INTRODUCTION

Few things remain to be said concerning the many wonders and worries of the great African continent. But to wildlife enthusiasts and biologists, Africa offers a myriad of quiet and subtely spectacular remnants of a continent where once, as Conrad claims, "the big trees were kings" and where some ancient forms of life have remained unchanged for millenia. Those remnants which have not already been made the special reserve of scientists, tourists or the media, remain largely so because of their relative inaccessibility, tragic impoverishment or perceived unimportance. In such a place there are now many opportunities to seek out and save the remaining areas of both natural wonder and scientific interest while at the same time being aware of an ever demanding and growing indigenous population.

Africa is clearly an ecologically rich continent which supports a great and varied diversity of animal life. Many of its unique habitats show a remarkable degree of endemicity, with an stunning array of beautiful and enigmatic creatures. One of these strange animals, an Elephant-shrew, is the subject of this report which is the result of an expedition undertaken in the summer months of 1992 in Tanzania. The aim of the project was to assess the conservation status and distribution of the Black-and-rufous Elephant-shrew, (*Rhynchocyon petersi*. Bocage, 1880) in the coastal forests of Tanzania and southern Kenya, particularly in relation to the recent destruction of these habitats.

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BACKGROUND

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Elephant-shrews: the Order Macroscelidea

Elephant-shrews present us with a fascinating enigma. At first glance even an amateur naturalist is struck by the weird collection of features that make up this unique creature. With their large eyes and long, minature antelope-like legs, a small trunk for a nose and a long rat's tail, they have been placed in an array of taxonomic groups. Since their earliest discovery in Africa at the turn of the century, they have baffled scientists and animal enthusiasts alike.

They have been predominantly classed within the Mammalian order Insectivora. This was primarily because their main source of nutrition was insects, coupled with the fact that they seemed to most people to be simply shrews with long noses, hence the name. In this way they were seen as a sister group to the shrews (Soricidae) and the hedgehogs (Erinaceidae) by several authors from Hollister (1918) to Grzimek (1968), and were still placed in with the Insectivora in Kingdon's seminal work on the Mammals of East Africa (1974). It has only been recently that the elephant-shrews were given fair representation as a quite distinct, and probably very ancient, mammalian order. Corbet puts the elephant-shrews in their own Order, Macroscelidea, containing 4 genus, *Rhynchocyon, Elephantulus, Petrodomus and Macroscelides.*

It is now clear from recent fossil evidence that they represent a distinct line of evolution to that of the insectivores, and in fact have a common ancestor with the rabbits and hares (Order Lagomorpha) that existed in Asia about 100 million years ago during the Cretaceous period. They now exist as two distinct insectivorous subfamilies, both in Africa; the giant elephant-shrews (Rhynchocyoninae) and the small elephant-shrews (Macroscelidinae). The giant elephant-shrew subfamily contains only one Genus, *Rhynchocyon*, from which the Black-and-rufous Elephant-shrew comes.

The Giant Elephant-shrews

This Genus comprises three species under Corbet's most recent system of classification, (three incipient species according to Kingdon's original system). They are the Golden-rumped (*Rhyncocyon chrysopygus*), the Chequered (*R. cirnei*, sometimes called *R. stuhlmanni*) and the Black-and-rufous (*R. petersi*) elephant-shrews. Records of these species to date, although scant, suggest that they all share similar life histories and ecology, although this is yet to be proved empirically.

Therefore the following resume of the life history and ecology of *R. petersi* is based largely on the observations made by Dr. Galen Rathbun during his study of the closely related *R. chrysopygus* species at the Gedi Monument and in the nearby Arabuko-Sokoke forest reserve, Kenya (1973), (Plate 1). Detailed descriptions of the habitats in which one might expect to find *R. petersi*, follow in the relevant sections (see Site Observations), so observations made during the project and specific to *R. petersi* are included in addition to Rathbun's work.

The Black-and-rufous Elephant-shrew**:** *Rhynchocyon petersi*

The Black-and-rufous Elephant-shrew is a diurnal, insectivorous mammal (Plate 2). It feeds on beetles, termites, centipedes, ants and other insects that it finds by burrowing in the leaf litter and digging in the soil of its forest habitats. Using its proboscis-like nose, which has fine sensory hairs along its length, it roots out the insects and crunches them with its sharp conical teeth while grasping them with the claws on its forefeet. These claws are also used for digging the soil where ants, termites and their grubs can be found, after which the elephant-shrew inserts its nose and flicks the prey into its mouth using its long tongue. These digging sites can sometimes be identified as evidence for the presence of elephant-shrews in an area, but can easily be confused with the scrapings of other mammals like squirrels or rats.

Giant elephant-shrews occupy and defend a home range of about 1.5 Ha (for *R. chrysopygus*), and they live in monogamous breeding pairs that build 6 or 7 nests each within this range. These nests are constructed by digging a small depression in the ground which is then lined with shredded, dry leaves. A pile of leaves is then arranged spirally on top of the dip and the result is a rather inconspicuous mound of dry leaves. In addition to this, the nest is usually built in thick undergrowth or under a low bush or tree, making it very difficult indeed for a predator, (and a human observer!) to see. Nests are usually about 60-70 cm long and up to 15 cm deep, and when in use they form a quite impressive oval dome! A nest that is not being used by an elephant-shrew any longer has a similar appearance to a newly built nest except that the top has collapsed inwards and a depression can be seen in the roof of the construction.

Every night around dusk the elephant-shrew will approach one of the nests in its home territory. After 10-20 seconds sniffing and watching for any sign of an observer, it slips under the leaves, rustling the nest for a few seconds as it settles down for the night. The young elephant-shrews are kept in one of these nests as they are quite fragile when born, and would be exposed to many dangers. The rule for elephant-shrews is one offspring at a time, but twins have been reported (FitzGibbon; personal communication).

The main predators of *R. petersi* are predaceous birds like eagle-owls and southern banded harrier eagles, snakes like the Black mamba and Forest cobra, and forest dwelling felids like leopard and caracal. An elephant-shrew is exposed for much of the day while foraging for their insect prey and they rely on their speed and agility when attempting to escape from these formidable adversaries. They can run at speeds of 25 kph and more across the forest floor, and being relatively small can pass through patches of dense undergrowth that would obstruct pursuants. In addition to these tactics there is a suggestion from several observers that both *R. petersi* and *R. chrysopygus* use previously "mapped out" paths, along which they run, either to escape predators or in every day life to navigate their way around the forest. These are reminiscent of the complex trail systems used by both the Rufous elephant-shrew (*E. rufescens*) and the 4-toed elephant shrew (*Petrodomus tetradactylus*); the latter of these two lives alongside *R. petersi* in many of its forest habitats where the extensive trail systems of the nocturnal *P. tetradactylus* are clear to see. The use of paths or "runs" by *R. petersi* is not clearly established, as the animal may actually be using pre-existing game trails trodden by other forest animals like duikers and bush-pigs.

Coastal Forests

Africa is the largest remaining fragment of Gondwanaland, an ancient giant supercontinent, which broke up some 270 million years ago (mya). By 100 mya, Africa had become completely isolated, and remained an island for a further 70 million years until it collided with Eurasia, resting in its present position. Subsurface currents, and this extensive plate activity caused huge upheavals in the continent's crust which has served to produce such landscapes as the massifs of the Sahara, and the mountains of eastern Tanzania. To the east of these ancient mountains that run north-south along the edge of the continent, lie the coastal forests.

Coastal forests provide one of the most stable climates in a variable and often unstable continent. Despite wild swings of climate on the continent over the past 15 million years, from wet to dry, and cold to hot, there have been evergreen or semi-evergreen forests in this eastern mountain arc continuously. This stable climate results from a combination of two factors, the Indian Ocean, and the hills. The Indian Ocean has been a warm tropical sea for at least 30 million years. Warm currents and winds flow towards the East African coast; moist, warm sea air meets the land mass, rises, cools and sheds its moisture on the lowlands and hills near the coast. The hills produce rain shadows, and to the west there are very steep climatic gradients, from the moist forested hills near the coast, to the near desert in the Maasai Steppe of the African interior.

With two rainy seasons, one from March to late May and the other from late October to early December, plant growth and animal breeding continues year round in the sub-tropical cloud forests. Despite the constancy of the climate, there is considerable environmental variation due partly to the presence of a wide variety of geological substrata. There are terrestrial and marine muds, silts, sands, and limestones. Those rocks deposited adjacent to the coast are generally less than 1 million years old. Inland the rocks date from the Miocene to the Pleistocene and are generally around 30-32 million years old. Also present are older Jurassic and Cretaceous marine silts and limestones.

This extraordinarily stable climate, with its steep climatic gradients as well as the diverse geology found in the coastal forests, results in an amazingly diverse flora and fauna making the most of the vast array of microhabitats which are available. The biological diversity is also increased as a result of immigrant species arriving at more than one time from more than one area. As well as the opulence of endemic species, the flora and fauna of these forests has been augmented by immigrants from the forests of central and west Africa, Asia, and Madagascar making them biological kaleidoscopes.

This combination of long term stability, steep climatic gradients and variety of different micro-habitats has tended to increase the levels of endemism in many areas. This is one of the major reasons why the coastal forests are so unique. There have been some 3000 species of plant identified in the habitat, 500 of them are endemic. Forest cover has existed in these areas for possibly the last 100 million years and these forests have been isolated from the major areas of African forest perhaps for over a third of this time. The remaining forest belt has been fragmented as a result of glacially induced climatic fluctuations and unsustainable human actions.

There is now thought to be less than $300km^2$ of coastal forest remaining in Tanzania. This is made up of at least 21 separate forest patches all of a relatively small size. The fragmentary nature of these “islands” of forest may result in a high extinction rate of species, often due to the presence of significant ecological boundaries between forest patches which prevents species replenishment. Another result of their small size is that they have a very high perimeter length compared to their total area. Therefore patterns of disturbance usually restricted to the forest edge may strongly influence the composition of the whole forest.

The areas of coastal forest that do remain relatively untouched are of great interest to many people who recognise that the habitat is unique both to Africa and to the Earth. The few square kilometres of forest left contain an array of rare and unique animals and plants about which relatively little is known. With the exception of forest reserves like Pugu Hills in Tanzania, (Plate 6) and Arabuko-Sokoke in Kenya, very little environmental protection has been afforded to these forest fragments mainly as result of this lack of knowledge. As is often the case, the more we learn from research in these areas, the more aware we become of the need to preserve them. In addition to studying elephant-shrews, Njule '92 endeavoured to gain insights into the present state of some of the more extensive coastal forests in the hope that this will encourage investigation of their unique and varied wildlife in the near future .

METHODS

It was decided that in each forest site visited, we would attempt to study two habitat types: pristine forest, which is free from human actions, was studied in conjunction with one other habitat, either one detrimentally affected by man's actions or an adjacent habitat lacking in primary coastal forest.

It should be noted that if the coastal forest habitat is assumed to be the natural habitat of the Black-and-rufous Elephant-shrew then, pristine forest at different sites is comparable, and the affected habitat studied at each site is comparable to the adjacent pristine forest, however the secondary habitats at different sites should not be directly compared since the numbers of elephant-shrews found will probably not only be dependent on the habitat, but on the density of elephant-shrews in the adjacent forest. To avoid biases habitat descriptions were formulated before the transecting began.

In each habitat type at each site, eight transects 400m long were cut. The transects were allocated starting points and bearings that ensured as large amount of forest as logistically possible was studied, and also that the transects were at all times at least 200m from their neighbours. The total transect length studied in each site was therefore 3200m. This is thought to be the minimum length of 4m wide transect needed to give an accurate estimate of the density of Black-and-rufous Elephant-shrews in a 20ha area. A 20ha area is in turn thought to be a large enough area to include all habitat changes in a reasonably homogeneous forest, consequently it should produce an accurate population estimate for the whole forest.

It must be stressed that these methods are based on work done by Dr. C. Fitzgibbon on the Golden-rumped Elephant-shrew in Arabuko-Sokoke forest, Kenya (1990-1992). Since the two animals are sub-species; thought to be very similar in their natural history, and because of time constraints, we have assumed that the Black-and-rufous possess the same number of nests per monogamous pair as the Golden-rumped, which is seven. This assumption is important when analysing the results of the project, since it is by counting the number of new nests per transect that we have estimated population density. It should also be noted that little is known about the decay rate of both old and new nests, or seasonal fluctuations in the number of nests to be found, although Rathbun (1974) points out that a peak in nest building activity occurs in September, in Kenya. A study of these factors would be fascinating, as would the employment of radiotracking techniques at one site for an extended period of time.

On each transect a reading was taken every 20m. Several facets of the habitat were recorded on a transect sheet, a specimen of which may be found in the appendix.

a) Cover. The total cover was estimated; essentially it is the percentage of incident light being cut out in the field of vision, taken from a point on the ground. The total cover was then split up to give the proportion of the cover given by three different layers, greater than 8m, between 4-8m, and below 4m including ground vegetation. It is hoped that the results will give an idea of the forest architecture and homogeneity.

When estimating the total cover in a given forest patch, a problem of interpretation arises. Because the transect itself does not represent the forest in its natural state (i.e. it has been cut), an estimate of total cover was made to one side of the line of transect. The light that an observer can see from this spot is actually a cone of light from the surrounding forest, as shown in the following diagram. It is thought that this is an honest representation of the situation at ground level where the elephant-shrew nests are found, and as such gives an idea of the light conditions under which these animals prefer to build nests.

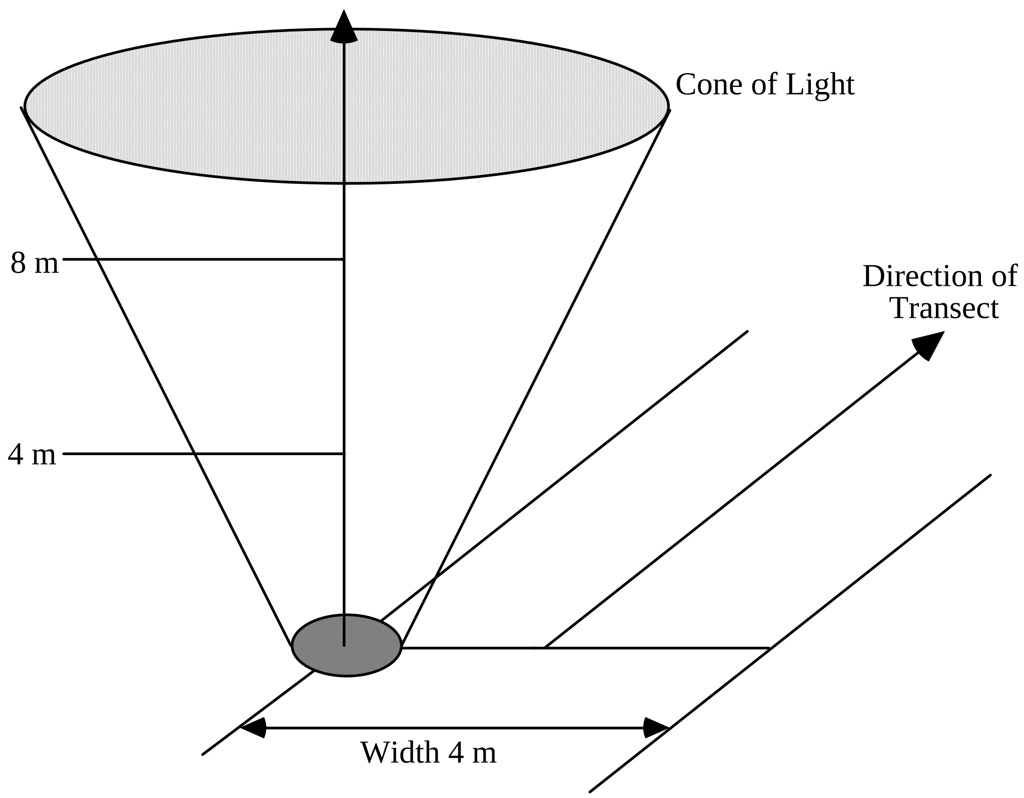

Fig. 1 - *Diagram of habitat data and cover data collection on transects*.

b) Leaf litter. This is an estimate of the percentage of ground covered by dead leaves. In cases where leaf litter gave 100% cover the depth of the material was also noted.

c) Comments. Further qualitative observations that may be of use were noted.

Of course, every 20m the number of new and old elephant-shrew nests found was noted, in addition to this habitat data.

New nests are distinctive mounds of leaf litter on the forest floor. The pile will be soft to the touch, and if opened up there is found to be a small bowl around 20cm long, 15cm wide, and 10cm deep dug out from the soil, (Plate 3, overleaf).

Old nests are similar to the new, but are obviously not maintained. There is a dip in the pile of leaves, where they have collapsed in to the depression below, (Plate 4, overleaf). In very old nests there may be fewer leaves present. Both nest types are easily distinguishable to the trained eye, and in any cases of doubt no quantitative recording was made.

In addition to studying the population density of the elephant-shrew in various habitats, an attempt was also made to trap them alive, for subsequent release without harm. The method employed followed that devised by Dr. Rathbun (1974) during his study at Gedi in Kenya.

Fishing nets, 45m long, with 3 inch mesh, and 2m high, were used. The nets were laid on a trail approximately 180m long through areas where elephant-shrews were known to be. The nets were hung at a height of about 30cm, the remainder of the material was laid on the ground, (See Plate 5, after Site Observations section). The intention is that the animals walk into the upright portion of the net, and trap themselves. The nets were checked every 2-4 hours during the day. They were rolled up and lifted off the ground during the night to avoid catching animals during this period of about ten hours when the nets could not be checked. This prevented causing any unnecessary stress to animals that were caught.

RESULTS 1:
QUANTITATIVE ANALYSIS.

After carrying out the experimental techniques proposed, the following results were obtained:

Forest Site	Nests <2m New	Nests <2m Old	Total nests New	Total nests Old	4-Toed runs
Pugu	13	9	15	12	14
Kazimzumbwi	11	25	14	26	50
Ruvu South	7	30	7	31	30
Kiono	7	14	11	15	20
Kisiju	0	0	0	0	present
Kwamkoro	0	0	0	0	0
Kiwanda	0	0	1	1	present

Fig. 2 - *Table to show the number of elephant-shrew nests found in the various pristine areas of forest within each forest reserve sites.*

Forest Site	Habitat Type	Nests <2m New	Nests <2m Old	Total Nests New	Total Nests Old	4-toed runs
Pugu	Cassia/Eucalyptus Plantation	6	5	8	6	15
Kazimzumbwi	Shamba/Agricultural land	0	1	0	1	0
Ruvu South	Miombo woodland	0	0	0	0	0
Kwamkoro	Tea plantation	0	0	0	0	0
Kiwanda	Teakwood plantation	0	0	0	0	0

Fig. 3 - *Table to show the number of elephant-shrew nests found in the various disturbed or non-pristine study areas.*

One of our main aims was to find out the exact population densities of the Black-and-rufous Elephant-shrew in the pristine areas of the study sites we visited. The first method used to calculate this is very simple. In each forest, the number of nests found on each of the eight transects were noted. They fell into the four categories :

1. New nests within 2m of the centre of the transect.
2. Old nests within 2m of the centre of the transect.
3. New nests outside the transect width.
4. Old nests outside the transect width.

The first calculation to be done involves a scaling up of the data obtained. Each transect is 400m long and 4m wide. In each site eight transects were cut and walked. When the total number of new nests found within 2m either side of these transects is divided by 8, the average number of new nests per transect is gained.

To calculate the number of new nests in each area of pristine forest, all that remains to be done is to scale this result up. Then, to calculate a population density of the elephant-shrews in the forests, this obtained value must be divided by the number of nests known to be possessed by each individual elephant-shrew. Dr. Clare FitzGibbon states from her preliminary research that it seems that 0.69 new nests found in one of her 100m by 6m transects, is equivalent to 0.9 Golden -rumpled Elephant-shrews in each hectare. The same statistic will be used for this calculation with the Black-and-rufous Elephant-shrew, and thus it is perhaps best to convert it into a more usable form. This is simply that very close to an average of 2 (actually 2.05) elephant-shrew nests per 4x400m transect is equivalent to the presence of one elephant-shrew per hectare. Thus, the population densities of the Black-and-rufous Elephant-shrews in the pristine areas of each of the sites visited are as follows :

Forest site areas	**Area (km^2)**	**Population density in pristine areas of forest reserve (No./km^2)**
Pugu	11	79.3
Kazimzumbwi	29	67.1
Ruvu	98	42.7
Kiono	20	42.7
Kisiju	2	0

Kwamkoro	N/K	V. low
Kiwanda	N/K	V. low

Fig. 4 - *Table to show estimated population densities of elephant-shrews in the study sites.*

Another way of calculating the density of elephant-shrews is by utilising information on the number of new and old nests inside and outside the transect. This form of calculation allows accurate densities to be calculated even in areas where population densities are very low. However, this relies on their being a certain number of old nests per new nest, and we are not sure if this number is the same for the Black-and-rufous Elephant-shrew as it is for the golden-rumped variety. This data will be utilised once work has been carried out to ascertain this figure.

It would obviously also be possible here to calculate the population densities of elephant-shrews in the woodland and disturbed sites. However, in most cases, this would not seem to be productive as the actual number of nests found was particularly small. One exception to this was Pugu plantation, in which 6 new nests were found within the boundaries of the transects. This leads to an estimated population density of 22.9 Black-and-rufous Elephant-shrews per km^2. This plantation clearly shows a much lower density than any of the pristine sites, although less drastically so than the other non-pristine ones. On testing using a two-sample t-test at a 5% level, the null hypothesis being that there is actually no difference between the number of elephant-shrews in natural and disturbed sites of each area, the hypothesis is rejected in all instances apart from that of Pugu plantation.

The reasons for this are likely to be complex, but it possible that the habitat differences found between natural and disturbed areas are a major contributing factor. The following statistical calculations (accompanied by some graphs) have been performed to attempt to account for the differences.

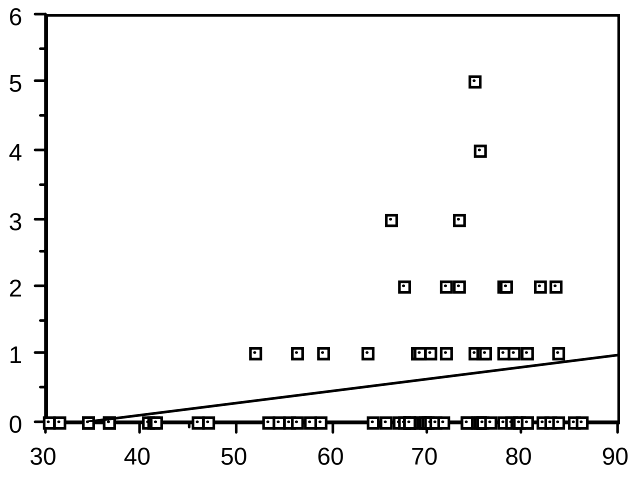

Fig. 5 - Graph to show the relationship between total vegetation cover and number of nests/transect.

Statistical analyses show that there is a very significant relationship between the total vegetation cover and the number of nests found per transect (D.F.=1, F-ratio=5.11, P-value=0.027). From Fig. 5, it is clear that the relationship is a positive one, meaning that as total vegetation cover increases there is an increase in the number of nests found and thus elephant-shrew density. It is likely that there are several factors influencing this result. For instance, elephant-shrews may prefer high cover habitats because they come under less threat from predators, as they and their nests are less visible. Alternatively, high levels of cover may relate to high levels of leaf litter, and it may be that leaf litter is the important factor : high leaf litter levels may make nests invisible and provide ample nesting material. Analysis of the data does demonstrate a significant relationship between leaf litter cover and number of nests per transect (D.F.=1, F-ratio=12.38, P-value=0.001).

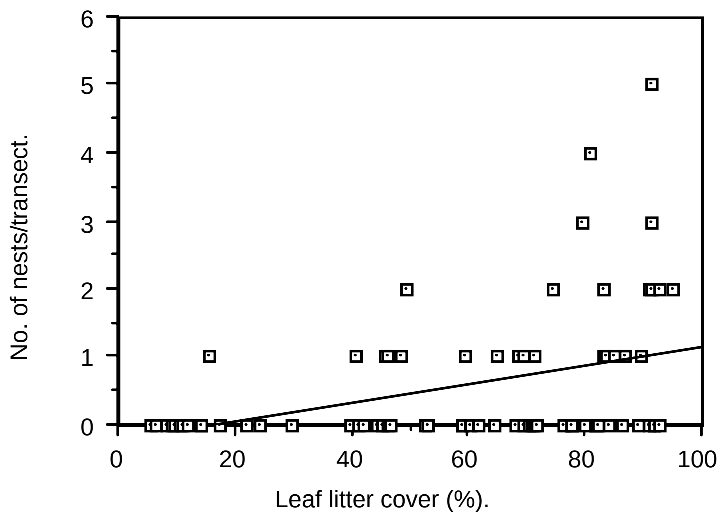

Fig. 6 - The relationship between leaf litter cover and the number of nests per transect.

However, the very strong relationship between total vegetation cover and leaf litter cover in Fig. 6 (D.F.=1, F-ratio=93.54, P-value=0.000) makes it impossible to distinguish one or the other as the factor responsible. Both factors are likely to contribute and the fact remains that from our calculations it can be seen that a reduction in either total vegetation cover or leaf litter cover to less than 50%, results in population densities of elephant-shrews dropping to less than half their density at 90% cover.

Differences in elephant-shrew densities can also be witnessed within some of the sites, allowing clear inferences to be made on vegetation preferences. In Kazimzumbwi Forest Reserve, the densities of elephant-shrews are significantly different in the pristine compared to the casava plantation (D.F.=14, T-ratio=3.6, P-value=0.0029). There is also a significant elephant-shrew density difference between pristine and woodland sites in Ruvu (D.F.=14, T-ratio=3.8, P-value=0.002). Thus, not only is it possible to relate elephant-shrew densities to vegetation cover and leaf litter levels, but also to specific vegetation types.

Significant differences in population densities are not witnessed within any of the other sites, most probably due to the small amount of actual nest data collected. Nevertheless, the lack of a significant result from Pugu Forest Reserve is likely to be due to other reasons, as high elephant-shrew densities were found in both pristine and plantation areas. The suggestion here is that this Eucalyptus / Cassia plantation type is capable of supporting a population of elephant-shrews not significantly different from the neighbouring pristine. The implications of this will be discussed in the conclusion.

Data was also collected concerning the number of 4-toed Elephant-shrew runs that were found along the transects, to establish the population densities of these animals in the sites visited.

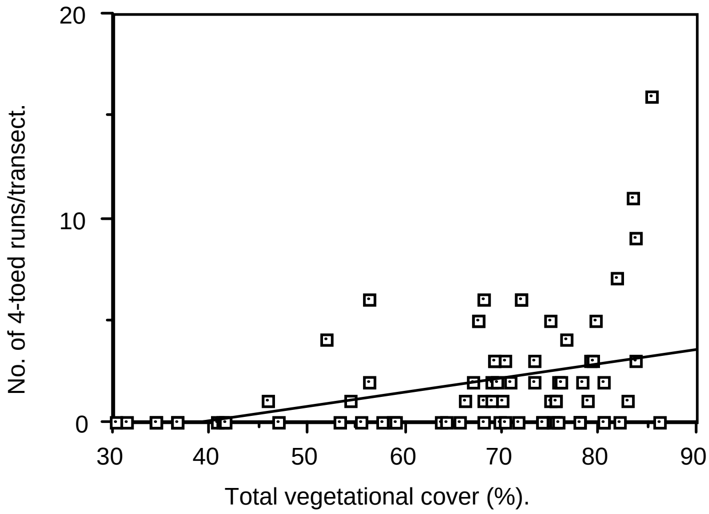

Fig. 7- The relationship between total vegetation cover and the number of 4-toed Elephant-shrew runs/transect.

It appears that there is a very strong positive relationship between the total vegetation cover and number of 4-toed runs (D.F.=1, F-ratio=10.77, P-value=0.002). Thus, it may well be the case that 4-toed Elephant-shrews prefer vegetation similar to that preferred by Black-and-Rufous Elephant-shrews. This similarity also appears to hold for leaf litter cover, as can be seen in Fig. 8, overleaf.

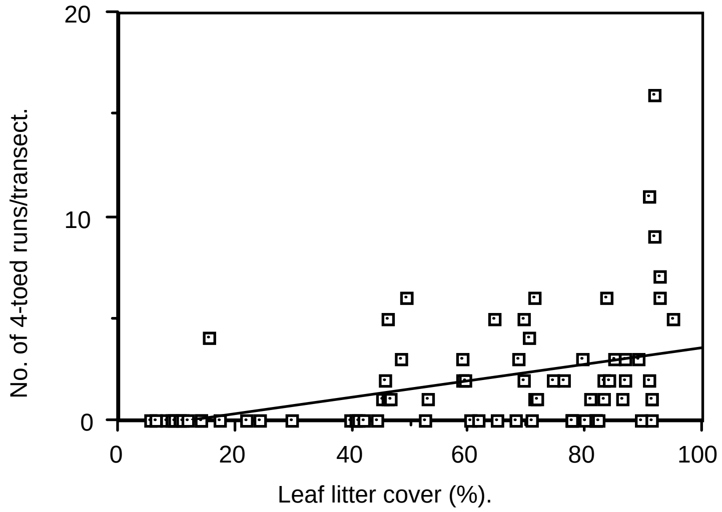

Fig. 8- The relationship between the leaf litter cover and number of 4-toed Elephant-shrew runs/transect.

Again, there is a very strong positive relationship (D.F.=1, F-ratio=14.63, P-value=0.000), areas of high leaf litter being capable of maintaining high densities of elephant-shrews.

Further analyses were performed to ascertain the effect of different vegetation covers at less than 4m, 4-8m, and above 8m, to assess whether these could be correlated with Black-and-Rufous or 4-toed Elephant-shrew densities, on the suggestion of Dr. FitzGibbon. However, these were not found to be significant. Unfortunately, it is difficult to say whether this is because there is no relationship at specific levels, or purely that our judgement of height and cover in these instances was somewhat imperfect.

RESULTS 2:
SITE OBSERVATIONS

The following provides a description of all the sites that were studied, and includes more detailed assessments of what was found in each forest site, with reference to the Black-and-rufous Elephant-shrew.

Sites Studied

The forest areas that were studied during the expedition differed both in ecological character and in conservation status. They are listed below:

Country	**Region**	**Name**	**Status**
KENYA	Mombasa	Shimba Hills	National Park
TANZANIA	Coast	Pugu Hills	Forest Reserve
	Coast	Kazimzumbwe	Forest Reserve
	Coast	Ruvu South	Forest Reserve
	Coast	Kisiju Island	None
	Coast	Kiono (Miono)	Forest Reserve
	Tanga	Kwamkoro	Forest Reserve
	Tanga	Lunguza	Forest Reserve
	Zanzibar	Jozani	Forest Reserve

Fig 8 - *Table to show sites studied; their location and conservation status*

KENYA

Shimba Hills.

Shimba Hills is one of Kenya's National Parks, lying about 30 kms inland from the coast at Mombasa. It boasts a wide array of wildlife including giraffe, elephant, sable buffalo and baboons, and contains areas of both grassland and large primary forest, (Plate 6). It was in these patches of forest that we looked for the Black-and-rufous Elephant-shrew. We undertook informal surveys as we were not permitted to cut proper transects. From these walks we sighted three *R.petersi* bounding through the forest away from us, and found several nests. These were predominantly located within the first 15-20 m of the forest edge, where the vegetation below 4 m was particularly thick.

The presence of a complete canopy and the use of most of the forest by other larger animals seemed to have reduced this thick undergrowth towards the centre. This was accompanied by a reduction in the traces of elephant-shrews in this area. However, with the benefit of hindsight afforded us by the work in Tanzania, the fragmentary nature of the forest patches seems to provide a less than ideal habitat for *R.petersi*, especially when compared to the archetypal coastal forest habitat represented by Arabuko-Sokoke. This said, the Elephant-shrews that do live here are well protected by the National Park status of their habitat, so it is not thought that there is any great threat to them at present.

TANZANIA

Pugu Hills Forest Reserve

This forest reserve lies only 25 km south-west of Dar es Salaam, yet much of its astonishing degree of endemicity has been maintained in a patch of pristine forest, which has over halved in area in the last twenty years, now covering only 10 square miles (Plate 7). One of the largest kaolin deposits in the world lies within the forest reserve and a project proposed a few years ago to expand kaolin mining here could threaten the future of this vital habitat.

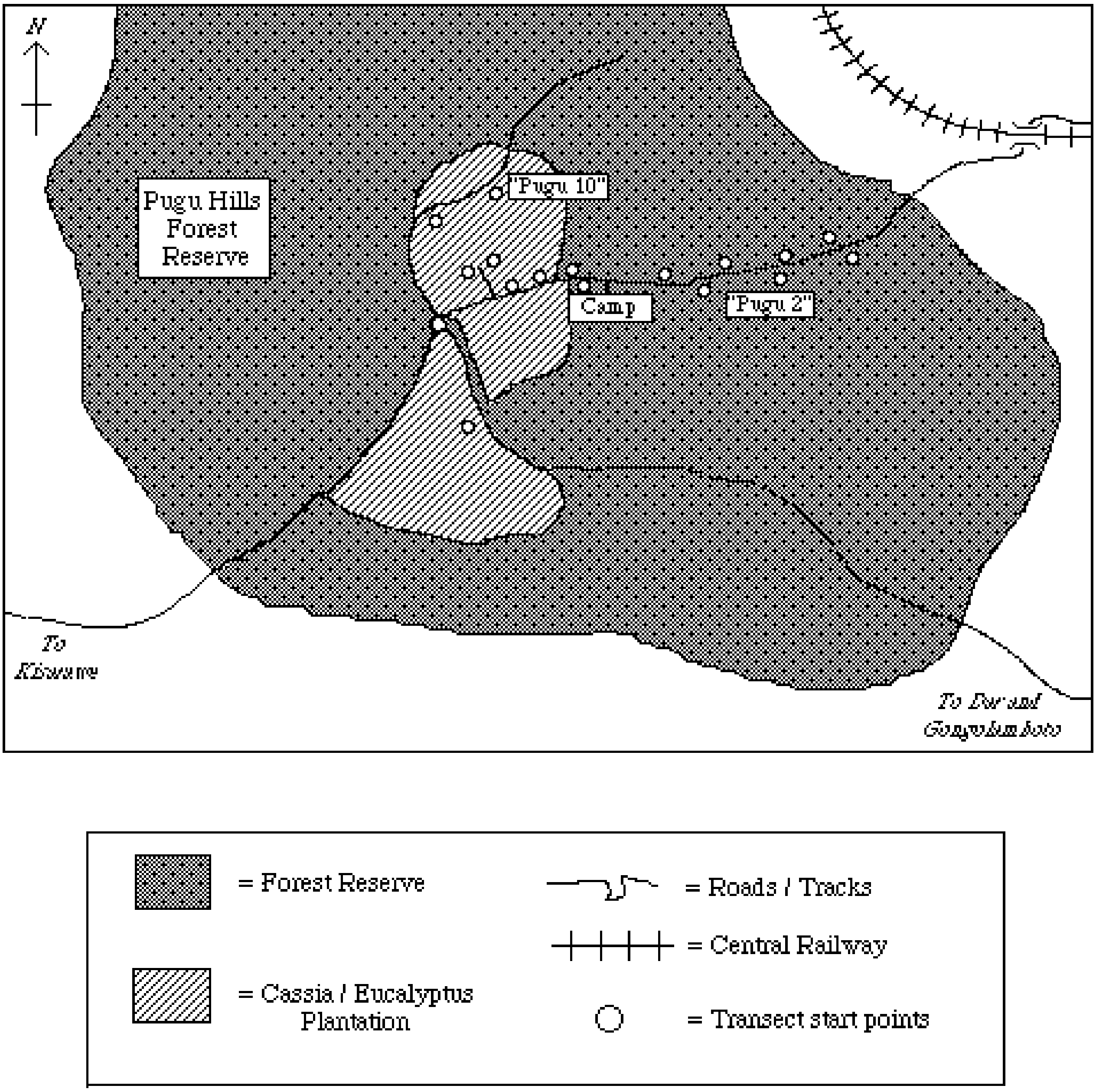

Fig. Y - *Sketch Map of Pugu Hills Forest Reserve showing study sites.*

Our research was conducted in an area of the reserve known to conservationists as Pugu 2 (see Fig. 9). It was originally intended that we would complete eight 600m transects in three habitat types in the reserve, once we were able to hire local labourers. Once transects were cut, it would take a minimum of 2 hours to collect all the data for that transect. Three or four transects could be completed each day, spending approximately eight days in each forest site.

However, this soon proved to be impossible, because the ascaris (forest guards) could not cut more than 200m per day up the steep hills and through the extremely dense undergrowth of the valley bottoms. The collection of data also proved to take considerably longer than we had hoped. Reducing the frequency of habitat data recording from once every 10m to once every 20m saved considerable time and still provided adequate detail for our survey. The transect lengths were between 600m and 400m each, as this was shown to be sufficient for a statistically reliable density estimate of the elephant-shrew. Transects cut by the ascaris, who initially believed that they had completed 400m cutting, would often turn out to be under 200m long, when the actual distance cut was measured accurately. A great deal of time would have been wasted if we continued with this measuring each day. So, it was decided to take data whilst the transects were being cut, so that the 400m of cutting could be accurately verified when complete, without having to re-measure at the end of each day. Finally, it was calculated that we would have enough time to do just two clearly different but adjacent habitat types in each forest site in the time available.

Nets were erected along an already existing transect in Pugu 2, but no elephant-shrews were caught. Several bush pigs managed to pull the nets down at points, although the nets themselves still remained intact. It is thought that this may have provided elephant-shrews with a passage through the net, which would have stopped them getting caught. It is therefore of great importance to check the nets every few hours, even if no elephant-shrews have been caught, as only constant repair and "re-hanging" of the nets will ensure the greatest chance of catching a wandering elephant-shrew!

The transects completed in Pugu pristine habitat indicated that the Black-and-rufous Elephant-shrew did not build nests in very thick woody/shrubby undergrowth and only one "old" nest was found on the steep valley sides. In contrast, on more shallow slopes and on ridge-tops and valley-bottoms and in less dense undergrowth, there tended to be higher densities of elephant-shrew nests. It is likely that these latter areas provided the elephant-shrew with sufficient space to run with little hindrance on the forest floor, yet they still afforded adequate protection against predators from above.

It is important to note that the type of undergrowth that occurs may play an important part in the distribution of the Black-and-rufous Elephant-shrew. It was noted in this and other forests including Kazimzumbwe and Kiono, that the elephant-shrew would often build nests under the protection of the native shrub *Coffea*. This was further supported by the observations in the *Cassia* and *Eucalyptus* mixed plantation habitat in Pugu: this showed that although the Black-and-rufous Elephant-shrew did unexpectedly live in these areas of low total cover, they tended mainly to build nests where there was a significant regrowth of the natural scrub/undergrowth of the type that occurred in the adjacent pristine forest. Several of the plantation nests were found under *Coffea* shrubs. All of the plantation areas studied in Pugu had been unmaintained (ie: the regeneration of native plants had been unimpeded) for at least the last 10-15yrs.

However, there is further evidence that the elephant-shrew relies on the presence of more than just the native undergrowth. Several nests were found to be built mainly with leaves from the tree *Afzelia quanzensis*. However, it was noted that there were no *Afzelia* trees within the approximate home-range of this elephant-shrew's territory. This may suggest that elephant-shrews are actually transporting these large, waxy and waterproof leaves (good for building dry nests) from the pristine forest, which is about 150m away from where these nests were found. This may explain why there were elephant-shrew nests in a plantation with low leaf litter cover (<50%) which would not normally be expected to provide sufficient leaf litter for the elephant-shrews to build nests.

In contrast, transects carried out in Pugu 10 plantation (see fig. 9) showed no evidence of Black-and-rufous Elephant-shrew nests or digging sites. There was very little ground cover in this plantation area, save for some very low scrub (2-3ft high) in small patches. It is suggested here that there is not yet enough grow-back of native undergrowth that would allow the elephant-shrew to re-inhabit this area following its conversion from pristine forest to *Cassia/Eucalyptus* plantation some 10-15 years ago.

It appears that the elephant-shrew may be adaptable to a certain extent in this forest, but it is probable that the animal relies to a large extent on undisturbed forest. There are no elephant-shrews inhabiting the plantation unless the latter is adjacent to undisturbed pristine forest (of which there is little left in Pugu!) and only if the plantation contains native shrubs that have grown back to at least 4-5 ft.

Kazimzumbwi Forest Reserve

The reserve is sityated to the south of Pugu Hills and to the west of the villages of Chanika and Buyuni, about 50 km inland from Dar.

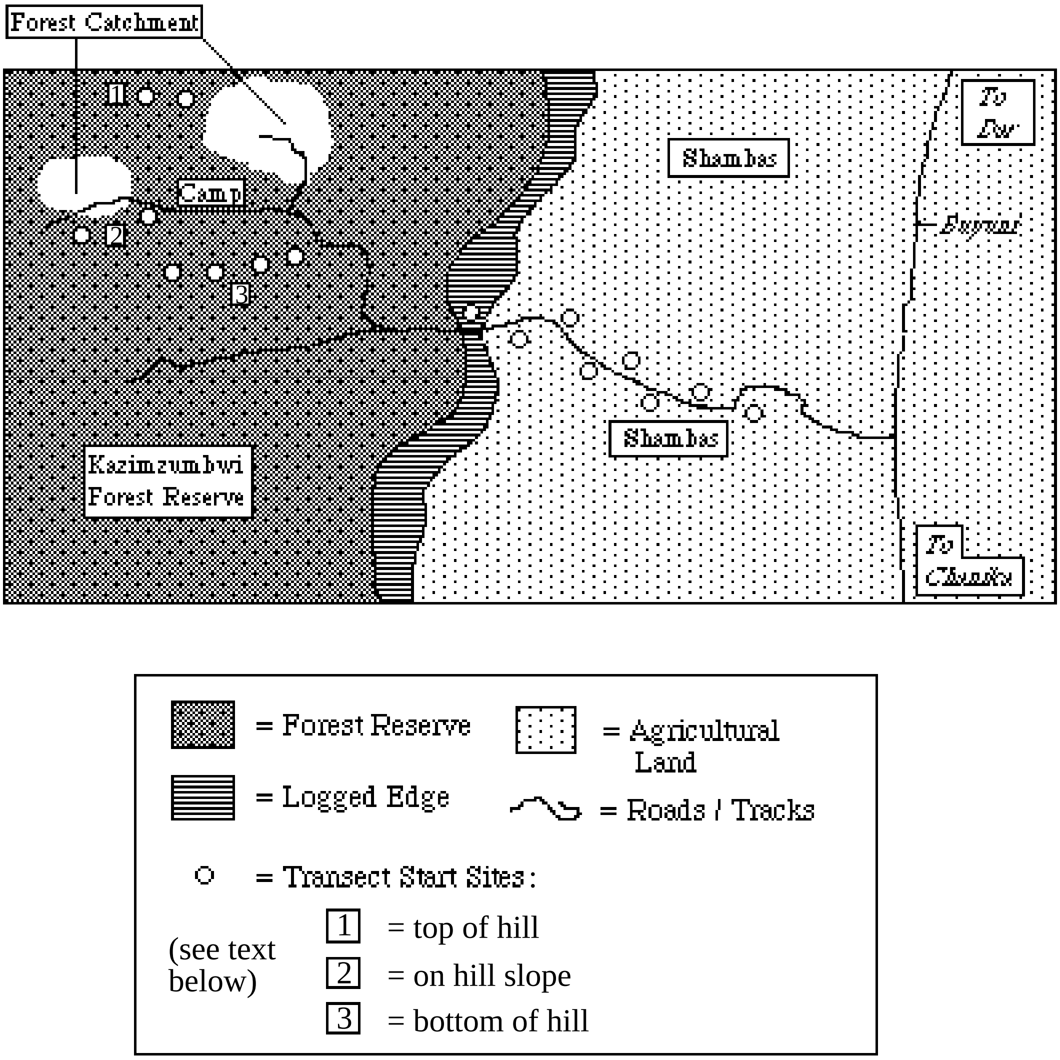

Fig. 10- *Sketch Map of study area in Kazimzumbwi Forest Reserve and surrounds.*

The main canopy forest in this reserve is situated partly on the same hills as Pugu, and and like the latter forest, Kazimzumbwi also contains dominant trees such as *Afzelia* and *Albesia*. There are also tall stands of *Pteleleopsis,* and *Cassia* stands were planted here at the same time as the *Cassia* that was studied in Pugu.

A large part of the reserve, however, consists of lowland Miombo: grassland interspersed with *Brachystegia* trees. Throughout this, are patches of dense woodland with a virtually complete canopy. Some reconnaissance on our first full day here showed us that many of these patches in the south and south-west of the reserve have been fully logged. Charcoal production, as well as the production of carvings from ebony hardwood, which is common in this area, are thought to have contributed to this deforestation process. Two possible sites were suggested to us by the ascaris, but neither had disturbed ground of the sort that was required by the expedition as a comparison habitat to the pristine forest. Later, however, the ascaris took us up to the hills in the northern part of the reserve where, in addition to finding a overturned lorry full of logs taken from inside the forest reserve, we found an area of pristine forest bordering on a small strip of logged scrub which in turn, bordered onto agricultural land, (Plate 8).

Initially, transects were cut in pristine forest on the top of the hills (1: see fig 10). No new elephant-shrew nests were found, although several old nests were found. This result may be seasonal, in that the elephant-shrews move to different sites throughout the year within a forest, thus none inhabited the area studied at the time of the surveys. Alternatively, the presence of old nests without new nests may suggest that recent nearby deforestation for charcoal and timber production has not allowed the elephant-shrew to survive. Transects made nearby on gently sloping hills (2) indicated that the elephant-shrew was occupying pristine habitat close to this area, although it was more removed from the forest clearance than the pristine forest on the top of these hills. Finally, transects carried out at the base of the hills (3), within about 500m of the "slope" transects, revealed that the animal lived at a similar density here as on the transects carried out on sloping hills and there were no obvious differences in habitat type between the two areas. The difference may well be due to changing soil types, which will support slightly different flora and fauna at differing altitudes on the hill. Again, however, the increase in density in the lowland pristine may be due to the increased isolation of this latter part of the forest from the deforestation activities that are occurring on the hills above.

It became very clear that the agricultural land bordering the forest reserve, west of Buyuni did not support Black-and-rufous Elephant-shrews. However, one was sighted in a small area of shrub, which was isolated from the main forest and surrounded by the agricultural land. It is unlikely that the elephant-shrew would move from the main forest to the thicket, because there was at least 300m of cleared agricultural land between the two areas. The transects were carried out across many contiguous family shambas (field/vegetable patch) which consisted mainly of cassava, maize and sweet potato.

It is most likely that the total cover of vegetation at all levels (see Methods) is not sufficient for the elephant-shrew to successfully avoid predation. In addition, the leaf litter levels were rarely above 15% in these agricultural patches and it is proposed that this level is also inadequate for elephant-shrew inhabitation. Even in the "low" leaf litter cover in Pugu plantation, where elephant-shrew nests were found, there was seldom less than 40% cover.

Dr. FitzGibbon (1992 unpubl.) found that the leaf litter and total vegetation cover variables both correlated positively with the number of elephant-shrews caught in nets over a three day period in a Kenyan study. Although no Black-and-rufous Elephant-shrews were caught in Kazimzumbwi, it may be possible that the animal will only live in areas of a certain, sufficient total vegetation cover and leaf litter cover. Our data suggests that these values should be at least approximately 50% leaf litter and 40% total cover, in order for any Black-and-rufous Elephant-shrews to survive at all. It appears that the Four-toed Elephant-shrew has at least as strict minimum habitat requirements as the above. Four-toed "runs" did not occur where vegetation cover was less than 40%, whilst the leaf litter, for the most part, was not lower than 70%. However, the above "requirements" are not sufficient for conservation initiatives aimed at protecting the elephant-shrews. They are purely indicators as to whether the elephant-shrew is likely to exist in a forest or not. This topic is discussed further in the Conclusions section.

There are large areas of cleared pristine forest on the hills to the west of Buyuni, which have no vegetation apart from patches of grass and illegally grown tobacco growing on them. The expedition has shown that the elephant-shrew is not able to live on land such as this, or on the agricultural land created by normal logging and "slash-and-burn" activites. Meanwhile, the Black-and-rufous Elephant-shrew currently occupies pristine forest in and around these hills supporting the Pugu and Kazimzumbwi Forest Reserves. With the current state of affairs, the logging will continue unhindered and without prosecutions in these vital reserves. It appears that this deforestation is occurring in similar habitats along the coast, and therefore there is little chance for the Elephant-shrew's survival in the long term, unless conversion to agricultural and fallow land is stopped and what is left of the pristine coastal forests is treated as natural economic resources.

Ruvu South Forest Reserve

Ruvu, like Kazimzumbwi, consists largely of Miombo woodland. There is a wooded area of about 15-20 km^2 in the middle of this large reserve of low canopy woodland/forest which is on flat level ground.

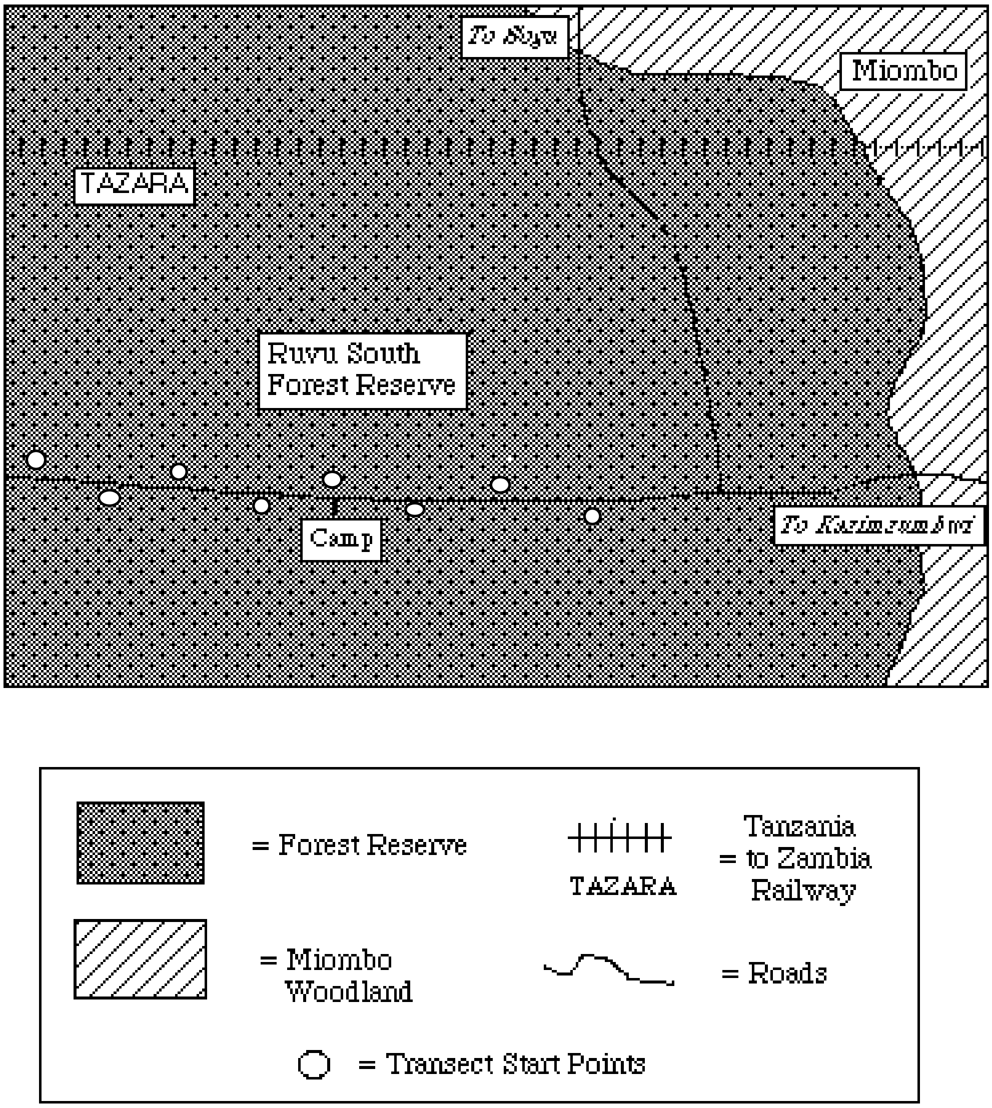

Fig. 11 - *Sketch map of study area in Ruvu South Forest Reserve* .

Most of the trees and other vegetation is below 8m high and it often forms a complete canopy. Trees above this height, such as the tall *Albesia* are more separated from each other and are seldom taller than about 12m high. The forest is further inland and dryer than the previous three, forming an intermediate habitat between the dense coastal forest habitat and the Miombo woodland/grassland mix, that dominates large areas of "inland" Tanzania. *Afzelia quanzensis* is very common here, although it does not grow as tall as in Pugu or Kazimzumbwi.

The pristine vegetation was relatively undisturbed compared to the previous forests studied. This is thought to be due perhaps to this forest's increased isolation from Dar es Salaam and from the main roads leading from it. Most deforestation is occurring in the Miombo surrounding the main forest in which we were studying. However, this seemed to be on a lower scale than in Pugu or Kazimzumbwe, as no burning charcoal piles were seen throughout our stay in this forest reserve and there was little evidence of logging in either the Miombo or the pristine forest, towards the centre of the Reserve. The pristine forest is more homogenous in its vegetation than either Pugu or Kazimzumbwe. We were therefore able to begin transects 400m apart without a change in the dominant vegetation type occurring. Placing transects far apart from each other is also desirable, in order to stop them from crossing over each other.

The transects revealed a lower density of elephant-shrews in this forest than in the previous two. This may be due to the dryer climate here, which makes the soil dryer, which in turn, may support less invertebrate prey for the elephant-shrews' dietary requirements. Seeing as the elephant-shrew relies on such prey, which live in the soil and leaf litter, it is likely that the food chain is only able to support a low density (42.7 per km^2) of this insectivorous creature.

Despite not finding a high density of the animal in Ruvu, we managed to capture a female Black-and-rufous Elephant-shrew, weighing only 495 grams, (Front Cover and Plate 8). It was probably a young female, as it had a very light rufous coloration compared to others sighted in this and all the previous forests. It had successfully tied itself up in the net, as we had hoped! However, it was obviously under stress by the time it was found (only an hour or so after it the nets had been set out that morning) which served as an additional warning to ensure that all nets were checked regularly throughout the day. It was returned unharmed to the forest after these photographs were taken.

Trapping was acheived successfully, because the nets were not put up until several elephant-shrew nests had been found close to each other. This had been easy to do in Kenya's Arabuko-Sokoke forest, but here in Ruvu South, it took most of a day to ensure that new (and therefore currently occupied) nests were found close together and were relocated exactly, when the 180m of nets were strung up along the forest floor. The nets had to begin about 20m in from the track through the forest. This provided all team members with an easily locatable site for the beginning of the net line, which consequently wound deeper into the forest, passing as many new nests as possible. There was no need for the net line to be straight, unlike the transects, because it was only the latter which recorded data based on specific positional and distance measurements.

In contrast to the pristine forest, the comparison habitat of Miombo woodland showed no evidence of supporting elephant-shrews, because no new or old nests were found on the transects. The grassland showed no evidence of elephant-shrew scratches in the soil, which firmly suggests that the elephant-shrew does not even forage in these open places. In any case, the grassland that dominates the vegetation below 4m high in the Miombo habitat does not have even nearly sufficient leaf litter cover (normally less than 10%) or total vegetation cover (except when in small patches of thicket) for elephant-shrews to build nests that are safe from predators (Plate 9). There are indeed, small patches of thicket and trees that are similar in composition to the pristine forest, but unless the former are within a very close distance of the forest (probably about 50m) it seems unlikely that a viable population (ie: at least one male and one female) of elephant-shrews could exist, over many generations, in patches smaller than about 100-200m^2.

However, a single old nest was found far off a transect, in “riverine thicket”, which is satisfactory evidence to suggest that the animal did exist in such a habitat, but no new nests were found and no sightings of the animal were made in the riverine thicket. Perhaps the animal does not live in these very thin but very long strips of thick undergrowth and trees in the dry season, (the time of study) only surviving in the larger forest itself over this period.

Kiono Forest Reserve

This forest reserve, variously known as Kiono, Miono or Zaraninge lies just 20 kms inland and borders onto the Sadani Game Reserve, being separated by the Dar to Tanga railway (see fig. 12). The main portion of “undisturbed” forest, about 20 km^2, is contained on a raised plateau which rises above the Wami river, 10 km to the south. This area of forest is dominated by many spectacular canopy trees (<30m) like *Manilkara sulcata*, *Scorodophloeus fischeri* and *Bombax schumannianum*, with a tangled understorey containing *Cynometra* spp.amongst many others. This gives the impression of a relatively old, well established forest and seems to represent the archetype of coastal forest habitat, (Plate 10). Enclosed in the middle of this forested plateau area is a grassy seasonal swamp which acts as a source of water for small antelopes, warthog and other animals.

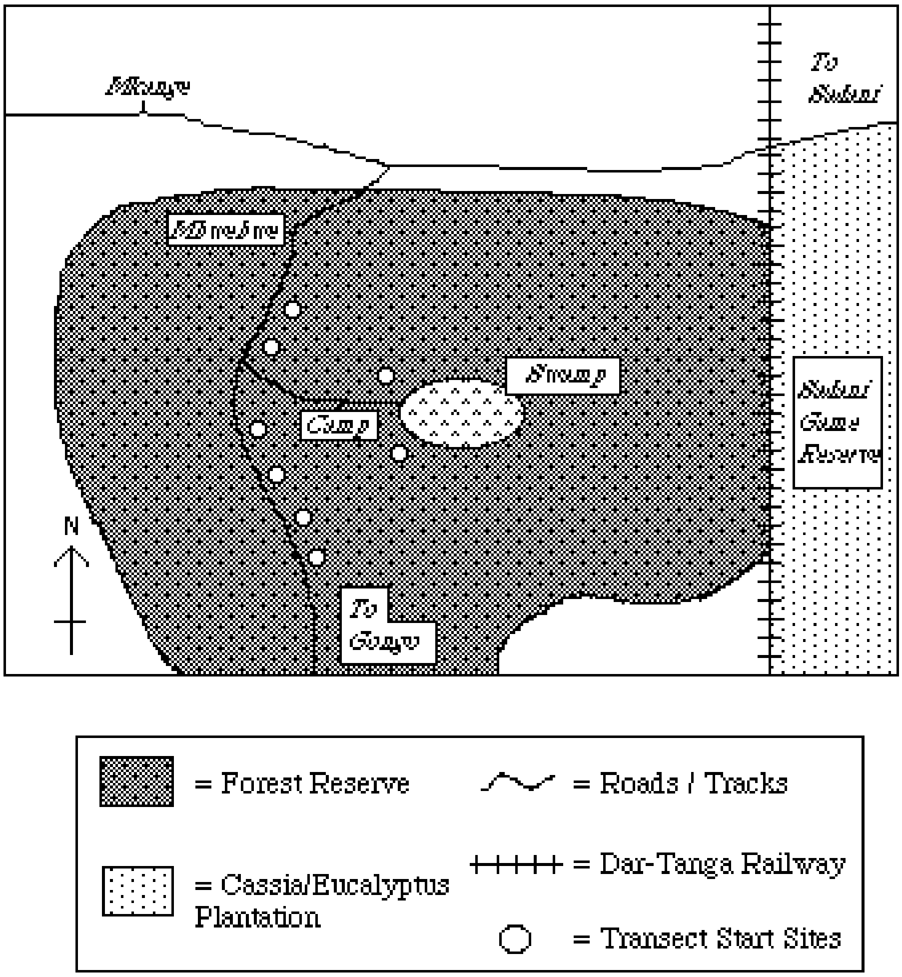

Fig. 12 - *Sketch map of study area in Kiono Forest Reserve.*

This area of primary forest is surrounded by lower lying areas of Miombo woodland which extend into the Sadani Game Reserve, so that for this particular forest it was decided to omit a comparative habitat study as Miombo habitat had been covered while in Ruvu South. Kiono, being both of similar size and apparent state of preservation as the closed forest of Ruvu, provides an interesting comparison of elephant-shrew numbers.

A tracks runs through the forest from Mkange in the north, through Mbwebwe and on to Gongo in the south, providing a route for logging which is evident to a small extent in some areas along this main track. From this track, 8 transects were cut through the forest, 4 east and 4 west, spaced at even intervals from the camp which was situated just off the path (see fig. 12). It soon became apparent that nests were being found in habitat similar to that present in the previous mainland sites. The combination of a largely closed canopy, indigenous low shrubs and bushes and a good layer of leaf litter resulted in the discovery of a few nests, and an elephant-shrew was sighted as it fled down what appeared to be a path through low *Cynometra* vegetation. This observation begs the question “do giant elephant-shrews use pre-cleared paths like those of the four-toed variety?” Our findings can in no way answer this, but it is very probable this particular Black-and-rufous was simply using the paths made by other forest animals such as duikers.

The data collected shows that the estimated density of elephant-shrews in Kiono forest is 42.7 animals per km^2, being equal to that of Ruvu south, but smaller again than either Pugu or Kazimzumbwi. Despite this relatively healthy state of affairs, the wildlife and habitats in Kiono are possibly more vulnerable than those in Ruvu, whose primary forest can be considered to be buffered by the large areas of surrounding Miombo woodland. The land around Kiono is rapidly being encroached upon by farmers and pole gatherers, and is only afforded protection to the East, by Sadani Game Reserve. In this way it can be seen as a classic case of fragmentation, leading to the loss of species as their densities dwindle. While working in Kiono, we observed groups of black-and-white colobus monkeys and blue monkeys, heard evidence of galagos and found traces of other small mammals, (some of which had broken the nets intended for the elephant-shrews!). If the primary forest disappears, it seems likely that the demise in elephant-shrew numbers will be mirrored by other species.

Whether this trend will continue remains to be seen. For the elephant-shrew, the loss of habitat may not be as terminal as for other species. Sightings were reported in shamba/agricultural land to the west of the reserve in Mandera, but it is likely that, as in Kazimzumbwi, this is the exception and not the rule. A local elder in the nearby "hamlet" of Mbwebwe confirmed that the elephant-shrew was hunted and eaten in surrounding areas, posing another threat to its long term survival. Considering that a 1990 Frontier Tanzania expedition reported the Black-and-rufous Elephant-shrew to be “abundant” in Kiono forest, these findings serve to emphasise the importance and necessity of quantitative data.

East Usambaras

The East Usambaras, a range of low lying mountains in the north-east of Tanzania, have been recognised by conservationists around the world as containing areas of quite unique habitat. One look at the IUCN “Red Data Books” shows how many rare and endangered endemic species are present in the mountainous countryside, which because of its high rainfall and temperate climate attracted colonial tea-planters and foreign foresters in the past. Now the same clement conditions have encouraged many local farmers to start farms in the lower parts of the range, as well as supporting the many ongoing tea plantation in the highlands. IUCN is presently involved in reversing the development trend, attempting to balance development with an extensive conservation project, (the IUCN East Usambaras Conservation and Development Project, based in Amani).

It remained for us to establish where the Black-and-rufous Elephant-shrew still lived, and how it was faring. To accomplish this we chose one highland site and one lower down in the foothills. The map over shows the two sites visited and indicates where transects were carried out with reference to specific forest reserves. See text for further information contained on the map.

Kwamkoro Forest Reserve

This reserve is situated some 6 km past Amani, deep into tea country. The forest reserve itself is just one of many conservation areas in the Amani region, and borders onto a large tea plantation in the Kwamkoro Tea Estate, (Plate 11). The primary forest, covering ground which is steeply inclined in most places, is comprised of impressive forest trees, some above 30 metres tall with a thick undergrowth of cycads, ferns and *Coffea* type bushes. This habitat provides a home for many species of birds and has been studied previously by Bill Newmark. With a high canopy and thick leaf litter, it seems a suitable habitat for the Black-and-rufous Elephant-shrew.

Transects were conducted in this site and no traces of elephant-shrews were found. It is possible that the temperature, although high in the daytime, may be inadequate for the species in this habitat. In addition to this restriction, it may be that the high amount of rainfall and sharp relief of the habitat may restrict establishment of the species here, although more detailed work is needed to verify these suggestions.

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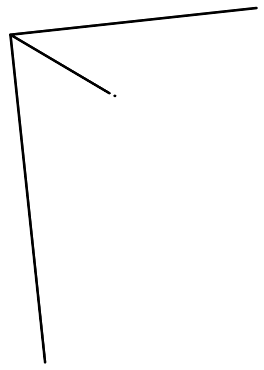

Following enquiries in local villages, several separate reports indicate that the Black-and-rufous had been sighted in disused tea plantation near the more northern villages of the Eastern Usambaras, where the leaf litter can be very high (often 100%) and the total cover exceeds 80%. Further, the Black-and-rufous has been sighted in forest around Makanya Hill (se fig. 13), which is, at 800 metres, below Kwamkoro, but higher than the foothills in the Kambai Forest Reserve where it had been sighted by a Cambridge University Expedition. The second site chosen was one at the bottom of the escarpment from Makanya Hill across from Lunguza Forest Reserve, serving as a comparison to the highland forests.

Kiwanda Area.

To investigate the density of elephant-shrews living in the lower parts of the East Usambaras, the pristine forest to the west of Kiwanda in the northern part of Lunguza Forest Reserve (across the river) and Kwamarimba Forest Reserve were surveyed, as well as the teak plantation in the south of Lunguza forest (see fig. 13). The area is densely populated and as such, is given over to farming in many places, so that the forest reserves are isolated from each other to some extent. The Sigi River runs south close to Kiwanda, separating the village from the Kambai area and the Lunguza plantation, (Plate 12).

Transects through the forest yielded only one nest, in what was generally very poor habitat, in that it had clearly been exploited some time in the past, there being few mature trees. Further transects in the teak plantation failed to provide any evidence for the presence of elephant-shrews. The previously mentioned sightings reported by another team came from the Kambai Forest Reserve some 5 km north of Lunguza, and these observations serve to highlight the fragmentary nature of the elephant-shrew's range in this part of the Usambaras. While the Cambridge team reported many sightings of *R. petersi* in the area that they were based in, our quantitative work with transects revealed that the populations of elephant-shrews in neighbouring areas was for the most part noticeably lower, especially when compared with the numbers estimated for previous forest reserves.

On the Kiwanda side of the Sigi, transects were conducted in Kwamarimba Forest Reserve, 4 km north of the village, and again only one nest was found. This was surprising as we had been informed that elephant-shrews dwelt there by locals when we had inquired. Wide scale logging was evident, while a logger's hut was found deep in the forest. The relative absence of the elephant-shrew can only be attributed to habitat loss and fragmentation, as in other instances, with an unknown contribution from hunting in days gone by.

As was the case in Kiono, the Kiwanda locals maintained that no hunting of elephant-shrews occured on their side of the River Sigi, but they were sure that people on the Kambai side of the river still hunted the animal. Naturally, the locals living on the Kambai side claimed the opposite. Interestingly, we found a man living in the Kambai locality who freely admitted that he and several neighbours hunted them periodically. In any case, it appears that the elephant-shrew population in this area has been depleted considerably, as the densities were so much lower than would be expected in the pristine forest that was surveyed in this area.

It is hoped that further research in the Kambai Forest Reserve, further north of the area studied by NJULE ‘92, can be completed by students from WCST in Dar es Salaam and from the IUCN Forest Conservation Project in Amani. The Kambai area is being identified as a proposed nature reserve: it is suggested here that quantitative transect studies, comparing elephant-shrew nest densities in disturbed and pristine forest in the Kambai Forest Reserve area would be the only reliable method of estimating the animal’s density and that this information would be likely to contribute to the case for a nature reserve in this area. With more complete protection from logging and trapping, both of which seem to have already taken their toll on this species of elephant-shrew further south in Kiwanda, it is hoped that a nature reserve would serve to protect the Black-and-rufous Elephant-shrew from further depletion in the lowland East Usambaras.

8) Zanzibar Island:

The main forest site that was surveyed on the island was Jozani Forest Reserve. This consisted of several distinct forest types within a comparatively small area, such that it was possible to carry out informal surveys of each habitat type within the time that we had allocated to the this site. The map below shows the main forest reserve and the coral rag which surrounded it. The habitats that were encountered within the main forest reserve are listed in more detail after the map.

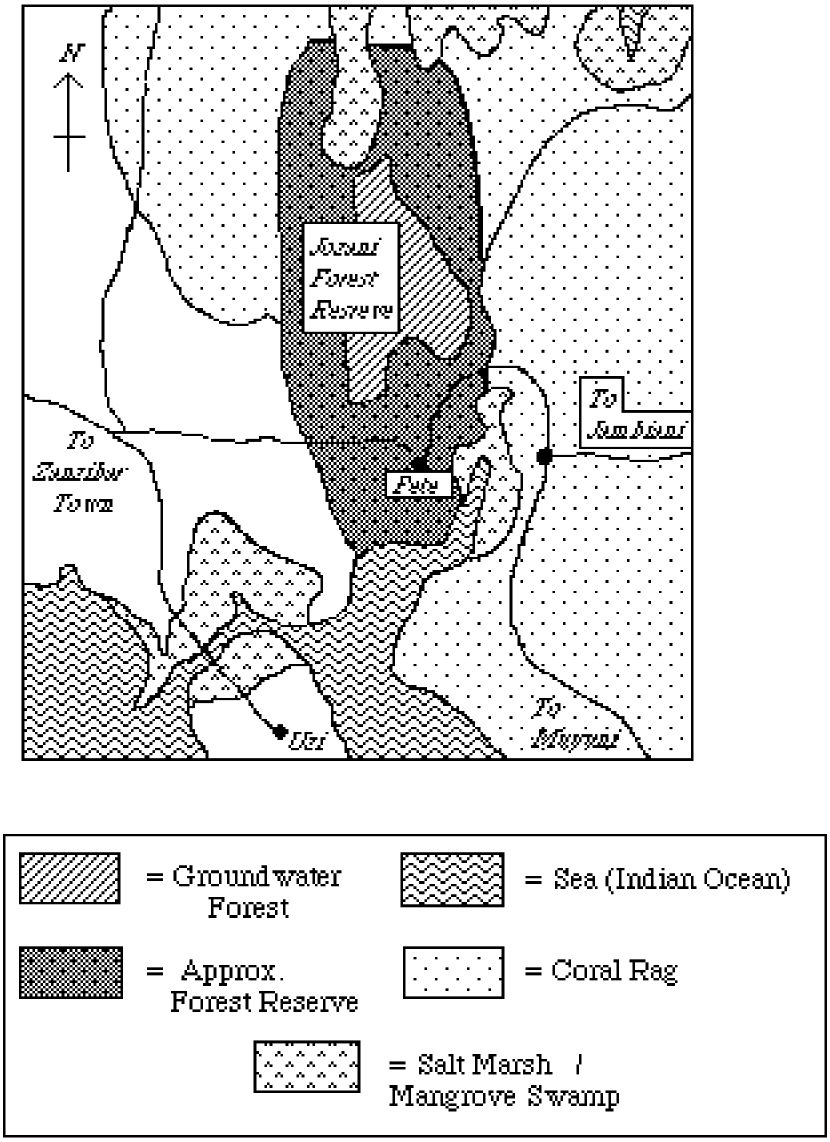

Fig. 14 - *Sketch map of study sites in Jozani Forest Reserve and surrounds.*

Main habitats enountered:

a) *Calophyllum inophyllum;*

b) Groundwater forest;

c) Coral rag-scrub (pristine);

d) Phoenix Swamp;

f) Australian pine (plantation habitat);

g) Coral rag-scrub (disturbed habitat).

Permission was not gained to cut transects on this island, so we could only carry out a series of timed random walks to reveal relative density estimates between the different forest types, also comparing them to the forest sites studied on the mainland. Two two-hour walks were carried out in each forest type over several days.

Calophyllum, a large complete canopy tree covered a wide area betwen the main road and the groundwater forest (see fig. 14). Underneath the *Calophyllum,* bracken formed a continuous thick mat, over most of the ground. After extensive searching in bracken adjacent to the main track through the forest, it was concluded that there were no Elephant-shrew nests in the thick loose soil and leaf litter underneath the bracken, although it was admittedly difficult to tell whether a soft piece of soil underneath one's feet was actually due to elephant shrew digging or not. Most times it was obvious, because there were no nests with their distinctive oval of leaves around a characteristic depression. This habitat may yet reveal the presence of elephant-shrews, but it is thought that the undergrowth very close to the ground was too thick to allow the elephant-shrew free movement and that the protection from aerial predators was not sufficient, as there was very little cover between 2m and about 20m, the height of the canopy.

The groundwater forest is, unsurprisingly, very damp underfoot (Plate 13). This habitat floods during the wet season and many parts were too boggy to walk upon, towards the end of the dry season, . It is unlikely that the Black-and-rufous Elephant-shrew would build nests in such waterlogged soil, as the insides of their nests are normally kept as dry as possible. (The inside of many nests were completely dry in some sites where there was heavy rain, suggesting that they are designed to protect the animal from waterlogging. The latter would negate the insulatory effect of the animal's fur, so it would seem natural that the animal would attempt to keep its nests dry.) The ground was so damp that it was competely covered with thousands of tiny crab holes in some places and it was impossible to walk without destroying at least ten crabs, or holes, at a time! (Plate 14) The Phoenix "swamp" was similarly waterlogged, so it was agreed in accordance with the preliminary observations of Dr. Galen Rathbun, that *R. petersi* is extremely unlikely to occur in these habitats, for the above reasons.

The Cynometra-like habitat to the right hand side of the main track through the forest provided good cover at low levels (about 80% of total cover was below 4m). However, the bracken down at ground level was, again, probably too thick for *R. petersi* to move around in easily. It is suspected that this may play a significant part in habitat choice, as whenever the elephant-shrew was seen in any forest site, its automatic reaction was to bound off at top speed fairly close to the ground. It is suggested here that the elephant-shrew would not be able to escape with ease in the bracken and that this may be a good reason for why no elephant-shrew nests or digging sites were found in this habitat type.

There are large stands of Australian pine in the east side of the reserve which produced no digging signs or nests of the elephant-shrew. This is probably due largely to the low leaf litter: most of the ground vegetation consisted of grass, along with a few widely spaced shrubs. It became fairly obvious that this would not support elephant-shrews because the trees were widely separated, creating spaces of several metres around each tree where there was no cover to protect the elephant-shrews from aerial predators.

Further to the east, pristine coral rag habitat began where the pine plantation ended (see fig. 14). Coral rag habitat covers a very large proportion of the island and is basically a very dry habitat, with a thin topsoil replaced mainly by sharp coral fragments. Cycads are common here, whilst trees above about 6m are virtually absent. (80% of the total cover was below 4m, the other 20% being predominantly below 8m.) The leaf litter averaged around 70% throughout, so we were not surprised when new nests started to appear! Two two-hour walks in this habitat produced an average of 1.25 new nests per hour. Several of the five nests that were sighted were situated under cycad trees, which perhaps afforded the nests with extra protection from predators. There were also many bush pig digging sites, as always. Most remarkable of all, however, were the Four-toed Elephant-shrew runs, which were actually more the size of "motorways," criss-crossing each other regularly. It was clear that they were not just animal tracks through the forest because they had been meticulously cleared of all vegetation and leaf litter, down to the bare soil. We found several instances where a Four-toed run would clearly exit the forest and enter it again on the other side of a main track through the coral rag. This had not been expected and it suggests that the Four-toed Elephant-shrew is not peturbed (at least on this island) by large breaks in the aerial cover, such as tracks or even roads. Although it is possible that the Black-and-rufous Elephant-shrew also uses these runs, no conclusive proof was found of this, so it is not clear whether *R.petersi adersi*'s habitat is fragmented by the creation of tracks through the scrub or if its passage is unhindered by such development.

A comparison habitat to the pristine coral rag was an area of disturbed coral rag further to the east of the forest reserve. Here, there were many shambas beside the road and the locals would go into the coral rag to cut firewood every day. As a result much of the coral rag in this area has been severely logged out in many places.

However, in one of these disurbed patches, the expedition found a huge new nest under a thick shrub which stood right next to a pile of recently cut logs! (Plate14)

The elephant-shrew nest density was not as high in the disturbed habitat as it was in the pristine coral rag (only two nests found infour hours of random walks) , but it is clear that at least this elephant-shrew is able to currently occupy an area which regularly experiences human disturbance. The nest was gigantic, so the occupier was probably a giant among elephant-shrews, unafraid of anything, including humans! Whatever the case, it seems that the Zanzibar island Black-and-rufous Elephant-shrew is perhaps more adaptable to habitat depletion than expected, living in disturbed habitat, often outside pristine forest. Reports of *R. petersi adersi* have come from various parts of the island, such as Mazizini Forest near Zanzibar town, the Muyuni coastal strip (Silkiluwasha 1981) and even from the coral rag on the east coast of the island, near Jambiani (Pakenham - no ref. date), so adding to the evidence for a widespread distribution of the animal on the island.

An attempt was made to reach Uzi Island to the south of Jozani forest, but the road was made from coral rag and was too rough and bumpy to be able to reach the island. See Logistics section for further advice on how to reach this island. It is of interest because it supports coral rag scrub which might in turn support a small population of *R. petersi adersi*, which could have been isolated from the main Zanzibar island "gene pool" for a very long time. It is hoped that Dr. Rathbun can complete a survey here.

Of further possible interest is that there was no sign of any elephant-shrew nests, runs or sightings during the brief visit to a forest reserve a couple of miles West of Jozani Forest, on Zanzibar, which consisted of pure stands of Eucalyptus. Maintained well and clearly younger than those Eucalyptus in Pugu, there was no native shrub at all in this plantation.The reserve did border on coral rag scrub which, from our research, seems likely to contain a population of *R.petersi adersi*. This then supports the idea that such native shrubs may well be a necessity for colonisation of tree plantation by elephant-shrews. Again more detailed analysis would be extremely useful to back up these observations.

<u>9 Kisiju Island Study</u>

General

This island lies 5 km up the coast from the fishing village of Kisiju which is itself 100km south of Dar es Salaam.

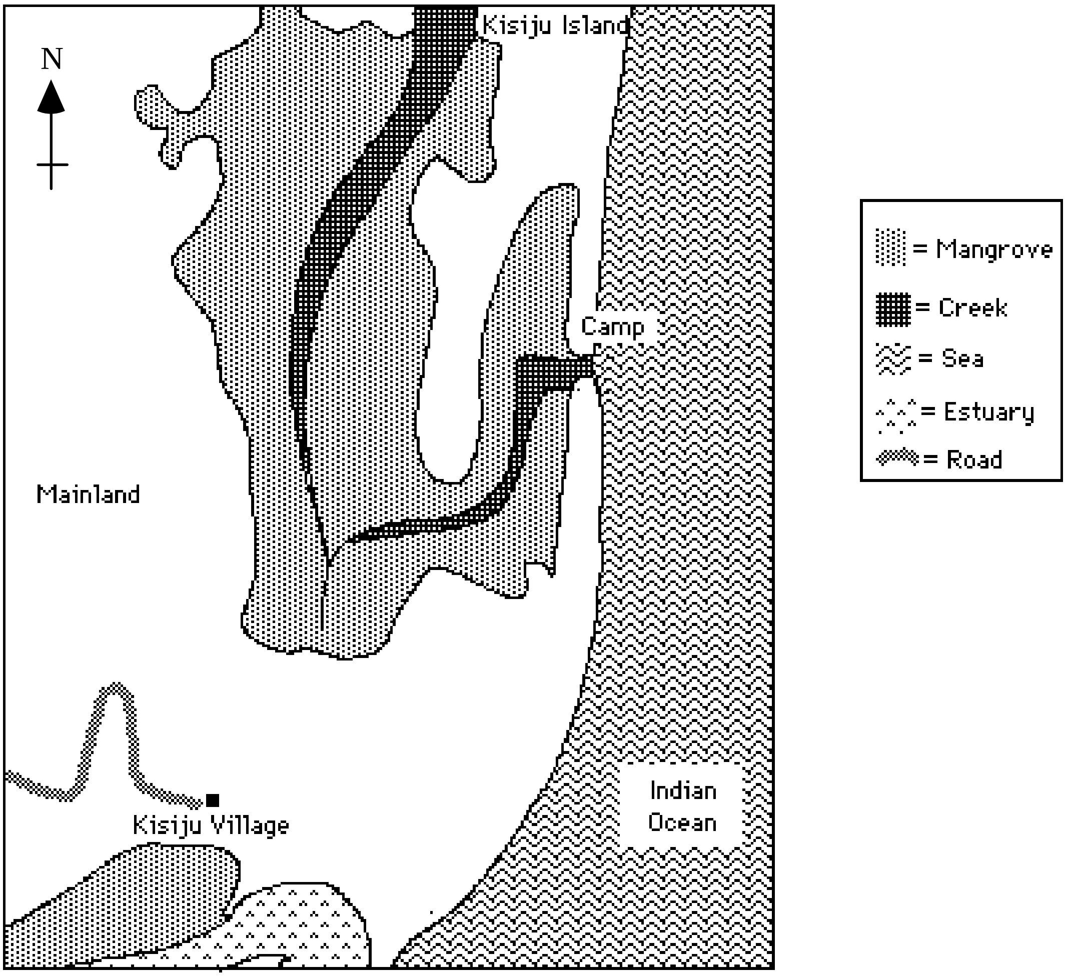

Fig. 15 - *Sketch map of Kisiju Island study site , showing access from mainland.*

The island has been of interest to the wildlife enthusiasts of Tanzania because of its isolated populations of Black-and-white Colobus monkeys and its relative isolation from the mainland. Recent reports from the forested island suggested that it had suffered from a certain amount of exploitation for wood and agricultural plantation, and that its avifauna in particular was generally depauperate (Burgess, 1990).

Knowing that the forest on the island represents a fragment of ancient coastal forest, Njule '92 went to Kisiju Island to repeat the techiques employed on the mainland in an effort to discover whether *R.petersi* could be found there.

Transect Work

The island is about 7 km long and 1 km wide at its widest point, so that most of its area could be surveyed. Nine transects were conducted at equal intervals along the length of the island, and while no traces of *R. petersi* were found in any of them, much useful habitat data was gained from the work. The state of the remaining primary forest can be estimated from the transect data, and an idea of the extent of the human exploitation can be seen from the proportion of the total length of transect which is not mature forest.

Qualitative Observations

The first impression that Kisiju gave was that of untouched tropical island surrounded by mangrove swamp and which promised a hidden array of wildlife. Unfortunately, after a day of reconnoitring the island it was obvious that there had been quite extensive cultivation for local shambas, and its forest had been heavily reduced by the activity of people who required new land for cashew plantations about 5-10 years ago. These areas had been cleared with fire, and it was shocking to see the remnants of the tall *Albesia* trees, left as skeletons in the midst of the burning, scattered everywhere, (Plate 15).

The trees are not generally used for timber or sold, because they cannot be transported to the mainland. As a result the trees are killed simply because the ground below them would be shadowed by an otherwise living tree. Despite the extent of the view shown above (see quantitative results), a mixed troop of Black-and-white Colobus and Blue monkeys were spotted in the burnt upper branches of these trees, and while on the island, members of the expedition saw vervet monkeys, hippo and duiker prints and species of bird such as the African darter, the Fish Eagle and the Palm-nut Vulture.

However, there was no evidence from the transects for the presence of *R.petersi*, a result which was ratified by the reports of locals who were living at the northern end of the island. Interviews with people who live in the village, but who stay on the island during the harvest, revealed the presence of a type of "Sange" (Kiswahili for small mammal, often meaning giant elephant-shrew), which in this case alluded to the

Four-toed Elephant-shrew (*Petrodomus tetradactylus*). Several independent sources confirmed that the Black-and-rufous variety could be found on the mainland adjacent to the village.

Quantitative Results

The habitat data compiled from the transect sheets summarises as follows. To estimate the percentages, the total length of a habitat type is taken as a fraction of the total length of transect covered. An estimate of the area represented by that habitat on the island is then calculated from the known area of the land.

Habitat Type	Length (m)	Proportion of Total (%)	Estimated Area (km^2)
Primary Forest	1640	33	1.5
Coppiced Forest	1160	23	1.1
Shambas	980	20	0.9
Other (dry scrub..)	1200	24	1.1
Total	**4980**	**100**	**4.6**

Fig 16 - *Estimated areas of different habitat remaining on Kisiju Island*.

Conclusions

It is clear from these figures that there is only a minimum amount of primary forest left, and the original transect sheets suggest that this forest is concentrated on a strip of land that extends from the southwestern portion of the island, above extensive mangrove swamps that surround the peninsula.

Dickinson (1991 unpubl.) estimated the area of forest as “3 km^2 and dwindling”, so our estimates suggest that there may have been some deforestation since this last estimate. There is no doubt that the forest is being cleared gradually by local farmers for agricultural purposes, and that in the process the tall canopy trees are being destroyed, not for timber, but simply to allow light through to the lower levels. In this way they are left dead with no upper branches, their trunks rotting and unused.

The small size and relative inaccessibility of Kisiju means that it does and will not support a permanent population, but for the same reasons the lack of communication will ensure that clearing can continue unchecked and those forest trees sacrificed for such operations can never be used profitably. With an expanding population on the mainland, pressure is being brought to bear on ever more remote areas like Kisiju where forest has ruled for many thousands of years. As others have discovered before us, the island forest does not boast an especially rich flora and fauna, due to its relatively short existence which precludes the build up of diversity. However, with populations of Black-and-white Colobus monkeys and encouraging spoor of Hippos and duikers, this case highlights the potential of any coastal forest remnant, and serves to remind us that even the smallest pockets of natural forest merit preservation.

CONCLUSIONS

Comparing Black-and-rufous to Golden-rumped densities

The results of NJULE '92 have shown that the densities of this elephant-shrew in many coastal forests are lower than previous estimates (Danish ICBP Expedition / Frontier Tanzania) of "abundant." When compared to densities of the Golden-rumped Elephant-shrew in Kenyan coastal forests, we have discovered that the areas of Tanzanian coastal forests, which are much smaller than those found in Kenya, hold disproportionately less Black-and-rufous Elephant-shrew nests per 100m than the Kenyan forests. Therefore, Golden-rumped Elephant-shrews occur in much higher densities than in any case of the Black-and-rufous Elephant-shrew that we studied, using the same survey methods as those used in Kenya. (ref: Discussions with Dr. FitzGibbon at end of expedition). This may have dangerous implications for the removal of further pristine forest in Tanzania, as the elephant-shrew numbers may decrease disproportionately more than the area of forest removed would typically suggest. This phenomenon is well known for other animals where fragmentation of their natural habitat has occured, so it is highly likely that this is the case. Bolger, Alberts and Soule (1991) have analysed occurrence patterns of bird species in habitat fragments and have noted that the persistence ability of a species has a strong positive correlation with its own density. "Populations of species that naturally occur at lower densities become extinct more rapidly than do those of more abundant species." Because of its characteristically low density, the Black-and-rufous Elephant-shrew could be highly likely to go extinct in many of the fragments of pristine forest along the Tanzanian coast in the near future.

Comparing Pristine to Disturbed Elephant-shrew Habitat Densities

There are signs that this elephant-shrew is able to live and forage successfully in habitats disturbed or created by human actions. In Pugu Forest Reserve, a significant number of nests of this elephant-shrew were found in mixed plantations of *Cassia* and *Eucalyptus* of varying age. Similarly, the Four-toed Elephant-shrew (*Petrodromus tetradactylus*) has invaded these areas of plantation, which suggests that it too can survive in this disturbed habitat, where the native shrubs have been allowed to recolonize.

It is clear that the levels of leaf litter in the plantation was significantly lower than in the pristine forest, but the former also had the highest leaf litter of any disturbed habitat that we studied. Thus , the leaf litter component may make the plantation a viable habitat for colonization, albeit because the leaf litter is partly from native shrubs and trees, as opposed to that of *Eucalyptus* or *Cassia*. The native shrubs provide protection for nest sites and perhaps this makes the leaf litter more similar, albeit poorer, to the pristine forest type. Moreover, it was noted that the leaf content of several of the nests in the plantation consisted of large amounts of *Afzelia quanzensis* leaves (a native tree), yet there was no sign of any such tree in the vicinity. Without being completely subjective, it is possible to suggest that the elephant-shrew has been transporting certain leaves from trees that are known to be preferable habitat to this species (FitzGibbon 1992), into areas where these trees are not present. It would be very interesting to do a further analysis of the leaf types present in elephant-shrew nests to test this suggestion. The pure stands of Eucalyptus in the forest reserve to the West of Jozani forest which were well maintained (there was no native shrub at all in this plantation) and clearly younger than the Eucalyptus in Pugu, support the idea that native shrub may well play a vital part in enabling the elephant-shrews to re-colonise the plantation. It would be extremely interesting to see if this is true.

The Black-and-rufous Elephant-shrew is, according to our research, not able to live in agricultural land typical of that created on the fringes of Tanzanian coastal forest by slash and burn activities. This "typical" disturbed land was studied in Kazimzumbwi and no sign of this elephant-shrew was found. The elephant-shrew sighted in the patch of scrub in the Kazimzumbwi agricultural land probably does survive in this thicket, but it is not clear how long this thicket has been isolated and it will probably be cut down in the near future. The presence of the Black-and-rufous Elephant-shrew in these small pockets of secondary habitat does not provide an excuse to say that the loss of pristine habitat has no damaging effect on the survival of the animal. This elephant-shrew has much lower densities in these thickets than in the pristine forest nearby. It is the pristine forest that needs to be protected: we cannot rely on the maintenance of shrub or thicket for the survival of this elephant-shrew, whilst the conversion of pristine forest into agricultural land is totally unacceptable if this elephant-shrew is going to survive.

The Black-and-rufous Elephant-shrew is reported to live in disused tea plantation. This, like the Pugu plantation habitat is highly unlikely to support densities as high as the neighbouring pristine habitat of the elephant-shrew. This is because the flora and fauna microhabitats created by disused tea plant monocultures are unlikely to support the diversity of elephant-shrew prey and leaf litter that pristine forest provides. The elephant-shrew may only forage in the disused tea and may only build nests in the neighbouring pristine forest. Further work in the Usamabara area may well reveal the extent to which the elephant-shrew relies on the disused tea plantation habitat.

It appears that the elephant-shrew on Zanzibar Island (*R. petersi adersi*), lives unexpectedly in its highest density in coral rag habitat, of which only a small part actually lies within the Jozani Forest Reserve. The pristine habitat inside the reserve boundaries, containing tall trees and a complete canopy, seems to support considerably less elephant-shrews than had been expected. The reasons for this are suggested in the Results-2: Site Observations section. In any case, because new elephant-shrew nests were found in coral rag sites adjacent to the pristine forest and more significantly, several kilometres away from the main forest, it appears that the elephant-shrew, (Zanzibar and Pemba Island only) may inhabit a substantial proportion of the coral rag on the island. It is hoped that a survey carried out by Dr. G. Rathbun in Summer '93 may be able to provide more quantitative density estimates of the Zanzibar elephant-shrew, comparing coral rag densities to different densities in other pristine habitats on the island.

The "disturbed" habitat type where selective logging had taken place was studied with clear implications in Kiwanda, the lowland Usambara site. It seems that very few elephant-shrews are left in the Marimba Forest Reserve area since it has been logged. Much of the pristine forest remains, but despite several separate reports of plentiful elephant-shrews in this area, the transects found virtually no sign of the animal living in the forest and building nests there. The Central Valley area of the lowland Usambaras seems to have already been fragmented into small forest patches of diminished ecological status. The information gathered by NJULE '92 suggests that the logging along with the development of agriculture and persistence of hunting in the valley has had a deleterious effect on the elephant-shrew density, such that the animal is unlikely to survive in this valley unless the nature reserve that is proposed in the Kambai area is put into effect in the very near future.

Deforestation Activities

It became increasingly obvious during our visits to several of the coastal forests that there is a considerable amount of deforestation occurring in many of the coastal forests of Tanzania, as suggested by previous visitors (Burgess (1991), Dickinson *et al.* (unpublished). The following section recounts some of the events that we experienced in specific reference to deforestation activities. The pattern may be typical of what occurs in many of the other coastal forests in Tanzania and it is vital that such activities are controlled if there is to be any hope of halting the continuing demise of what is left of the coastal forest reserves of Tanzania.

First, an area of several hundred metres square, on a hilltop in the middle of Pugu Forest Reserve had been completely cleared of both trees and shrub. This area was only found because a transect was cut straight into the area itself. Whilst taking the data for this transect, several forest guards were seen taking charcoal from one of the many smoking piles in this catchment. On seeing us they became quite uneasy and were anxious that no pictures were taken of them. What is more, several forest guards who were working with us cutting transects the day before, were taking part in this clearance and covered their faces or ran away when we attempted to take photographs (Plate 16). The local forest reserve officer was surprisingly flippant when we mentioned the presence of this forest catchment in this reserve, but made no comment on the matter.

In Kazimzumbwi Forest Reserve, stronger evidence of forest guard involved with deforestation activity was seen. Dunston, our assistant from the Wildlife Conservation Society of Tanzania (WCST) talked to several people in the local villages who said that the forest guards were alarmed at our presence. The guards are apparently used to directing lorries and pick-up vans to areas of the forest where they can cut trees such as Ebony and *Brachystegia* . Furthermore, most of these areas are inside the forest reserve. At our first site in Kazimzumbwi, we woke up to the sound of an axe chopping nearby. We made our presence known with several blasts on the Landrover's horn and the cutting stopped. Later in that day some forest guards took us on a reconnaissance walk to find elephant-shrews in the area. We found a large area of land in the southern part of the reserve that had been felled and burned in recent years.

As a result of this initial contact with the civilians and forest guards of the local villages, the forest guards started turning trucks away that were heading to the south of the reserve, probably because we were in that area. As soon as we had moved to a different site in the hills in the north of the reserve, the guards began letting the trucks through again. It was also suggested that there were "spotters" along the roadside that were noting the movements of our landrover, reporting whether we were going through with all our luggage on the roof (ie: moving base) or if we were simply coming into the village for supplies. The villagers were wary of us because our landrover was green, the same colour as those of the Government Forestry department. This evidently put them on their guard because the forest department had not inspected this reserve for some time and would certainly have found the evidence of illegal activity that we had seen.

We found several people selling charcoal along the main road through Chanika and Buyuni, without licences from the Forest Officer; several van full of charcoal sacks had no licences either. A truck full of *Cassia* logs taken from near to where we were working in the north of the forest reserve had no licence: the owner of the vehicle was clearly very worried about our presence. All of these people were on their way to Dar es Salaam, so they must have passed straight through the roadblocks along the main road through Chanika and Buyuni, right in front of the Forest guards who were meant to be there to stop them.

Clearly, there is a desperate need for several independent "overseers" to monitor the road blocks in this area. (It may also be expedient for some of the Forest guards to be replaced, as they have proved for whatever reasons to be untrustworthy.) We fully support the action being taken by WCST to install two independent observers in this important region of Pugu and Kazimzumbwi. We would also recommend the presence of Dunston Sanga, our assistant, because he has shown a very honest approach to this problem, which we believe would be extremely useful in helping to solve the problems we have identified concerning the local forest guards.

In Ruvu, which is controlled by the same authorities as Pugu and Kazimzumbwi, the dense woodland in the middle of the reserve is virtually untouched and in contrast to the previous forests, we saw no evidence of charcoal production in this area, save a couple of charcoal piles in the Miombo woodland which takes up most of the 98 km^2. The pristine forest covers a much smaller area towards the middle of the reserve. It is thought that the isolation of this part of the reserve has helped it to remain relatively unlogged compared to Pugu and Kazimzumbwi, which have much easier access from Dar es Salaam than Ruvu does.

Conservation Recommendations and Future Studies

Although it can be seen that the elephant-shrew had certain minimum habitat “requirements” in different forests (total cover, leaf litter, etc.), such values are not sufficient for conservation initiatives aimed at protecting the elephant-shrews. The values provided in the Site Observations section are indicators for researchers as to whether the elephant-shrew is likely to exist in a forest or not. The real requirements for use in a forest management plan must exceed these minimum requirements, in order to provide a “buffer zone” of sorts, because we cannot be certain as to the effects of imposing any “minimum habitat requirements” on an animal whose ecology is so little understood. The requirements do indeed vary between different forests and further work is required to study elephant-shrew densities in relation to the variation in natural pristine habitat within an individual forest reserve as well as studying dietary requirements of the shrew itself and how these might vary with the soil types within a forest. This must be done in order to be certain of any minimum habitat requirements or maximum allowable log removal in a particular forest.

Until this stage however, the only possible answer that will ensure the safety of this animal in the long term is to stop the deforestation that is occurring in the forest reserves, so that the pristine forest should remain uncoppiced and the removal of logs and timber in any form should not be allowed to occur. Again, in the long term, this may not be completely necessary, but it is surely not right to destroy pristine forest within reserves at this stage if we then find out that such habitat contained the highest elephant-shrew densities in the whole range of the Black-and-rufous Elephant-shrew.

Outside these reserves, official protection of pristine forest is virtually impossible and due to the increasing demand for land for agriculture, it is unlikely that the Black-and-rufous Elephant-shrew will be able to survive in many places outside forest reserves. It is perhaps best to concentrate on protecting certain areas outright, although this may well eventually result in fragmentation of the elephant-shrew's ancient habitat. It is a sad coincidence that the Black-and-rufous Elephant-shrew lives in such a small portion of the total area of Tanzanian forests and that it is this portion that is most threatened. On the other hand, however, it must be considered that there is a great demand for timber, firewood and agricultural land in the coastal regions of Tanzania, which are more developed than most inland areas of Tanzania. It is hoped that this expedition has highlighted specific forest reserves or regions which should be concentrated on, in order to ensure the long term conservation of the Black-and-rufous Elephant-shrew. They include areas which are already beginning to succeed with the conservation of the remaining forest, such that it should require little extra funding to ensure the conservation of *R. petersi*. This is simply because this animal's survival goes hand in hand with the survival of the ecologically rich and diverse coastal forests which this expedition has conclusively revealed as the elephant-shrew's optimum habitat.

Ayoub Njalale, Dunston Sanga and two other wildlife students have recently completed a survey of the giant elephant-shrew down near Lindi. Unfortunately, the project was dogged by logistical problems, but it appears that they have found an area very rich in giant elephant-shrews (*Rhyncocyon* sp.). The densities of nests were higher than any of those found on the NJULE '92 expedition, but at this stage it is unclear as to the exact species that occupies this territory. There may be a modified hybrid zone between *R. petersi* and *R. cirnei* (the Chequered Elephant-shrew) around the Rufiji River, but the nests probably belong to *R. cirnei*. The high densities are unremarkable, because the Chequered Elephant-shrew has a much less endangered distribution than either the Golden-rumped or the Black-and-rufous and its habitat is less disturbed.

It is hoped that the money left by NJULE '92 will allow Ayoub and Dunston, along with Peter Kabimba (from Amani IUCN) to continue elephant-shrew work in the Kambai Forest Reserve area of the East Usambaras (see map). There is much information to be gained in the Usambara area, both on habitat quality variation within forest reserves and status of the elephant-shrew, as well as on genetic studies and field metabolics of the animal. The Kambai area is being identified as a proposed nature reserve; it is suggested here that quantitative transect studies, comparing elephant-shrew nest densities in disturbed and pristine forest in the Kambai Forest Reserve area are the only reliable method of estimating the animal's density and that this information is likely to contribute to the case for a nature reserve in this area. With fuller protection from logging and trapping, both of which seem to have already taken their toll on the black-and-rufous elephant-shrew further south in Kiwanda, the hope is that a nature reserve would serve to protect the Black-and-rufous Elephant-shrew from further depletion in the lowland East Usambaras.

Seeing as this area does have significant financial support from the IUCN and several other bodies, it is suggested here that the lowland Usambaras area of the Central Valley should be targeted as a conservation site (especially if Kambai turns out to hold a high elephant-shrew density). The Pugu/Kazimzumbwi Forest Reserve complex further south on the mainland held high elephant-shrew densities and also receives considerable financial and practical support, which is largely controlled by WCST. It is therefore these sites on the mainland which should be targeted by conservation initiatives, as it is in areas where pristine forest protection and replanting schemes are already in place, that the elephant-shrew is most likely to survive. Forests such as Ruvu South and Kiono, although they hold lower densities of the elephant-shrew, they are under comparatively less risk from deforestation than others, due to their increased isolation. *R. petersi adersi*, on Zanzibar seems to have little risk of extirpation if it does indeed live throughout the coral rag/scrub habitat, as indeed seems likely.

Njule '92 is very keen to see that the recommendations posed here are adopted by the authorities and those interested in conservation in Tanzania, such that current conservation initiatives in the forest reserves are continued with greater reference and emphasis to the survival of the Black-and-rufous Elephant-shrew. Of course, if this is not done and the security of many of the forest reserves is not ensured, then it is quite clear that there will be no place left for this animal in the very near future, its fate being all too similar to the many other species that are now extinct as a result of deforestation activities in the Tropics. The animal's conservation is a simple notion, but a difficult practical problem for humans; however, the problem is one that we alone have the responsibility for solving.

ACKNOWLEDGEMENTS

We would very much like to take this opportunity to thank the many people who were willing to help NJULE '92. Thank you to all those who sponsored us, financially and in kind. We hope that this report encourages you to continue your support of such ventures as this.

From the beginning, Clare FitzGibbon was invaluable in helping to set the project up, providing useful advice at all the planning stages and teaching us the methods that we would use in Tanzania. Clare and John's great hospitality during the first and last weeks of the expedition was an extra favour to us that we are truly grateful for.

In Tanzania itself, Liz and Neil Baker provided us with vital support throughout the expedition period. We are all thankful for their generosity and hospitality during an obviously busy Summer period, for their part in setting up the local involvement through the WCST and for solving our many bureaucratic hassles! Thanks to all at the WCST office: especially Paul and Danny; and to Peter at Aquila.

Jim Creese could not have been more helpful, providing us with a home from home, as well as the brilliant landrover that we used for the whole expedition (which was made from spare parts in Nairobi in 1974!). Jim shall be remembered for his never ending supply of (cold) "Safari" lager which would appear like a vision from God when we returned tired, dirty and in a generally disgusting state from the field. His enthusiasm for wildlife conservation and the stories, which he has amassed over the years spent in East Africa, were inspiring to us all: we owe you one Jim!

We would all especially like to thank Ayoub Njalale, Dunston Sanga and Peter Kabimba for their unfailing dedication to the expedition. Ayoub's impressions of various people (who shall remain nameless!!) kept us in high spirits throughout his time with us. Dunston managed to teach us Swahili with varying levels of success and even ended up teaching us some English that we had never heard of!! He had a special talent for learning English slang and would have been able to insult any Englishman by the end of our time with him! We met Peter for the first time, underneath his motorcycle, in a ditch in Kwamkoro (having narrowly avoided him in our landrover on a nasty corner!) and even then he had a smile on his face! His knowledge of the East Usambara area and his interest in Elephant-shrews made him extremely useful. We hope that Ayoub, Dunston and Peter can continue the Elephant-shrew work in the Kambai area of the Usambaras, as we are sure that they would do a brilliant job.

Prof.Kim Howell in Dar es Salaam; and Dr. Alan Tye and Preben Enhard in Amani were all very helpful in ensuring that the expedition got to the right places and we thank them for their advice, which was enormously useful.

We would like to thank Dr. David MacDonald, Alex Dickinson and Neil Burgess for their advice on scientific and logistical aspects of the expedition. Thanks must go to John Grimshaw, (without forgetting his remarkably repulsive “bronze” turkey and his remarkably rude blue monkey) who lent his advice and copious quantities of Earl Grey tea to the expedition in its planning stages.

Thank you to you all,

From Neil, Jo, Aidan and Pete.

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APPENDIX 1

Local Involvement, Advisors and Permits

This section describes some fundamental points around which the expedition was organised successfully, which may often be useful to other groups planning expeditions to similair areas. The addresses of relevant authorities etc., are provided at the end of this section. Fund-raising is described in the next section.

<u>Local involvement</u>

One of the most important aspects of an expedition's ultimate success, as well as its success in raising funds, is the involvement of as many host country participants or supporters as possible. "NJULE '92" placed particular stress on involving Tanzanian research workers in the work. Our methods had never been used in Tanzania before, but we fulfilled our aim of teaching all these methods to three Tanzanian "co-workers" to the extent that they have now carried out a follow-up project independently.

Such cooperation is best arranged through a contact in the host country, who has day-to-day contact with research/conservation groups. This is much less hassle than trying to encourage people, through writing letters, to work for you if they have never even met you! The Wildlife Conservation Society of Tanzania (WCST) is such an organization, which is dedicated to the conservation of the coastal forests of Tanzania and is now also supporting conservation work on a wider scale, protecting birds, mammals and indigenous flora and fauna of particular interest. References from learned scientists or experts on the subject of the expedition should definitely be sent with any initial correspondence to WCST.

The WCST need to know how an expedition's aims are realistic and useful. They can advise further in this respect and they are often willing to support a project both logistically and financially. However, the society is extremely busy with its own projects and it is only likely to support an expedition that has some reliable backing already. (References were obtained from an Elephant-shrew "expert," from an ecologist renowned through E. Africa and from a well known mammologist in England. Such support from "academics" who are relevant to your aims or, at least, your proposed country of research, are truly invaluable in fund raising and encouraging host country interest and participation.)

The WCST were more than willing to give us two of their research assistants for a large part of the summer once they knew that we were very serious and were beginning to raise money. Dunston Sanga and Ayoub Njalale were paid a daily salary of about £4. They are worth far more than this in some ways, because they are extremely keen, speak fluent English as well as Kiswahili and they often know the research sites better than any written advice could ever provide.

Gaining Permission and Work Permits

Ideally, this should be approached once local involvement has been obtained, or at least planned. The Tanzanians are not interested in, and will not give permission to a project that does not involve citizens of their country. The details below were correct at the time this was written, but it is important to note that at present, many of the policies on foreign workers/researchers are changing rapidly with little or no forewarning.

Permission to carry out scientific research has to be obtained from the Committee for Science and Technology (COSTECH) in Dar es Salaam (DSM). An application form should be obtained from their address at an early stage. (Correspondence is extremely slow!) Once 1) a Field Agent (e.g. from WCST, WWF, IUCN, University of DSM, Mweka College) has been agreed in Tanzania, 2) a Home Agent has been arranged, 3) some of the funds have been raised, 4) some evidence of local participation has been planned, and 5) the importance of completing the research has been clearly indicated, then an application to the COSTECH will probably succeed. (NJULE '92 gained its permission through the intermediacy of the Mr & Mrs N.E. Baker, who applied to COSTECH on our behalf.)

In summer 1992, permission cost $200 per person; a standard charge, and a major part of our budget. Recently, however, the Tanzanian government has imposed a charge of $250 per person, for anyone requiring work permits (Immigration Class C), which are essential to any expedition. It is important to establish whether this is still absolutely necessary, as you cannot technically do any work in Tanzania without one.

The RGS recommended that expeditions inform the Tanzanian Prime Minister's office of their intentions. This was discouraged by residents in Tanzania. We sent a letter anyway but received no reply. Permission to work in the National Parks in Tanzania is required from the Director of Wildlife. Permission to work in the Forest Reserves is needed from the Ministry for Natural Resources and the Environment at both the Regional and District level. Such permission is difficult or impossible to obtain by letter, but is fairly easy if the offices are visited by expedition members accompanied by Tanzanian residents.

Details of permission to enter individual forests (ie: Forest Officers and District Commission offices) is contained in the LOGISTICS section, under the relevant forest title.

Expedition members:

Neil Hanna: Expedition Leader.
Jo Anderson: Equipment and Medical Officer.
Aidan Bocci: Expedition Secretary.
Pete Buston: Expedition Treasurer.

(See contact address on the front cover.)

Addresses of advisers:

The following people were vital advisers to the expedition. They may be willing to help further expeditions that aim to study elephant-shrews or carry out research in Tanzania, but it is important to note that they are always extremely busy with their own work as well.

Foreign Agent

Dr.Clare FitzGibbon,
14 Benson Rd,.
Cambridge,
England.

Home Agent

Dr. David Macdonald,
Dept. of Zoology,
South Parks Road,
Oxford.
Tel.: 0865-271132.

Tanzanian Contacts and Local Involvement

Dr. Kim Howell,
Dept. of Zoology,
University of Dar es Salaam,
PO BOX 35065,
Dar es Salaam,

Mr. and Mrs. N. E. Baker,
Honorary Secretary WCST,
P.O. Box 70919,
Dar es Salaam,
Tanzania.

Tanzania.

FAX/Tel.No.:
010-255-51-66379.

John Grimshaw,
International School of Moshi,
P.O. Box 733,
Moshi,
Tanzania.

Dr. David Mwanyanza,
Principal of Mweka College of African Wildlife Studies,
(Private Bag),
Nr. Moshi,
Tanzania.

Advisers on Elephant-shrews

Dr.Galen Rathbun,
U.S. Fish and Wildlife Service,
Piedras Blancas Research Station,
P.O. Box 70,
San Simeon,
California.
FAX. No.:(Calif.)..-805-927-3308.

Dr. Clare FitzGibbon (see above)

Dr. J. Kingdon,
Dept. of Zoology,
South Parks Road,
Oxford.

Advisers on Tanzanian coastal forests:

Alex Dickinson,
Frontier Tanzania,
Studio 210,
Thames House,
566 Cable St.,
London.
E1 9HB.

Neil Burgess,
Royal Society for the Protection of Birds,
The Lodge,
Sandy,
Beds.

Dr.Douglas Sheil,
Oxford Forestry Institute,
South Parks Rd.,
Oxford.

Dr. Alan Tye,
IUCN Conservation and Development Project,
PO Box 1,
Amani,
Tanga,
Tanzania.

Permission from COSTECH:

Mrs J. Ligunda,
PO Box 4302,
Dar es Salaam,
Tanzania. Tel.: DSM-74017.

APPENDIX 2

Logistics.

The aim of this section is to provide practical and logistical information that is important if these sites are to be visited by others. The work was based in Dar es Salaam, and therefore the descriptions given refer to this city as the starting point for any excursion to the sites mentioned. All forests visited, except those in the Usambara Mountains are within a days drive of Dar, and no more than two days travelling by any other form of transport.

The mode of transport used for this expedition was a four-wheel drive, short wheel-base, 88 model Land Rover with roof-rack. This proved to be an indispensable asset when attempting to reach all forest sites. Not only are most of the areas visited several kilometres from major transport routes, but the access to each one is often poorly represented by maps and much local inquiry was needed to find the desired forest! Local people's estimates of travelling times and distances are often remarkably inaccurate, and it is sometimes best to ask someone to accompany you if there is any doubt as to the exact direction. For this task, our Tanzanian counterparts (granted us by the Wildlife Conservation Society of Tanzania) were invaluable.

Prices, travelling times, road conditions, village names and other local information are correct only for the time of stay in 1992. It was the dry season, although some of the forests have variable micro-climates, often with out of season rain which can radically change the travelling conditions.

Maps:

Fairly accurate maps of the forests and there surrounding areas are available from the Government Map Office in Dar es Salaam. This is found behind an old colonial style building along the harbour front from the Kilimanjaro Hotel.

The maps are ordnance surveys (publ. 1988-1990) and include much useful information, although the positions of villages, borders of forest reserves and mapping of roads are not always true to reality! Maps cost 500 Tanzanian shillings each, and a colour photocopy reproduction of one costs Tsh 900 .

KENYA

1.) Shimba Hills National Park

Location: This small National Park is situated on a plateau of hills in the coastal lowlands of Kenya, about 30 km south of the major city and port of Mombasa.

Access: The park can be reached easily by taking the coast road towards the southern beaches from Mombasa and turning off inland to Kwale. From here the tarmac becomes a dirt road and enters the national park. Local buses run to Kwale, although it is a major tourist destination and reaching the park is not hugely difficult with the multitude of tour operator's minivans and other tourists making the trip daily. National Park fees must be paid on the gate.

Supplies: Supplies are available in Kwale, or even better in Mombasa.

Communication: Like all National parks there is a full ranger service operating within the park and is available for most medical and emergency needs.

Notes: Permission to work in the Kenyan National Parks should be obtained from the Director of Wildlife in Nairobi. However, depending on the nature of the project, this may not always be required. For the purpose of this study, which required us to walk in the forested parts of the park, permission was gained from the Park Warden (KWS), at the main offices.

TANZANIA

Mainland Sites

1.) Pugu Hills Forest Reserve

Location: Pugu Hills is situated about 50 Km directly west of Dar es Salaam, in the district of Kisarawe, Coast administrative region (Mr. Setcha: Forest Officer).

Access: The reserve can be reached by road and rail. From Dar the metalled road runs through the large village of Gongolamboto where it becomes a dirt road and continues up an incline to the village of Pugu. To reach the reserve the road to Kisarawe is followed which runs directly through the forest. Many of the sites which have previously been studied can be reached from this road; a major right turn on a hairpin bend leads to two tracks which penetrate the forest. Local buses run from Dar via Gongolamboto to Kisarawe and will drop passengers off in the forest. Trains run to Pugu station from Dar, but the station is situated in a small village 1 km from Pugu called Pugu Kisengeni. It is also about 2 km from the middle of the forest where the best sites can be found so expect a walk.

Supplies: These are best obtained in Dar before leaving for the forest. Food is available in quite good supply in Gongolamboto, with bread, fruit and vegetables usually on sale. Meat, as well as fish can sometimes be found, plus all the staple foods. Fruit, vegetables and occasionally meat can be bought in Kisarawe. Water can be obtained in Dar, and if necessary in Gongolamboto, but there is little in either Pugu or Kisarawe, and what there is should be left for local consumption if at all possible. However, it rains in the hilly forest frequently out of season, and water can be collected with the careful use of a tarpaulin! The last petrol station before the forest is at Pugu, and cold sodas can be bought here.

Communication: Being so near to Dar es Salaam, any emergency communication, medical or otherwise, is best handled personally by returning to the capital. The district forest officer at Kisarawe, Mr. Setcha is easily contacted and will convey messages to Dar if necessary.

Notes: Permission to work in the district can be obtained from the CCM commissioner's building in Kisarawe. Practical tips for camping in Pugu include not pitching tents in the wet stream/road/river valleys between the hills as they are poorly lit and very damp even in the dry season!

2.) Kazimzumbwi Forest Reserve

Location: Kazimzumbwi is part of a forest that used to also contain the forest area on the Pugu hills and extend even further along the coastal lowlands. It is only a few kilometres away from Pugu to the south, about 60 km from Dar. Kisarawe district, Coast administrative region (Mr. Setcha: Forest Officer).

Access: As for Pugu hills except that in Pugu village a left turn over the railway line must be taken, which takes you to Buyuni and Chanika villages. The forest can then be reached from one of these two villages. The north part of the forest is accessible from the road south of Buyuni, along a sand track that winds its way through several *shambas* before it climbs uphill to the "untouched" forest about 2 km further on. From Chanika the south part of the forest can be reached.

It is predominantly *Miombo* woodland but is constantly being extensively cleared. Local buses also run to Chanika, but are irregular and very "local".

Supplies: As for Pugu; however food can be obtained from both Buyuni and Chanika, although Chanika has the better supply. Water can be drawn from at least two standing water pumps which can be found on the Buyuni to Chanika road. This water should be treated with caution and preferably prolonged boiling or sterilising tablets!

Communication: As for Pugu Hills. The system of forest guards is similar to that of Pugu thanks to WCST, and guards can be found in both neighbouring villages. They will guide people to the forest but were found to be less conscientious than there counterparts in Pugu.

<u>3.) Ruvu South Forest Reserve</u>

Location: Ruvu South forest is situated about 100 km from Dar, south of the main Morogoro road. It covers a large area (98 km sq.) and is dissected by the mainline Tazara railway. The site studied by this expedition was a large patch of woodland/forest towards the middle of the reserve which is predominantly *Miombo* woodland, having a connecting wildlife corridor to the Selous ecosystem. Much of the land surrounding the north of the forest is given over to Agave sisal plantation. Kisarawe district, Coast administration (Mr. Kessy: Forest Officer).

Access: The forest can be reached from the Morogoro road by turning off south at Kibaha. The dirt road from here goes through several small villages and many sisal and *cassava* plantations before reaching the reserve near to the railway line. It is a very bad, rutted road that proves to be a slow route into the forest for the relatively short distance, and there is no clear way to follow through the plantations; it was a case of asking the way at every other *shamba*. An alternative approach is from the village of Kisarawe. The dirt road passes through Kazimzumbwi where a left fork after the railway bridge takes you onto a road running parallel to the railway and which passes directly through the middle of the reserve. This is at least relatively easier than the other route, but passes through Tse-tse fly infested countryside. Local buses go to both Kibaha and Kazimzumbwi, but there is no transport into the reserve itself from either of these places.

Supplies: If not in Dar, food can be bought in Kibaha; most fruit, vegetables, eggs and bread was available, and there is a petrol station just outside the town. Water is best brought from Dar, and cannot be obtained after Kibaha in the subsequent villages or in the forest. There are riverine streams in the *miombo* woodland, but these are waterless in the dry season.

Communication: The forest in the centre of the reserve is quite isolated, being one and a half hours drive from the main road. A vehicle is essential as very few people come through the reserve in a week, (we saw one in 5 days stay!), and in an emergency Kibaha must be reached where medical services are available.

Notes: There are elephants in Ruvu South. We saw plentiful evidence of spoor and stool, heard the animals at night, and one day saw a small troop crossing the track not 200 m from the campsite. Although elephants successfully (and sensibly) avoid humans, it is worth bearing this in mind if camping in the forest.

4.) Kiono Forest Reserve: (also Miono or Zaraninge Forest reserve)

Location: Kiono forest is found to the east of the new Tarmac sealed main road running from Chalinze in the south to Tanga and Moshi further north. The main part of the forest is situated on a raised escarpment with steep sides, and the reserve borders with the Sadani Game Reserve in the east, being separated from it by the Dar to Moshi railway line. Bagamoyo district; Coast administrative region.

Access: The forest is most easily reached from Dar, via Chalinze and the village of Mbwebwe on the main road. Three dirt roads go east from this main road, all leading to Miono where one road continues east towards Sadani. The turning to the reserve is not easy to find, and again much inquiry is needed to discover the right way. As a guide, it is near a village about 30 km from Miono, in the *miombo* type woodland. There is a right turn to the forest 4 km from here atop a ridge after two stream beds. This route is about 150 km round trip, but is much more reliable than the alternative.

This involves taking the Bagamoyo road from Dar which leads to the Bagamoyo ferry. If this is in service (check beforehand), the road can then be followed north to the Wami river where there is another crossing. This is very susceptible to disruption at short notice, combined with the fact that the road is completely dreadful and often impassable. There is a local bus service, but again no transport to the reserve itself, which encourages the use of a self-driven vehicle. The train from Dar stops at Mbwebwe station about 10 km from the reserve, and goes back to Dar two days a week at 2 or 3 o'clock in the morning!

Supplies: Food can be bought all along the main road from Chalinze, and limited amounts are available in Miono and Sadani. Water is scarce, but there is a water hole in Miono where canisters can be filled. Last petrol is in Chalinze, where there is a choice of 2 or 3 stations.

Communication: Kiono forest is at the least 3-4 hours drive from reliable medical aid and good means of communication, so the value of competent first aid skills cannot be stressed enough.

5.) Kwamkoro Forest Reserve

Location: Kwamkoro forest is situated a few kilometres past the small village of Kwamkoro, a centre for tea growing high (1000m) in the East Usambaras. It is just one of a great number of reserves set aside in this biologically unique range of mountains. Amani district, Tanga administrative region.

Access: The East Usambara mountains can be reached from Dar by taking the main road via Chalinze to the north towards Tanga. At Muheza there is a major junction off the Tarmac road from which a graded stone road runs to the foothills. Here it crosses the river Sigi and a steeply climbing dirt track leads to Amani, 19 km up the hill. From here the road continues to Kwamkoro, passing through tea and sugar cane plantations. It is almost impossible to miss the forest as it contrasts markedly with the low, uniform tea fields. The ascent is quite steep and four-wheel drive is often necessary, especially if there has been rain, a regular occurrence in the cloud forest covered mountains, even out of the wet season.

Supplies: Muheza is the biggest town near to the forest reserves and all necessary provisions can be bought there. However, due to the tea industry, there is a small duka (shop) in Kwamkoro which sells most essentials and sometimes has red meat and chicken. Next best is Amani where a limited range of goods can be purchased.

Water is not generally a problem in the Usambaras, except in the form of a tropical downpour, as the mountain streams are always running high. Nonetheless, boiling or some other treatment is advised. The last petrol station is in Muheza.

Communication: There has been a medical research centre at Amani for several years now, and there are other clinics dotted around the tea plantation settlements that are well staffed and competent in treating small injuries, so medical help is close at hand. The nearest big hospital is in Tanga, 100 km away. Amani has a post office and the IUCN are running a very well supported forest conservation project from the village, so in an emergency help should be sought from them.

Notes: In Kwamkoro the local Forest Reserve officer is Mr. Malya who lives near to the tea processing plant. He should be notified of presence in the area, via Mr. Tye. Mr. Chris Johnson, one of the managers of the ITC project in Kwamkoro, was very willing to help us to find a suitable study site. (Permission to work on their land should be sought from the director, Mr. Simon Hill.)

6.) Lunguza Forest Reserve

Location: This reserve is located in the lowland forest of the East Usambaras at an altitude of about 400 m. It is on the west side of the Sigi river and is largely given over to Teak plantation. Amani district, Tanga administrative region.

Access: It can be reached from either side of the river, from Kambai or from Kiwanda. Kambai is nearer to the reserve, but is considerably more treacherous to reach by dirt track. The main road from Muheza crosses into the forested areas by a bridge over the Sigi. A right turn directly after the bridge leads to Lunguza, a tiny village, and from here the road continues to Kambai, 6 km further on. The road is often impassable even in four-wheel drive vehicles and there is a small river crossing just half a km out of Lunguza that may prove tricky for many vehicles. The alternative, that opted for by our expedition, is to camp in the village of Kiwanda on the east side of the Sigi and to cross every day. Kiwanda is reached by taking the right fork in the road in, Bombani, the village before the bridge, and continuing for 10 km. The northern extremes of this area contain better forest and can be reached from Tanga, via Gombero.

Supplies: Much as for Kwamkoro. Running water is available in Kiwanda, and if arranged with the local college administrator, showers can be arranged!

Communication: As for Kwamkoro, except that Muheza is nearer and is at least half of the way to Tanga.

Notes: An expedition team from Cambridge spent a full 3 months in the lowland areas described briefly here and almost certainly have more detailed information concerning access to these and other forest sites in the East Usambaras.

Gaining permission and advice in the Usambaras: The system of jurisdiction over the different forest reserves is unclear in some cases, with the tea companies, IUCN and the East Usambara Forest project all being involved heavily in the area. Permission is required over and above the standard scientific research clearance given by the TCST (Tanzanian Commission for Science and Technology) from the Director of the Catchment Project, whose office is in Tanga, on the third floor above the Housing Bank, one block from the sea-front. Helpful advice can be sought from Mr. P. Enhard and Dr A. Tye who work for the IUCN East Usambaras Conservation and Development Project in Amani.

Island Sites

1.) Kisiju Island

Location: Kisiju is a very small island (5 km long) situated not 100 km south of Dar es Salaam separated from the low lying coastal belt by only a few kilometres. There is a rapidly diminishing stand of ancient coastal forest there supporting a number of unexpected relic populations, especially primates.

Access: Kisiju village is accessible from the main Dar to Kilwa and Lindi road. The village lies at the end of a sand road that branches left from the main road at Mkuranga. The road has recently been improved for much of its length due to a presidential visit to one of the villages in the area. Local transport runs to the village, often in the form of a lorry carrying timber from the area! Once in Kisiju the island itself, 4-5 km from the village, can be reached in one of two ways. By arrangement with the local Fisheries and Resources officer, Mr. Sulmani, porters can be hired to both guide to the island and help in carrying supplies. The journey there, (or back) requires at least one crossing of a creek; in the case of this expedition a local fisherman agreed to help and ferried us across in his *mokoro* (dug-out canoe). The alternative method of reaching the island is by *dhow*. Many fishing *dhows* are kept in the village by local fishermen and with some negotiation through Mr Sulmani, transport can be arranged. But beware if there wind is not strong as you must expect a slow *dhow* to Kisiju. (1 km/h!)

Supplies: The village of Kisiju has a selected range of fruit, vegetables and fish. There is sometimes fish to be bought on the island itself from the locals who cast their nets in the silty shallow waters within the reef; in the last resort, cassava is available! More reliable supplies are available in Mkuranga on the main road. The last petrol station is only a few miles outside Dar, so reserves for the 250 km or so round trip must be taken. Fresh water is not freely available from the village or the island; water was brought from Dar for the purpose of our short visit, but for longer stays some local arrangement would be necessary. Small cafes in the village serve *chai* and simple meals through the day.

Communication: As the island is at least two hours walk from the village, there is little or no regular contact with the mainland. However, people come and go from time to time as they move on to the island to attend to or harvest the crops that they grow there. It is sensible to ensure that your presence on the island is known by the local people so that messages can be conveyed at least relatively quickly.

2.) Jozani Forest Reserve (Zanzibar Island)

Location: This unique forest is found in the southern part of Zanzibar, an island situated about 30 km from mainland Tanzania. It is a ground water forest, growing on a small strip of land that lies between two mangrove/salt grass dominated creeks, encroaching in on the land from both east and west. The boundaries of the reserve are very poorly defined as in addition to the groundwater forest there is a considerable adjoining area of coral rag scrub in various stages of decline, some of which is within the reserve. There are plans to create a national park around the forest in the near future.

Travel to Zanzibar: Zanzibar Island can be reached either by ferry, hydrofoil or jet catamaran. The ferry takes 4-5 hours, costs £5 or $10, and goes from Dar in the afternoon and from Zanzibar in the morning. The other two cost £10 or $15, take 2-2 1/2 hours, and go twice a day. Port tax of $5 must be paid on leaving Tanzania and on leaving Zanzibar, as the Zanzibar administration is separate from that of the mainland; this also means that full customs procedure must be followed, including currency declaration and vaccination certificate presentation.

Access: Jozani forest lies just off the main road which runs across the island to the east coast. It is Tarmac for about 10 km and then becomes broken stone and old Tarmac for the remaining 10 km. Just past the village of Pete there is a small left hand turn which leads to the warden's office. The groundwater forest begins near here. To reach the coral rag scrub, the road most be followed past this turning for another km., where there is a left turn onto a sand track. This goes into the unmistakable coral rag. Many private four-wheel drive taxis run regularly across to the east coast from Zanzibar Town, and will stop at the forest, (usually to give tourists a glance off the rare Red Colobus monkey that lives there), and there is also a local bus service which runs at a pace in character with the island. The most flexible mode of transport to get around the island on is by motorcycle or moped. With some persistent searching these can be hired in Zanzibar Town.

Supplies: There is no problem finding food, water or petrol on the island which is geared to the tourist market. Zanzibar Town is the best stocked, with limited supplies available as far as Pete.

Notes: The Zanzibar administration demands that foreigners (Tanzanian non-residents) pay in foreign currency ($ usually) for hotels. Prices are higher in general than those on the mainland.

Addenda

<u>Uzi Island, Zanzibar</u>

An attempt to reach Uzi Island was made by some of the expedition team. The island lies about 2 km south west of Zanzibar Island, and is only separated by a tidally flooded mangrove swamp. There is an area of coral rag scrub on Uzi, and if similar to the scrub adjacent to Jozani would undoubtedly have been of interest to the expedition with the possibility of it supporting a population of elephant-shrews. Unfortunately the broken coral rag road that leads to the island proved to be too much for the road clearance of the motorcycle we had, and as the tide moves in quickly here, there was no way of continuing on foot. A more detailed knowledge of the tide times are required for access to this island (from Zanzibar Town).To reach the island, a very tough 4-wheel drive vehicle should be used, or a motorbike with good ground clearance and off-road tyres. A lorry crosses to the village of Uzi and back on selected days of the week, and has seating for a few on the rocks it hauls as a load! It is best to catch it at the fork in the road from Zanzibar town leading to Pete or to

Unguja Ukuu. Very little is known of the island and the condition of its flora and fauna.

Permission to enter forest reserves:

As with every site, formalities must be exchanged and permission granted from the local village CCM chairman before commencing work. It is advisable to have some form of interpreter present who speaks both English and Kiswahili as the village elders sometimes need careful persuasion.

APPENDIX 3

Fund-raising and Budgets

Fund-raising

Raising money was initially done by sending a full project proposal and encouraging covering letter to relevant charities and trust funds listed at the back of the book "Planning a small expedition seminar," available from the RGS Expedition Advisory Centre. An eye-catching letterhead and a professional, clearly structured proposal are important in persuading potential sponsors that you are organised, dedicated and determined. Pictures or sketches are useful in making an attractive prospectus, and they break the monotony of reading page after page of everyone else's proposals! Further funding sources were found by looking exhaustively through directories of grant-making trusts and companies in the town library.

It is important to send a covering letter with any application for money, so that you can show how your expedition is particularly relevant to a certain source's categories of funding. Regular up-dates to all potential sponsors are vital because they show an interest over and above any half-hearted applications and also show that you are progressing well. Wherever it is possible, type all applications.

After some support had been gained, a mini-prospectus of two sides of A4 made into a leaflet, with succinct summaries of aims, methods, justification, budget and team members was useful in attracting support from businesses and bigger charities (in addition to a full prospectus in many cases). It is also extremely useful to put any names of respected charities, societies, trust funds etc., which are supporting you on the front of the leaflet, because it seems that the more support you have, the more willing others are to support your cause.

Predicted Budget

The following is the predicted expenditure as given in the prospectus.

EXPENSE	**AMOUNT £**
Flights	1650
Living costs	3940
Internal travel	350
Insurance	280
Equipment	100
Local involvement	500
Pre travel costs	150
Post travel costs	300
Research permission	450
Expedition bulletin	200
Customs & Miscellaneous	100
Sponsors reception	100
Contingency	1220
TOTAL	**9340**

Sponsorship And Donations

The following table shows a list of donors, and summarises all the money that was raised to fund the expedition.

DONOR	DONATION £
Peoples' Trust for Endangered Species	2000
New York Explorers Club Youth Activity Fund	1016 ($3000 received $2000 retained)
B.P. Conservation Expedition Award. ICBP + FFPS	1000
Gurney Travel Prize. (Christ Church College)	500
Bedford Modern School	500
The Albert Reckitt Charitable Trust	500
The British Ecological Society	500
The Mike Soper + Jimmy Elliott Memorial Funds	400
The Oxford University Exploration Club	400
The University Chest	353
The Royal Geographical Society	350
NJULE '92 T-Shirt sales	300
Gilchrist Educational Trust	300
Brasenose College	250
The Wildlife Conservation Society of Tanzania	250
The King's School Worcester	100
HCS Industrial Automation Ltd.	100
Allied Lyons	100
Dr. J.Lobo	50
The Society for the Protection of Animals Abroad	50
TOTAL	**9019**

We are very grateful to you all, for enabling the project to go ahead as smoothly and successfully as it did.

<u>Expenditure of Money Raised:</u>

The following table provides a breakdown of how the money that was spent throughout the whole expedition:

EXPENSE	AMOUNT £
Flights	1800
Living costs	3440
Internal travel	750
Insurance	400
Equipment	360
Local involvement	500
Follow-up project	500
Pre travel costs	300
Post travel costs	300
Research permission	450
Oxf. Univ. Expedition bulletin	200
BP Awards Reception/Display	80

TOTAL	**9080**