study of the Sykes monkeys in Watamu

The objective of this phase was (i) to identify the numbers and individuals in the Sykes group targeted for relocation and (ii) to establish the group's home-range boundaries.

Identification of group size and demographics

Three groups of Sykes monkeys that used the premises of two of Watamu's hotels were identified. One of the groups used both hotel premises and was therefore selected for relocation. This selected group was observed for four months in order to collect sufficient data to determine socio-ecological factors considered essential for capture and relocation success. Group members were counted daily to establish the number of individuals in the group and to identify the group's demographics and composition (Butynski & Mwangi 1994). Age classes were defined according to Altmann *et al* (1977). Juveniles were not sexed because reproductive organs were not yet visible. The group comprised 3l individuals: one adult male, ten adult females, one subadult male, five subadult females, twelve juveniles and two male infants. Behavioural data were difficult to collect because establishing the identity of individuals in a large primate troop takes a long period of time (Scott *et al* 1976), and as a result it was not possible to examine individual social bonds. In some species, naturally occurring features can be used to distinguish individuals, while in others distinguishing characteristics may be subtle and their use greatly depends on the location of the features and the visibility afforded by the habitat (National Research Council 1981). Distinguishing individual animal characteristics prior to capture proved to be a difficult task.

Establishment of targeted Sykes group's home-range in Watamu

Home-range is the entire area occupied or travelled by a social group during a year (Jewell 1966) or another specific period (Boornratna 1993). The Sykes monkeys' daily routes within the home-range and their sleeping sites were observed and recorded. This information assisted in mapping the actual area used by the troop, and in determining areas of overlap with immediate neighbouring Sykes groups. The home-range of the targeted Sykes group was mapped out using a scaled grid map of 50–100 m depending on the visibility of the habitat. The direction of the Sykes group's movement was recorded on the grid map for 30 mins in the morning and 30 mins in the afternoon for a period of 21 days prior to capture (Struhsaker 1975; Rudran 1978; National Research Council 1981; Butynski 1990). The group's home-range was plotted (see Figure 2), and the total home-range area was estimated to be 1.75 km^2, including areas of overlap with neighbouring Sykes monkey troops.

Phase 2: Survey of Sykes monkeys and habitat in the ASFR

The main objective of this phase was to determine the population and distribution of Sykes monkeys in the three habitats in the ASFR in order to identify the most suitable habitat for the release of the translocated group.

Five line transects (trails) totalling a distance of 386 km and covering all three habitats in the ASFR were selected, and surveys were conducted in these transects. The Sykes monkeys were monitored as described in Burnham *et al* (1980). At times, the Sykes monkeys were extremely shy and difficult to sight, and vocalisations (Chivers 1974) were used instead of relying on visual encounters alone.

The survey established that the *Afzelia* forest had the highest density of Sykes monkeys, followed by the *Cynometra* forest and then the *Brachystegia* woodland. Crop raiding by primates in areas around the boundaries of the ASFR has been documented (Muoria 2001), and the local human population often consider wild primates, especially baboons, to be agricultural pests. With this in mind, the main factors chosen to determine the suitability of the new habitat for the targeted Sykes group within the ASFR were:

1. Moderate density of indigenous arboreal monkeys.
2. Acceptable buffer zone with sufficient distance between the group's new habitat and the forest boundaries to avoid the animals raiding the crops of neighbouring farms.
3. Biotic and abiotic structure of the habitat to conform to the previous home-range habitat of the troop in Watamu.

According to these criteria, the most suitable relocation habitat for the Sykes monkey troop was the *Cynometra* forest. The intermediate *Cynometra* was selected because of its similarity to the troop's home-range habitat in Watamu.

Phase 3: Habituation of the targeted Sykes group to aid capture

The main objective of this phase was to habituate the targeted Sykes monkeys to the traps that would later be used in their capture, in order to maximise the number of troop members caught. This entailed conditioning the animals to feel safe in the traps, which were located at capture sites

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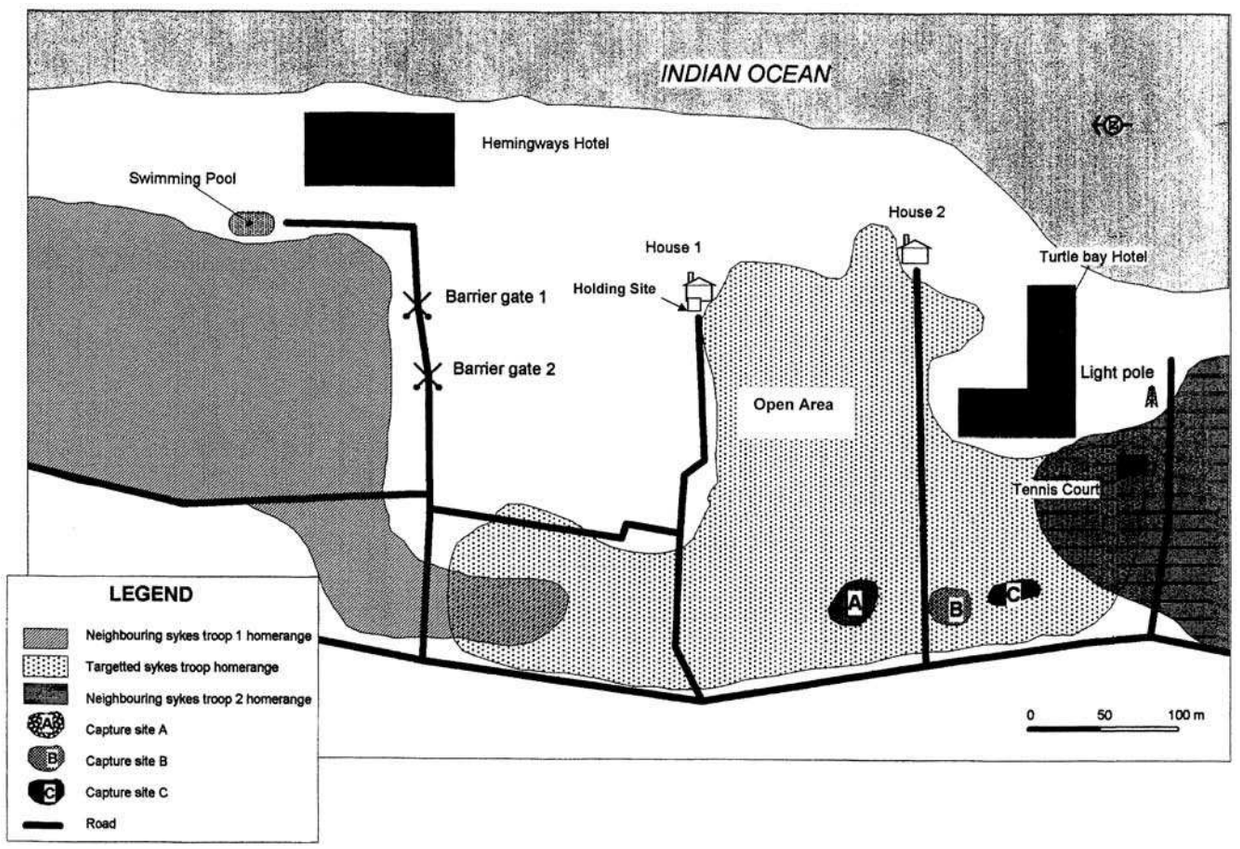
Figure 2



Home-range of the targeted Sykes group in Watamu prior to relocation.

(CS) in areas of their home-range where the animals were perceived to feel most safe.

Identification of suitable capture sites in Watamu, and test capture

Suitable CSs are vital for capture success, which, in the present study, was taken as the capture of all or most of the targeted group members. Capture sites were established in selected areas of the group's home-range, and baited traps were left at these sites for a period of time, but were not set for capture. The habituation of primates to traps before capture is a technique that has been used by the Institute of Primate Research (IPR) in Kenya for many years (Suleman 1998). This approach conditions the primates to feel increasingly safe and confident to take food from or eat within unset traps. During a 14 day habituation period, 17 unset metal baboon traps (Figure 3a) were situated in an open area within the group's home-range. Maize cobs were placed in each trap to attract the monkeys to enter. On the 14th day, the traps were set for capture with the usual maize bait, and six individuals were caught. This number was considered too low and the capture process was abandoned. The captured monkeys were marked with coat dye for identification to facilitate observation studies, and were released at the capture site. At this point it was realised that more suitable capture sites, fulfilling the following criteria, had to be identified:

1. The site must offer shelter by trees and bushes to increase the likelihood of the monkeys entering the traps. This may apply generally to forest primate species, which avoid open areas where they are more vulnerable to predation.
2. The site must be within an area in which the targeted group spend most of their time. For example, areas in which the animals rested during the heat of the day or slept at night were identified as potential CSs.
3. The site must be in an area of the group's home range that does not overlap with the ranges of neighbouring Sykes groups. This was necessary in order to avoid mistakenly capturing members of neighbouring Sykes groups.

Additionally, it was decided to select more than one CS in order to increase the number of captured animals. Three CSs (A, B and C, as illustrated in Figure 2) were selected since they complied with all of the above-mentioned criteria.

Habituation to traps

The second habituation period lasted 25 days. After the test capture (described above) the monkeys took longer to respond to the bait, and it was considered important to increase the time allowed for habituation. The number of

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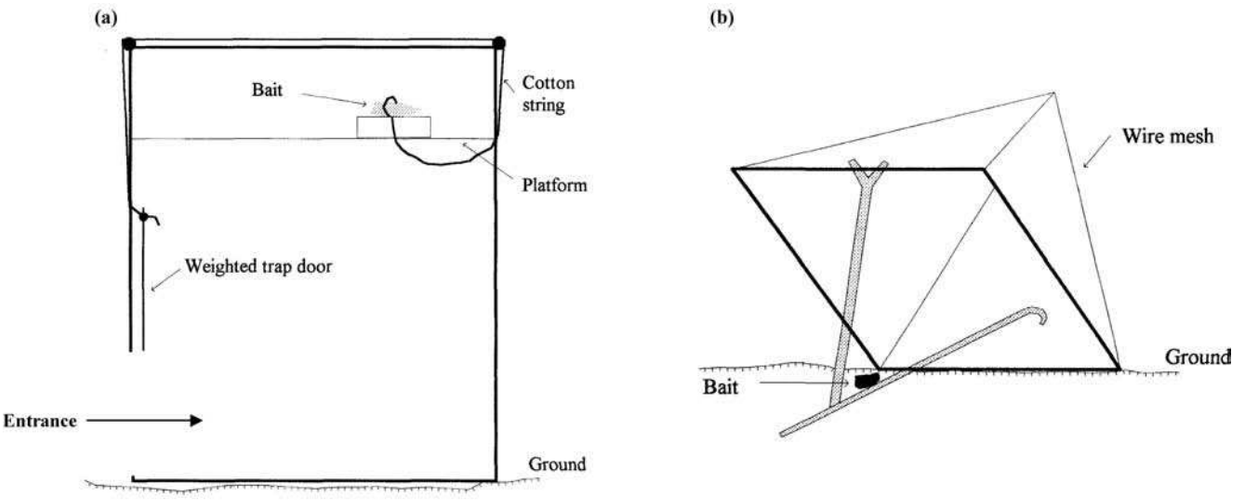
Figure 3



Diagrams showing (a) the setting of a baboon trap (cross section) and (b) the setting of a basket trap with a half prism shape, base area of 1 m^2 and height of 2 m.

traps was increased to 33 to further increase chances of capture. Basket traps (Figure 3b) were introduced in addition to the standard metal baboon traps. Eighteen traps were placed in CS A and 10 in CS B. A further five traps were situated under trees in which the monkeys slept, CS C. The Sykes monkeys' crop raiding habits in Watamu were also considered. Baiting the traps with locally grown fruit and crops would increase the existing problem of animals raiding residents' gardens for fruits and maize. Consequently, different baits were tested, and those preferred by the monkeys — bananas, passion fruit and apples — were used. When the Sykes group was observed to be responding well to the traps, they were set with bait for the actual capture.

Phase 4: Capture in Watamu

The objectives of this phase were (i) to capture as many individuals as possible from the targeted Sykes group, (ii) to collect biomedical data from the captured individuals, and (iii) to mark the captured individuals for ease of identification during post-relocation monitoring in the ASFR.

Capture process

Twenty members of the targeted Sykes group were captured within five days (Table 1). Eleven individuals were captured on the first day; after which capture rates gradually decreased. All individuals were captured in either basket or baboon traps, with the exception of the adult male in the group and one subadult female who were darted with ketamine hydrochloride (15 mg/kg) and captured.

The largest number of animals (10) was captured at CS C. This CS was situated around the monkeys' sleeping trees, which contributed to their feeling of safety and familiarity.

The factors found to be important to the successful capture of Sykes monkeys included:

1. Capture sites with above average vegetation shelter and in areas where the targeted group spent most of their time.
2. Baiting the traps with more attractive fruits than were found in the group's home-range. The bushes within the Sykes monkeys' home-range were fruiting, and the baits used included maize and more attractive fruits such as mangos and paw paws.
3. Using a large number of traps and several CSs to increase the chances of capturing as many of the Sykes monkeys as possible within as short a time as possible, in order to limit the time that animals had to spend in holding cages prior to transportation and release.

Biomedical sampling and identification marking of captured animals

Monkeys caught during the capture period were kept in cages at a holding site where they were maintained for six days before transportation. The holding site was an open garage-type building (approximately 15 × 15 m) with adequate sunlight and aeration, and was isolated and secure from free ranging monkeys and human disturbance. Groups of 3–4 individuals were held in 1 × 2 × 1 m cages, and the adult male was housed individually (0.6 × 0.6 × 0.75 m cage) because he was due to be released later than the rest of the group (as explained below). Females and their infants were caged together to avoid harm to the infants. The holding cages were arranged in a circle so that the monkeys were in view of each other. Shelter from unfavourable weather conditions was provided, and food and water were available *ad libitum*.

Sampling and identification marking took place in the holding site and were carried out by two experienced veterinarians. Each animal was anaesthetised with 10 mg/kg of ketamine. Body weights and measurements of different body parts were recorded (Table 1). Recognition of individuals is

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Table 1 Summary of capture details.

Individual	Collar number	Radio collar telemetry duration	Site captured	Type of trap	Weight (kg)	Mean weight (kg)
AD (M)	–	1 year	C	dart	7.10	7.10
AD (F)	03	–	A	basket	3.25	
AD (F)	04	–	A	baboon	3.95	
AD (F)	–	6 months	B	basket	3.45	
AD (F)	–	6 months	A	baboon	3.45	
AD (F)	02	–	C	baboon	3.30	
AD (F)	01	–	B	baboon	4.40	
AD (F)	05	–	C	basket	3.70	
AD (F)	06	–	C	basket	2.80	3.11
SA (F)	–	–	B	basket	3.20	
SA (F)	–	–	C	dart	2.95	3.08
JV (F)	–	–	A	baboon	1.05	
JV (F)	–	–	B	basket	2.00	
JV (F)	–	–	C	basket	1.85	
JV (F)	–	–	C	baboon	1.05	
JV (M)	–	–	A	baboon	2.00	
JV (M)	–	–	C	baboon	2.90	
JV (M)	–	–	C	baboon	2.25	1.87
IN (M)	–	–	C	baboon	0.50	
IN (M)	–	–	C	basket	0.50	0.50

AD = Adult; SA = Subadult; JV = Juvenile; IN = Infant; (M) = Male; (F) = Female

a prerequisite of many studies of primate behaviour (Scott *et al* 1976; Glander *et al* 1991). When large numbers of individuals are to be observed, as in this study, total reliance on natural distinguishing features has proved unfeasible, hence many researchers resort to artificial marks (Scott *et al* 1976; Jones & bush 1988; Karesh *et al* 1998). Radio collars (Yaesu [2m, Ft-290] Yaesu Musen Company, Japan) were fitted on the adult male (active life of collar: 12 months) and on two adult females (active life of collar: 6 months). The remaining six adult females were fitted with identification neck collars that were numbered 01 to 06. The animals seemed undisturbed by the collars. Individuals without radio collars or numbered neck collars were marked with dye on the lower, mid or upper margins of their fore and hind limbs. Each was marked with a unique combination to enable identification during post-translocation monitoring, and the markings remained visible throughout the study period.

Phase 5: Relocation to the ASFR

The objective of this phase was to establish a release protocol for relocation.

Transportation

The 20 captured Sykes monkeys were transported by pick-up truck to the release site in the ASFR the day after anaesthesia and identification marking. They were transported in holding cages in two trips: 11 individuals at midday and the remaining nine at approximately 1400h. Each journey took approximately 1 h and the monkeys were not sedated or anaesthetised.

Release

Upon unloading in the ASFR, the monkeys were fed with bananas, passion fruit and apples whilst still in their holding cages. Two hours later, when they appeared calm and settled, they were released from their cages simultaneously — with the exception of the adult male. Initially, the released Sykes monkeys scattered in different directions. Most of the individuals soon regrouped towards the northwestern side of the release site, less than 25 m from the release site, while a few others appeared to regroup on the southwestern side. Since adult male Sykes monkeys are often solitary, the adult male was released soon after the rest of the group so that he would follow the other group members while they were still within sight. This approach was believed to minimise the risk of the adult male becoming solitary after release. The adult male immediately joined the few members that had regrouped on the southwestern side of the release site. During the release, no vocalisations were heard except that of an infant who, together with its mother, was the last to leave the cage. The mother and infant joined the group at the southwestern side of the release site.

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A method that may minimise the risk of losing group cohesiveness is the so-called 'soft release method' as compared to the 'hard release method' that was applied in our study. The soft release method involves holding the individuals in an enclosure at the release site and providing them with food and water for a period of days to acclimatise them to the new environment. The food provided is then decreased gradually and, as the time of release approaches, the cages are opened, allowing the animals to leave at their own pace. This method minimises the risk of closely related individuals scattering after release. However, since the early captivity period causes significant stress to many wild primates (Suleman *et al* 1999, 2000) we chose to use immediate release in this project.

Phase 6: Post-relocation monitoring in the ASFR

The objective of this phase was to monitor the behaviour, numbers and demographics, as well as the home-range and habitat use of the translocated Sykes group for the first six months after release. Although the relocated group were a subset of one single group in Watamu, after release they divided into two subgroups, which were named the Northern Group (NG) and the Southern Group (SG). The adult male (SAM: Solitary Adult Male) separated from the SG within a few days of release and remained alone throughout the rest of the post-relocation monitoring period.

Group numbers and demographics

Despite the coloured collars of the adult females and the dye markings of the juveniles and infants, it proved extremely difficult to visually observe the relocated Sykes individuals. This was mainly because the two subgroups' movements varied greatly in the initial period after translocation — this has also been observed in previous primate translocations (Strum & Southwick 1986), especially within the first two months after release. Another reason for poor visibility was the difficulty in accessing some of the areas that the Sykes monkeys moved to, such as the dense *Cynometra* thicket. Many attempts to catch up with the subgroups scared them away further because of our awkward and noisy movements since there were no trails in most of the areas that the groups moved into. This made it difficult to follow the animals on a regular basis. As reported in previous studies (Mech 1983; Jones & Bush 1988), we found the radio transmitters to be invaluable for tracing the movements of the monkeys, and fortunately the solitary male and one individual in each of the subgroups was radio-collared. The collars' signals were used to identify and locate the animal using specialised radio receivers (Brander & Cochran 1969; Mech 1983), and were plotted on a scaled map of the ASFR to provide information on the directions and distances travelled from the RS. The furthest recorded point that each of the three factions (ie NG, SG and SAM) travelled from the RS was estimated for each two-month interval (ie 1st & 2nd months, 3rd & 4th months, 5th & 6th months) for comparative purposes.

Directions and distances travelled from the release site

Figure 4 illustrates the movements of the SAM and the two subgroups during the 6 month period after relocation. In the first two months, the movements of all three factions generally seemed erratic. The NG moved north from the RS in the 1st and 2nd months, but later changed direction and headed southwards, and eventually narrowed down its movements into an area less than 1 km southwest of the RS during the 5th and 6th months post-relocation (Figure 4 and Table 2). The SG moved 2.1 km southwest from the release site, after which the group's signal was lost during the 2nd month of post-relocation monitoring. The SG telemetry signal was picked up again during the 6th month post-relocation, approximately 4.7 km southwest of the RS (Figure 4 and Table 2). This was the furthest recorded distance travelled from the release site by any group. The SAM's distance from the RS remained more or less the same between months 1 and 2 and months 3 and 4 (1.3 km and 1.4 km respectively). However, the direction of his movements varied within this time (Figure 4 and Table 2). In the last two months of monitoring (months 5 & 6), the distance moved southwards from the RS almost doubled.

Estimated areas covered and habitat used

During the periods when all telemetry signals could be recorded, the three factions maintained varying distances of approximately 2–4 km apart and no overlap of area was recorded. Home-ranges were difficult to estimate for the first four months post-relocation because of the erratic and large distances covered, indicating that specific home-ranges had not yet been established. During the 5th and 6th months, the distance covered by the NG had not only reduced drastically, but also the area used had been narrowed down to an area close to the RS. The estimated home-range of the NG in this period was 3.6 km^2, which was larger than the home-range used in Watamu, despite the subgroup being smaller than the original group. It was not possible to estimate the home-range of the SG over the last two months since this group's signal was absent for much of this time. The telemetry signal may have been lost because the terrain through which the SG moved weakened the signal's reception or perhaps because of a technical problem with the telemetry collar. The signal had become increasingly weak during the month before it disappeared and it was still very weak when it was picked up in the 6th month of monitoring. The SAM's home-range was not as well defined as the NG's within the last two months of post-relocation monitoring, and as a result the area travelled within this period was 4.3 km^2 — an area larger than that used by the NG.

The NG was always recorded within the *Cynometra* forest habitat. During months 5 and 6, when the NG appeared to have developed a more distinct home-range, the habitat structure that was preferred by this subgroup was *Cynometra* intermediate. During the period when it was possible to record the SG's signal, the habitat this subgroup occupied was *Cynometra* thicket. The SAM appeared to move between the *Cynometra* thicket and the *Brachystegia* woodlands, with his telemetry signals being recorded in the *Brachystegia* woodlands for almost 70% of the time. No interaction with other Sykes troops was observed during the observation period.

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Discussion

Group cohesiveness is considered to be one of the most important features of measuring translocation success in primates (Strum & Southwick 1986). In the present study, the composition of the captured and relocated Sykes monkeys was identified as a cohesive subgroup. However, the outcome of the present study suggests that the relocation of a captured subgroup should be considered only when the relationships between the group members are already well known. Social bonds between individual group members need to be known especially when relocating subgroups because the closer the bonds between certain members of a group, the greater the chance that the subgroup will remain together after translocation.

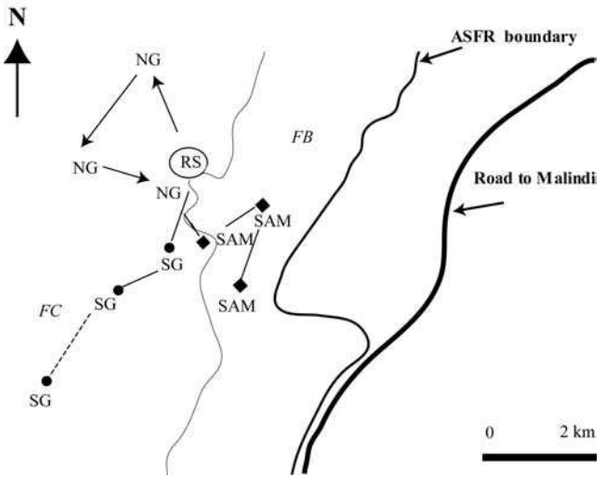
Capture by trapping seems at present to be the best and quickest way to capture selected animals. Darting animals is both difficult and dangerous and requires skill and opportunistic timing. The animal needs to be darted in fleshy body parts, such as the upper forelimb and hind limb, to avoid injury. The thigh is the safest area to dart since it provides the largest area with the least danger of hitting bone or piercing an organ. If the animals are high up in trees they may lose their grip, which could have serious consequences. As a result, darting as a routine method of capture may require more time, and we consider the trapping method used by the IPR to be safer and more practical.

Relocating a percentage of an original population, representing a cohesive subgroup, has been successfully done with rhesus monkeys (Southwick *et al* 1984). However, in this study the subgroup members were selectively chosen to maximise group cohesiveness after relocation. The effects of this were clear in that a few individuals from the translocated group who had dispersed after release, regrouped five months into the post-relocation period. This did not occur in the current study during six months of monitoring in the ASFR. Despite the fact that the NG and SG remained in the *Cynometra* habitat, as predicted from the initial analysis of the ASFR, these two subgroups continued to exist as two separate and distinct groups.

The NG, however, did move closer to the RS during the last months of monitoring, and its movements became less erratic. This may be attributed to the subgroup gradually establishing a more defined home-range. This suggestion is further supported by the fact that the NG's movements appeared more consistent within this area and that NG members repeatedly used this area over the last two months of post-relocation monitoring. The movements of the relocated factions within this phase were difficult to interpret. Previous studies have observed that patterns of ranging behaviour in primates can be influenced by many factors, such as the distribution and abundance of food (Bennett 1986), group size (Olupot *et al* 1994), group movement on previous days (Fossey & Harcourt 1977), location of sleeping trees (Davies 1984) and interaction between conspecific groups (Sekulic 1982).

The reasons for the SAM becoming solitary are not clear. He may have isolated himself perhaps because he had a larger area available to use and a greater choice of diet, and did not need to remain with the group for safety (as, for example, females and juveniles did). Solitary Sykes males in general have less defined home-ranges and mainly appear to follow other Sykes groups, particularly during the mating season (Cords 1987a). The finding that the SAM preferred the *Brachystegia* woodland habitat conforms to the data collected in the ASFR during the survey phase, which indicated that solitary males were mainly sighted within the *Brachystegia* woodlands.

Figure 4



Movements of the relocated subgroups (North Group [NG], South Group [SG] and the solitary adult male [SAM]) during the six months of post-relocation monitoring in the Arabuko Sokoke Forest Reserve. (RS: Release site; FC: *Cynometra* forest; FB: *Brachystegia* woodland; dotted line indicates assumed route taken by the South Group.)

Table 2 Distances covered by the relocated subgroups (North Group [NG], South Group [SG] and the solitary adult male [SAM]) during the six months of post-relocation monitoring in the Arabuko Sokoke Forest Reserve.

Groups	Estimated distance (km) from release site		
	1–2 months	3–4 months	5–6 months
NG	1.3	2.2	0.8
SG	2.1	–	4.7
SAM	1.2	1.3	2.3

Animal welfare implications and recommendations

The aim of this project was to identify important principles associated with the relocation process that could be of general use when relocating other forest monkeys, such as threatened primates in Kenya. Based on the project's findings, the following measures are recommended in order to minimise the stress experienced by animals involved in relocation projects.

1. Adequate behavioural data should to be collected prior to pre-conditioning and capture to provide a comprehensive

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overview of the social bonds between individuals within the troop (see eg Augustsson & Hau 1999). This will maximise the chances of the relocated troop maintaining their social structure after release.

2. The animals' home-range, wake/sleep behaviour patterns and resting and sleeping sites should be studied to assist in the selection of captures sites.

3. The animals should be habituated to traps using preferred bait for a period of no less than three weeks depending on the targeted primates' response to the traps.

4. Many traps should be used simultaneously to capture the animals within the shortest possible time-span, thereby minimising the period of time spent in cages prior to release.

5. The largest possible number of animals in a given troop should be captured in order to maintain troop cohesiveness and minimise damage to social structure.

6. A suitable relocation site should be selected based on the biotic and abiotic structure of the new habitat.

7. The 'soft release method' should be tested for species known not to be too stressed by captivity.

8. Monitoring equipment should be tested in the field before translocation to ensure reliable data collection during the post-relocation period.

9. The behaviour of the relocated troop(s) should be studied in order to assess the welfare and prospects of survival of the relocated animals, as well as to gain experience and knowledge on which to base protocol refinements.

10. Post-relocation monitoring should be continued for at least one year to collect adequate behavioural and demographic data, and this greatly depends on the habitat in question.

11. The features of forest habitats need to be carefully considered when identifying the most effective and efficient methods of collecting post-relocation data — in particular, the accessibility of the habitat type and structure.

The welfare consequences for the animals not caught and relocated, and perhaps constituting a vulnerable group of animals, must also be considered in relocation programmes. The Sykes monkeys in the Watamu troop that were not caught and relocated were also studied and these findings will be presented in a later publication analysing the long-term effects on the welfare of all of the monkeys affected by the relocation project.

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