FRONTIER TANZANIA

INTERIM REPORT

Preliminary results of biological surveys in seven coastal forests of Tanzania:

July to September 1989

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October 1990

THE SOCIETY FOR ENVIRONMENTAL EXPLORATION

PREFACE

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CONTENTS PAGE

1.0 INTRODUCTION

This report presents a summary of the scientific findings of the Frontier Tanzania TZ01 expedition to seven monsoonal coastal forests in Tanzania between early July and late September 1989.

1.1 AIMS

The aims of the project were to collect information on the status, distribution and biological importance of selected coastal forests, mostly within a day's drive of Dar es Salaam.

1.2 JUSTIFICATION

The coastal forests of eastern Africa are of global conservation importance in that they support a unique flora and fauna with a well developed endemic element. Coastal forests in Tanzania are scientifically poorly known as they have received little detailed study. They have recently been identified as priorities for botanical, ornithological and entomological categorisation by the World Wide Fund for Nature, Royal Botanic Garden at Kew, Missouri Botanic Garden, the International Council for Bird Preservation, and the Wildlife Conservation Society of Tanzania.

2.0 FORESTS VISITED

The expedition commenced on 9th July with a one day visit to Pugu Hills coastal forest just to the southwest of Dar es Salaam. Subsequently a camp was established in Pande coastal forest 15km to the north of Dar es Salaam and this was investigated between 14th July and 1st August. From this camp, the adjacent Bana Forest Reserve was searched for evergreen coastal forest, but none was found. The camp then moved 100km north to Kiono/Zaraninge forest, adajcent to Sadaani Game Reserve, between 16th August and 4th September. All personnel then returned to Dar es Salaam and a small party was despatched to search for forested areas on the

western end of the Kichi Hills, south of the Rufiji River and approximately 10km south of Utete. No true forest was found although the woodland was particulary dense and possessed an evergreen shrub-layer in places. On the return trip to Dar, a provisional visit was also made to Vikindu Forest, 25km south of Dar es Salaam, to assess its suitability for establishing an expedition camp. This forest was found to be largely destroyed and the reconnaisance party returned to Dar es Salaam to rejoin the main group and consult with local experts. A forest near Kisiju on the Indian Ocean about 100km south of Dar es Salaam was identified as being suitable for study and was visited by the expedition between 13th and 18th September.

In addition, a team of ornithologists from the expedition visited Pugu forest between the 3rd and 8th August, and two members of the expedition visited Rondo forest near Lindi on the 28th and 29th August to collect data on the structure of the forest vegetation. The dates visited and number of days spent in each forest are presented below in Table 1.

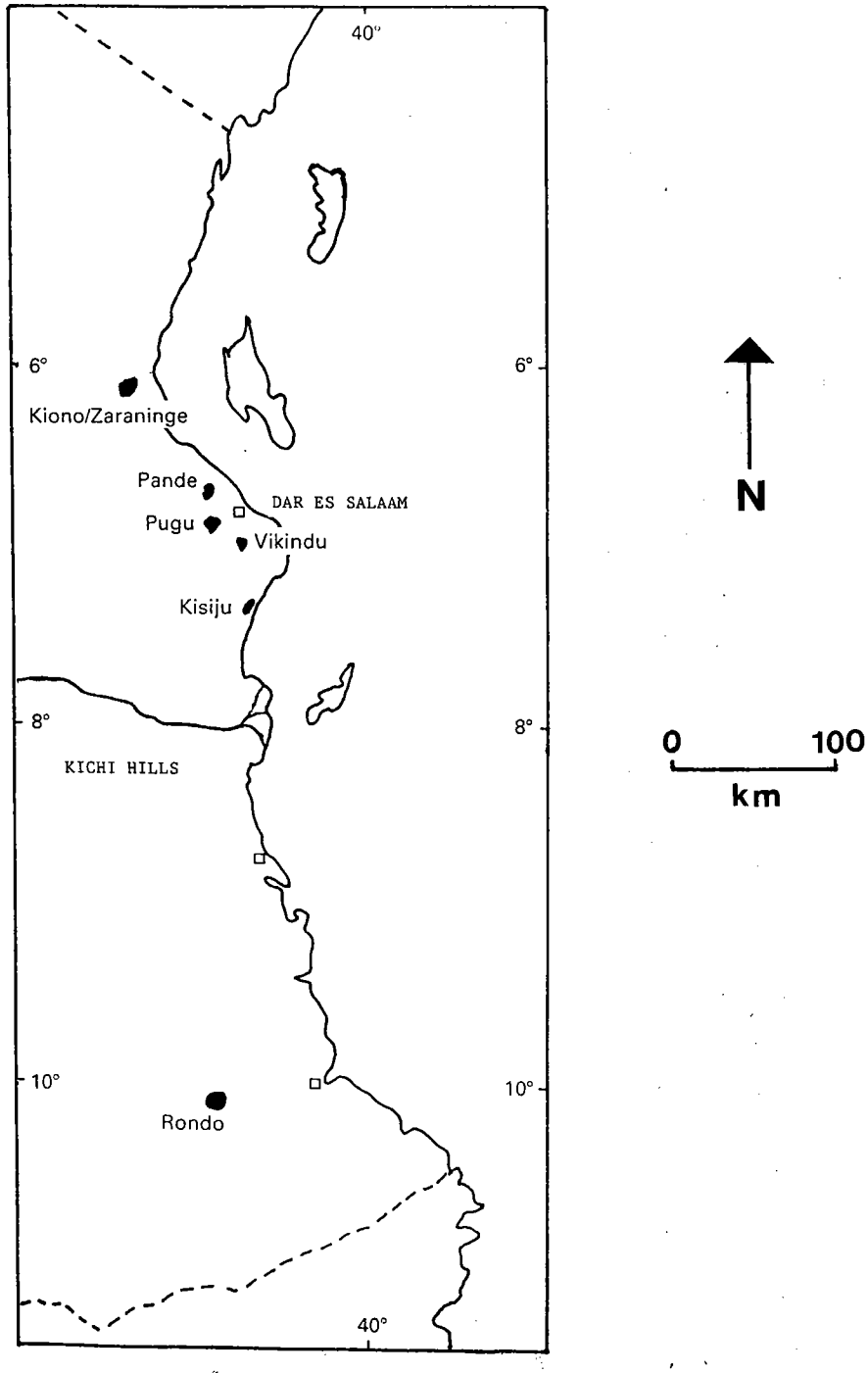
TABLE 1: DATES VISITED AND NUMBER OF DAYS SPENT IN COASTAL FORESTS VISITED BY FRONTIER-TANZANIA EXPEDITION TZ01 (EARLY JULY TO LATE SEPTEMBER 1989).

FOREST	Dates Visited	Number of days
Pugu (recce)	9th July	0.5
Pande	14th July to 1st August	19
Pugu (bird-team)	3rd August to 8th August	6
Kiono/Zaraninge	16th August to 4th September	20
Rondo	28th and 29th August	2
Kichi Hills	9th and 10th September	2
Vikindu	11th September	0.5
Kisiju	13th to 18th September	6

TOTAL NUMBER OF DAYS EXPEDITION MEMBERS WERE IN FORESTS = 56

Details of the location of all forests mentioned in the text are presented on Figure 1, and they are more fully described in Appendix 4.

FIGURE 1: LOCATION OF FORESTS VISITED BY THE EXPEDITION FROM EARLY JULY TO LATE SEPTEMBER 1989



3.0 PROJECTS

3.1 ORNITHOLOGY

Mist netting and ringing of birds was undertaken in four forests (Kiono/Zaraninge, Kisiju, Pugu and Pande) of which only Pugu had previously been netted for more than a few days. All netted birds were identified, then weighed and measured prior to ringing and release. The various products of this work are outlined below:

1) Species-lists: Species-lists of forest birds were compiled for each of the forests visited. This data form part of a paper (Burgess *et al.*, submitted) and the species list for Pande, Kiono/Zaraninge and Kisiju is presented as Appendix 1.

2) Rare species: Several globally scarce birds, as defined in the ICBP/IUCN Red Data Book for Africa and Related Islands (Collar and Stuart, 1985), were recorded in Pande, Kiono/Zaraninge and Kisiju forests. The most important were Sokoke pipit (*Anthus sokokensis*) which is regarded as 'Vulnerable', and Uluguru violet-backed sunbird (*Anthreptes neglectus)*, Plain backed sunbird (*Anthreptes reichenowi*) and Southern banded snake eagle (*Circaetus fascicolatus*) which are regarded as 'Near-Threatened'. Five 'Candidate' Red-Data Book species, whose global populations are poorly known, were also identified. These were Kretschmer's longbill (*Macrosphenos kretschmeri*), Tiny greenbul (*Phyllastrephus debilis*), Chestnut-fronted helmet-shrike (*Prionopus scopifrons*), Green tinkerbird (*Pogoniulus simplex*) and Little-yellow flycatcher (*Erythrocercus holochlorus*). Records of these species by forest are presented in Table 2.

The montane species Orange ground thrush (*Turdus gurneyi*) was also captured in Kiono/Zaraninge.

Sokoke pipit had previously only been captured at three sites in the world, one of which has probably been destroyed. These data have been produced as a paper (Burgess *et al.*, in press) which is presented as Appendix 2.

3) Relative abundance: The relative abundance of the various forest-birds was also assessed for Pande, Kiono/Zaraninge Kisiju and Pugu forests. Methodology involved recording the total area of net (m^2) in place over the study period and the number of birds of the various species captured (n). Then the number of birds captured per net metre hour (birds m^{-2} hr^{-1}) was calculated (Table 3).

TABLE 3: NUMBERS OF BIRDS (BIRDS PER 10,000 NET METRE HOURS) OF VARIOUS SPECIES MIST-NETTED IN SOME COASTAL FOREST OF TANZANIA

	FORESTS STUDIED			
	Pande	Pugu	Kiono	Kisiju
SPECIES				
Accipiter tachiro	-	-	-	0.54
Ispidina picta	1.16	-	2.6	1.1
Halycon albiventris	-	-	0.2	-
Pogoniulus bilineatus	-	-	-	1.1
Smithornis capensis	0.58	-	0.4	-
Dicurus ludwigii	1.0	0.9	1.2	-
Trichastoma rufipennis	-	12.9	-	-
Phyllastrephus debilis	7.8	11.1	8.6	-
Phyllastrephus fischeri	0.4	-	-	-
Phyllastrephus flavostriatus	1.6	4.3	6.8	-
Phyllastrephus terrestris	-	1.7	-	-
Chlorocichla flaviventris	2.5	-	1.2	1.1
Nicator chloris	0.8	1.7	0.4	1.1
Andropadus virens	-	3.4	-	-
Cercotrichas quadrivirgata	2.7	0.9	2.0	1.6
Cossypha natalensis	3.9	6.0	6.6	4.3
Neocossyphus rufus	0.2	0.9	1.8	-
Sheppardia gunningi	-	15.4	-	-
Turdus gurneyi	-	-	0.2	-
Camaroptera brachyura	6.2	4.3	2.2	1.1
Macrosphenos kretschmeri	-	0.9	-	-
Batis mixta	-	2.0	1.7	-
Trochocercus cyanomelas	0.4	5.1	1.8	-
Terpsiphone viridis	0.39	0.86	-	-
Anthus sokokensis	-	-	0.4	-
Anthreptes collaris	0.6	-	-	-
Anthreptes reichenowi	0.2	-	1.2	-
Nectarinia olivacea	5.2	12.9	1.2	7.8
Nectarinia bifasiculata	0.2	-	-	-
Ploceus bicolor	0.58	0.86	-	-
Hypargos niveoguttatus	1.8	1.7	-	-
Mandingoa nitidula	1.8	0.9	-	0.5
TOTAL NUMBER OF NET METRE HOURS	51,562	11,664	49,860	18,501
TOTAL NUMBER OF BIRDS CAUGHT	136	103	210	37

The most notable differences between these figures are that East coast akalat (*S. gunningi*) and Pale breasted illiadopsis (*T. rufipennis*) are common at the Pugu Hills, whereas they appear absent elsewhere. Moreover, the few species recorded at Kisiju were generally at much lower densities than elsewhere.

4) Vegetation structure: Structural characteristics of the forest vegetation were recorded with the aims of facilitating investigations into the different abundancies of forest-birds between forests, and perhaps of explaining the highly disjunct distribution of some forest-dependent species.

Structural data were collected at thirty points in each forest. Recording sites were located 20m apart along transects passing through representative stands of forest vegetation in the region of the mist nets. The following structural variables were recorded:

A. Canopy and shrub height (metres). The height of the canopy and shrub layer was recorded directly above the head of the observer at each site along the transects. Canopy height was estimated with a zoom lens attached to a Single Lens Reflex camera. Procedure was to focus the camera on the uppermost foliage of the canopy and read the distance off the scale on the side of the lens. The same procedure was then used to record the bottom of the canopy and the height of the shrub layer.

B. Vertical canopy and shrub density (% cover). The density of the vegetation (leaf cover) in the canopy and the shrub layer was recorded by assessing the percentage leaf cover through a sighting tube pointing directly upwards from the observer. Toilet rolls or similar cardboard tubes were used as sighting tubes.

C. Ground layer vegetation cover (% cover). The cover of the vegetation on the ground was assessed by means of a simple $0.5m^2$ quadrat made from locally derived wood, and subdivided into quarters with string to facilitate the assessment of the plant cover.

D Horizontal shrub density (metres). This measurement aimed to assess the horizontal density of the shrub layer at four different heights at each site.

Procedure was to construct a 40cm x 40cm board from plywood and then paint or otherwise mark a black and white grid 10cm x 10cm on the board surface. One person held the board at a predetermined height and walked backwards into the forest and away from an observer standing at the starting point. When 50% of the board was obscured by vegetation the board holder was asked to stop. The distance between the board holder and the observer was then measured. This measurement is termed the half-sighting distance and produces a valuable index of the shrub density. Measurements were made at heights of 0.5m, 1.0m, 1.5m and 2.0m from the ground at each site.

E. Tree diameter (metres). At each site the diameter of the nearest tree was measured in metres at breast height (DBH). This provides a valuable index of the maturity of the forest.

The structural data collected from Pande, Pugu, Kiono/Zaraninge, Kisiju and Rondo forests are presented in Table 4.

There are obvious differences in the density of the shrub layer between the various forests, and in the height on the canopy and canopy density. Blencowe (1989) has presented preliminary analyses of the relationship between bird species diversity and vegetation structure, showing some interesting correlations. However, until detailed statistical comparisons are made between the structural variables and the abundance of forest-birds it will be difficult to draw firm inferences from these data.

Up to four volunteers were involved in the ornithological work and Mr Charles Mlingwa, an MSc student to the Department of Zoology in the University of Dar es Salaam, benefitted greatly from his fieldwork experience with the group.

TABLE 2: The presence of globally scarce species in study forests (rarity criteria from Collar and Stuart, 1985).

	RARITY CRITERIA						
	Endangered	Vulnerable	Indeterminate	Rare	Insufficently known	Near-threatened	Candidate
FORESTS							
KIONO		SP				PBS,SBSE,UVBS	TG,CFHS,KL,LYF,GT
PANDE						PBS	TG,CFHS,KL,
KISIJU							

Legend: SP=Sokoke pipit, PBS=Plain-backed sunbird, UVBS=Uluguru violet-backed sunbird, SBSE=Southern banded snake eagle, CFHS=Chestnut-fronted helmet shrike, KL=Kretschmer's longbill, LYF=Little yellow flycatcher, TG=tiny greenbul, GT=Green tinkerbird

TABLE 4

DETAILS OF THE FIVE FORESTS SAMPLED; VALUES GIVEN FOR THE VEGETATION PARAMETERS ARE THE MEAN ± STANDARD ERRORS (n=30)

FOREST		VEGETATION PARAMETERS										
		HEIGHT OF FOLIAGE LAYERS (m)			VERTICAL FOLIAGE DENSITY (% cover)			FHD	HORIZONTAL SHRUB DENSITY			TREE CIRCUM-FERENCE (m)
		CANOPY TOP	CANOPY BOTTOM	SHRUB LAYER	CANOPY	SHRUB LAYER	GROUND VEGETATION		½ sightings at: 2.10 m	1.50 m	0.20 m	
Kiono		17.0±1.4	-	5.8±0.8	66.9±10.2	59.5±10.2	14.6±5.8	0.95	11.2±1.4	10.9±1.3	12.1±1.4	0.8±0.2
Pande		11.6±0.8	8.6±0.4	6.0±0.7	49.2±13.4	47.3±12.3	29.2±10.0	1.08	7.6±0.9	7.5±1.1	3.4±0.6	1.0±0.2
Fugu		11.5±2.0	7.9±0.9	3.5±0.5	31.8±13.4	82.9±10.0	6.5± 4.3	0.76	3.6±0.9	4.4±0.9	7.32±1.0	0.6±0.2
Kisiju		19.1±0.7	11.0±1.2	4.3±0.7	62.6± 6.2	33.0± 9.8	6.9± 4.1	0.85	13.0±1.5	13.5±1.5	14.8±1.1	1.1±0.2
Rondo		17.0±1.4	12.7±1.2	4.9±8.5	48.8 ±8.5	39.2±10.5	28.5± 7.8	-	11.8±1.7	11.4±1.8	9.3±1.3	0.8±0.2

3.2. QUANTITATIVE ASSESSMENT OF PLANT ABUNDANCE IN PANDE AND KIONO/ZARANINGE FORESTS

The species-composition of the forest vegetation in Pande and Kiono/Zaraninge forests was quantitatively sampled along transects through representative areas of forest. In particular, it was hoped to collect data from the eastern and western sides of the forests to assess variation in the species-composition caused by the prevailing rainfall originating from the east.

Forestry tracks served as baselines for transects that ran east/west, or north/south either side of the base line. Transects were sited every 100m along a base-line and started *c.*20m perpendicularly to tracks so as to avoid any vegetation features resulting from human disturbance. Sample points were positioned at regular intervals 20m along the transect, and all plant species occurring within a 5m x 5m quadrat were collected, pressed and numbered. Species were recorded as trees (T); shrubs (S); woody lianas and scandent shrubs (L); climbers (C); herbs (H) and grasses and sedges (G). Lianas and scandent shrubs are indistinguishable in this context. Plant material was dried in the field and in the Botany Department of University of Dar es Salaam. All material was identified by Leonard Mwasumbi from the Herbarium in the Botany Department.

The species-lists produced for Pande and Kiono/Zaraninge are presented as Appendix 3. No previously published list was available for Kiono/Zaraninge Forest and this collection has discovered a possible new genus of forest tree. Range extensions for other rare forest species were also demonstrated. For instance, *Uvaria* sp. nov., *Uvaria pandensis* and *Ecbolium umbrossus* were found to be common in Kiono/Zaraninge, whereas they had been previously thought to be largely confined to Pande coastal forest. Additional collections at Kiono/Zaraninge also discovered a species of *Kalanchoe* which may be new to science.

Leonard Mwasumbi of the Department of Botany supervised this work which involved other technicians from the Department and between four and six Frontier volunteers for three weeks.

3.3. POLYMORPHISM IN SNAIL SHELLS

Large numbers of shells of tree snails were collected in Pande and Kiono/Zaraninge coastal forests. These snail shells have variable patterns reflecting their differing genetic makeup and are therefore particularly useful in studies of genetic evolution, especially within the context of the small and isolated coastal forests. There was shown to be substantial variation in the shell patterning between different populations. Sufficient data were collected during this period to enable Dr Peter Kasigwa of the University of Dar es Salaam and Dr John Allen of the University of Southampton to test an hypothesis on geographical variation in the patterns of shell polymorphism in two of the species of mollusc encountered (*Rhachidina braunsii* and *Sitala jenynsi*). Dr Kasigwa and Dr Allen are preparing two publications from these data for submission to international scientific journals (Kasigwa *et al.*, in prep. and Allen and Kasigwa, in prep.).

This work employed several volunteers whilst Drs Kasigwa and Allen were on site and smaller numbers were involved in follow-up work in other regions of the forest when these scientists were back in the University.

3.4. ASSESSMENT OF COASTAL FOREST RESOURCE

Vikindu, Pugu, Pande, Kisiju, Rondo and Kiono/Zaraninge coastal forests were visited during this period and brief assessments were made of their size, biological importance, level of destruction and current threats. Subsequent to the return of the author to the UK a thorough literature review has been undertaken on all aspects of the biological importance, distribution and status of Tanzanian coastal forests. Moreover, subsequent phases of Frontier have visited several other forests. This work has resulted in a draft paper summarising much of the readily available knowledge on these forests. This is presented as Appendix 4.

In Tanzania this work drew heavily on the knowledge of staff from the University of Dar es Salaam and the Wildlife Conservation Society of Tanzania. All volunteers were used to map the forests and collect the biological information.

3.5. INVERTEBRATE AND VERTEBRATE COLLECTIONS

Butterflies were collected in Pande and Kiono/Zaraninge forests, mainly by Mr. T.J. O'Hara under the supervision of Dr. John Allen. This information is being prepared for publication (O'Hara *et al.*, in prep.) and the species-list for these two forests is presented as Appendix 5.

At Kiono/Zaraninge and Kisiju collections were also made of the diverse invertebrate fauna using pit-fall traps located on the forest floor. All material was sorted to Order in the field, preserved in formalin and passed to Professor Kim Howell of the Zoology Department in the University of Dar es Salaam. Some of this material is being identified in Tanzania, and Prof. Howell has distributed other groups for study by international experts. As yet, specific identifications of material collected from these forests are not available, therefore no assessment of the importance of these sites for these groups can be made. However, similar work in other coastal forests by subsequent phases of the Frontier-Tanzania project (Sheil and Burgess, in prep.) implies that these collections will supply many records of rare species, and large numbers of species new to science.

Small collections were also made of reptiles and amphibians. These were passed to Professor Kim Howell for identification.

Collection of invertebrates and vertebrates utilised small numbers of volunteers throughout the periods in these forests, with much of the collection being opportunistic in nature.

3.6. COLLECTION OF PLANT SPECIMENS FOR ANTI-CANCER ACTIVITY TESTING

Two hundred different species of woody plant and herb were collected for testing for anti-cancer activity by the National Cancer Institude in the USA. For the woody species, 200 gramme dry weight samples were required of leaves, bark and roots. This necessitated the collection of branches off trees and shrubs and the digging of roots. Back in camp, leaves were stripped from branches, bark stripped from larger pieces of wood, larger branches split into small sticks, and roots chopped into small pieces. This wet material was then provisionally dried in baskets in the camp and transported each week to the University for final drying and transport to the USA. An electrical drier was built by expedition members in the Department of Botany. All the requested samples were collected, dried, processed and sent to the USA within the time period of this report.

This work was supervised by Frank Mbago and Haji Suleiman from the Department of Botany, and involved all volunteers throughout the periods in Pande and Kiono/Zaraninge Forests.

4.0 CONCLUSIONS

This work has contributed scientific data to the overall knowledge of these forests, and further helped show they possess global biological importance. Species of plant new to science and the third known locality for Sokoke pipit were discovered, and data have been gathered which augment the known range of rare and threatened flora and fauna. The preliminary work on the status, distribution and biological importance of coastal forests has enabled a plan of work in these forests to be constructed for the next few years. Further work is also contemplated in the forests visited during this period with the hope of eventually producing a definitive compendium of information on this important biological resource, and of compiling Management Plans for the various forests.

5.0 ACKNOWLEDGEMENTS

All members of the Departments of Botany and Zoology at the University of Dar es Salaam are warmly thanked for their input into this, the first, Frontier expedition to Tanzanian coastal forests. We would specifically like to thank Professor Feetham Banyikwa, Dr. Zak Rulangaranga, Mr. Leonard Mwasumbi, Mr. Jon Lovett, Mr. Frank Mbago and Mr. Haji Suleiman from the Botany Department, and Professor Kim Howell, Dr. Peter Kasigwa and Mr Charles Mlingwa from the Zoology Department. Without their assistance all work in coastal forests would have been impossible.

Dr. John Allen from the University of Southampton (UK), Neil and Liz Baker of the Wildlife Conservation Society of Tanzania and Nicholas Payne and Eibleis Fanning of The Society for Environmental Exploration (UK) are also thanked for their respective contributions to the project.

Nicholas Payne provided valuable comments on earlier drafts of this report.

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APPENDIX 1: SPECIES-LIST OF FOREST BIRDS IN PANDE, KIONO/ZARANINGE AND KISIJU COASTAL FORESTS

	KIONO	PANDE	KISIJU
Accipitridae (Eagles and Hawks)			
Circaetus fasciolatus Southern banded snake eagle	x(4)		
Accipiter melanoleucus Great sparrowhawk	x(4)		
A. tachiro African goshawk	x(3)	x(3)	x(3)
Stephanoaetus coronatus Crowned eagle	x(4)		
Numididae (Guineafowl)			
Guttera pucherani Kenya crested guineafowl	x(2)	x(2)	x(3)
Columbidae (Pigeons and Doves)			
Turtur tympanistria Tambourine dove	x(2)	x(2)	
Psittacidae (Parrots)			
Poicephalus robustus Brown-necked parrot	x(2-3)		
P. cryptoxanthus Brown-headed parrot			
Musophagidae (Turacos)			
Tauraco livingstoni Livingstone's Turaco	x(2)	x(3)	
Cuculidae (Cuckoos and Coucals)			
Ceuthmochares aereus Yellowbill	x(3)	x(3)	x(4)
Chrysococcyx montanus Barred long-tailed cuckoo			
Strigidae (Owls)			
Ciccaba woodfordi African wood owl	x(2)	x(2)	
Caprimulgidae (Nightjars)			
Caprimulgus pectorialis Fiery-necked nightjar	x(2)	x(2)	
Trogonidae (Trogons)			
Apaloderma narina Narina's trogon	x(2)	x(2)	
Alcedinidae (Kingfishers)			
Ispidina picta Pygmy kingfisher	x(1)	x(1)	x(2)
Bucerotidae (Hornbills)			
Bycanistes bucinator Trumpeter hornbill	x(1)	x(1)	x(2)
Capitonidae (Barbets)			
Pogoniulus bilineatus Yellow-rumped tinkerbird	x(1)	x(1)	x(1)
P. simplex Green tinkerbird	x(3)	x(3)	
Buccanodon leucotis White-eared barbet			
Indicatoridae (Honeyguides)			
Indicator variegatus Scaly-throated honeyguide	x(1)		
I. minor lesser honeyguide		x(1)	
Picidae (Woodpeckers)			
Campethera abingoni Golden-tailed woodpecker	x(3)		
C. cailliautii Little spotted woodpecker	x(3)	x(2)	
Eurylaimidae (Broadbills)			
Smithornis capensis African broadbill	x(2)	x(2)	

	KIONO	PANDE	KISIJU
Hirundinidae (Swallows, Martins, Rough-wings)			
Psalidoprocne pristoptera Black Rough-wing			
Dicruridae (Drongos)			
Dicurus ludwigii Square-tailed drongo	x(1)	x(1)	
Pycnonotidae (Bulbuls)			
Chlorocichla flaviventris Yellow-bellied greenbul	x(1)	x(1)	x(2)
Phyllastrephus fischeri Fischer's greenbul	x(1)	x(2)	x(2)
P. flavostriatus Yellow-streaked greenbul	x(1)	x(1)	
P. debilis Tiny greenbul	x(1)	x(1)	
Nicator chloris Nicator	x(1)	x(1)	x(2)
Turdidae (Thrushes, Robins etc.)			
Cercotrichas quadrivirgata Eastern bearded scrub robin	x(2)	x(1)	
Cossypha natalensis Red-capped robin chat	x(1)	x(1)	x(1)
Neocossyphus rufus Red-tailed ant thrush	x(1)	x(2)	
Turdus gurneyi Orange ground thrush	x(4)		
Sylviidae (Warblers)			
Apalis melanocephala Black-headed apalis	x(2)		
Camaroptera brachyura Grey-backed camaroptera	x(1)	x(1)	x(2)
Macrosphenos kretschmeri Kretschmer's longbill	x(3)		
Muscicapidae (Flycatchers)			
Batis mixta Forest batis	x(2)		
Erythrocercus holochlorus Little yellow flycatcher	x(2)	x(2)	
Trochocercus cyanomelas Crested flycatcher	x(3)	x(2)	
Terpsiphone viridis Paradise flycatcher	x(2)	x(2)	
Bais musicus Black and white flycatcher			
Motacillidae (Wagtails and Pipits)			
Anthus sokokensis Sokoke pipit	x(4)		

15.2mm; tarsus length 14.2 and 17.6mm; tail length 48.0 and 53.9mm. These and the plumage markings were in agreement with other descriptions of the species. Photographs of the first specimen are deposited in the Red Data Book files at the ICBP in Cambridge.

These two records greatly add to our knowledge of the species in Tanzania and indicate that further work on the remaining unstudied Tanzanian Coastal Forests may discover additional localities for this, and possibly other critical species.

Collar, N.J. and Stuart, S.N. 1985. ICBP/IUCN RED DATA BOOK 1: Threatened birds of Africa and related islands. International Council for Bird Preservation, Cambridge.

APPENDIX 3: SPECIES-LIST OF PLANTS COLLECTED IN PANDE AND KIONO

SPECIES	FORM	PANDE	KIONO
Acacia adenocalyx	L	x	x
Acalypha neptunica	S		x
Aidia sp. Procter 2813	S		x
Ageratum conyzoides	H	x	x
Angylocalyx braunii	T		x
Asparagus falcatus	C		x
Asclepiadaceae?? (Gen. nov.)	C	x	x
Asteranthe asterias	S	x	x
Baphia kirkii	S/T	x	x
Baphiopsis africana (undesc)	T	x	
Basananthe zanzibarica	C	x	
Bidens pilosa	H	x	
Blepharispermum zanguebaricum	S		x
Blighia unijugata	S	x	x
Blumea aurita	H	x	x
Bonamia mossambicensis	C	x	x
Bombax schumannianum	T	x	
Brachyleana huillensis	T		x
Bridelia micrantha	S/T		x
Canthium mombazense	S		x
Canthium schimperianum	S		x
Canthium setiflorum	S		x
Capparis erythrocarpos	C		x
Cassipourea malosana	S/T	x	
?Cassipourea (Gen. nov.)	S/T		x
Cissus producta	C	x	x
Cissus rotundifolia	C		x
Cladoceras subcapitatum	S/L	x	
Clerodendrum capitatum	S	x	x
Cola clavata	S	x	x
Cola microcarpa	S	x	x
Coccinia sp.	C		x
Combretum harrisii	L	x	
Combretum illiaris	L	x	x
Combretum pentagonum	L	?	?
Combretum schumannii	L		x
Combretum sp.	C/L		x
Craibia brevicandata	T		x
Croton pseudopulchellus	S		x
Cynometra webberi	T		x
Cynometra suahelensis	T		x
Cyphostemma buchananii	C	x	
Cyphostemma hildebrandtii	C	x	
Dichapetalum arenarium	L		x
Dichapetalum mossambicense	L	x	
Dichapetalum stuhlmannii	S	x	
Digitaria milanjiana	G	x	
Diospyros brucei	S		x
Diospyros greewayi	S		x
Diospyros verrucosa	T	x	x

Drypetes arguta	S/T	x	x
Drypetes reticulata	S		x
Drypetes sp.	S/T		x
Ecobolium umbrossus	H	x	x
Emilia japonica	H	x	x
Encephartos hildebrandtii	S	x	
Eragrostis ciliaris	H	x	
Erythroxylum sp.	S		x
Ehretia bakeri	S	x	
Ery??	S	x	
Garcinia buchananii	S/T		x
Garcinia sp.	S		x
Gardenia transvenulosa	S		x
Gardinia volkensii	S		x
Gossypioides kirkii	S	x	
Grewia forbesii	L		x
Grewia goetzeana	L		x
Grewia leptopus	L	x	
Haplocoelum foliolosum	S	x	
Haplocoelum inopleum	S		x
Haplocoelum trigonocarpum	S/T	x	x
Harungana madagascariensis	S		x
Hippocratea africana	L/S		x
Hippocratea clematoides	L		x
Holarrhena pubescens	S/T	x	x
Hugonia castaneifolia	S/L	x	x
Hugonia sp	S		x
Hymenocardia ulmoides	S		x
Landolphia kirkii	C	x	x
Lannea schweinfurthii	S/T	x	
Leptactina platyphylla	S	x	
Manilkara sulcata	T	x	x
Manilkara sansibarensis	T		x
Markhamia zamzibarica	S		x
Mariscus sp.	G	x	
Maytenus undata	S	x	
Megastachya mucronata	G		x
Memecylon sansibaricum	S		x
Microcoelia exilis	orchid		x
Mildbraedia carpinifolia	S		x
Millettia impressa	L/C	x	x
Millettia usaramensis	L/S/T	x	
Monanthotaxis buchananii	L/S		x
Monanthotaxis formicata	L	x	x
Monanthotaxis trichocarpa	L	x	
Monodora grandidieri	S		x
Monodora minor	S	x	
Mostuea brunonis	S		x
Nesogordonia holtzii	S	x	
Newtonia paucijuga	T		x
Ochna thomasiana	S		x
Ochna sp.	S		x
Ophrypetalum odoratum	S		x
Oxyanthus zanguebaricus	S		x

Pancovia hildebrandtii	S	x	x
Pancovia holtzii	S		x
Panicum deustum	G		x
Panicum trichocladum	G	x	
Pennisetum purpureum	G	x	
Psychotria holtzii	S		x
Psychotria riparia	S		x
Rinorea sp.	S		x
Rhizophoraceae gen nov.	S/T		x
Rhoicissus revoilii	L		x
Rothmannia macrosiphon	S	x	x
Rytigynia microphylla	L	x	
Saba comorensis	L	x	
Salacia elegans	S/L	x	x
Salacia madagascariensis	S/L	x	x
(Sapindaceae) (Gen. nov.)	T	x	
Schlechterina mitostemmatoides	L/C	x	x
Scleria lithosperma	G	x	x
Sclerochiton vogelii	S	x	x
Scorodophloeus fischeri	T	x	x
Sideroxylon inerme	T		x
Strophanthus petersianus	C	x	
Strychnos panganensis	C		x
Strychnos usambarensis	L		x
Suregada zanzibarensis	S		x
Synaptolepis kirkii	S	x	
Tarenna drummondii	T	x	
Tarenna nigrescens	S		x
Teclea simplicifolia	S		x
Teclea trichocarpa	S		x
Tinospora caffra	C/L	x	x
Tricalysia allocalyx (Rubi)	S	x	x
Tricalysia ovalifolia	S	x	x
Tridax procumbens	H	x	x
Triumfetta rhombifolia	H		x
Uvaria acuminata	L	x	x
Uvaria pandensis	L/S	x	x
Uvaria tanzaniae	S		x
Uvaria sp. nov.	L	x	x
Uvariodendron kirkii	S		x
Vernonia cinerea	H	x	
Vismia orientalis	S	x	
Whitfieldia stuhlmannii	H	x	x
Zanthoxylun holtzianum	T	x	
TOTAL SPECIES IN QUADRATS		80	104

APPENDIX 4: DRAFT PAPER "ASSESSMENT OF THE RESOURCE OF COASTAL FOREST IN TANZANIA"

ABSTRACT

The lowland forests of coastal Tanzania comprise small and geographically isolated remnants of evergreen or semi-evergreen forest vegetation of the restricted Zanzibar-Inhambane section of the Guinea-Congolian Phytogeographical region. They are normally located within 50km of the Indian Ocean, often on the tops of low hills, and are subject to a markedly seasonal (monsoonal) rainfall pattern. Forest vegetation has been present on these sites for up to 100 million years and the 'coastal forests' may have been isolated from other forest-blocks in Africa for the past 30-40 million years. The few forests which remain, and have received detailed scientific study, show that this long period of isolation is reflected in a diverse flora and fauna, with a well developed endemic element.

This paper presents a preliminary assessment of the distribution, status and biological importance of 16 areas of Tanzanian coastal forest believed to be over 2km^2 in extent. The largest known forests are Kiwengoma Forest on the Matumbi Massif to the south-east of Utete which occupies between 10km^2 and 25km^2, and Kiono/Zaraninge Forest which occupies around 20km^2. All other forests are believed to be under 20km^2 in area. In total the forests described occupy less than 200 km^2 of which less than half remains in primary condition. Further, forested areas exist but their size, status and biological importance is poorly documented.

Around 40% of the trees within these forests are endemic to the coastal forests as a whole and at least 45 plants are endemic or near-endemic to one of the forests described. Moreover, 6-7 globally rare birds occur, and there are endemic or near-endemic species of mammal, reptile, amphibian and invertebrate. Hence, considering the small area of these forests their global conservation importance is high.

All fourteen forests are being destroyed by unsustainable human actions including: a) logging of canopy trees for timber and fuel, b) removal of hardwood poles to build houses, c) wholesale burning of woody plants to produce charcoal, d) wholesale removal of vegetation to allow conversion to agriculture. At the present rate of destruction these remnant forest patches, with their globally important flora and fauna, may be completely destroyed.

INTRODUCTION

The lowland coastal forests of East Africa are a heterogeneous group of isolated forest patches which grow close to the coast on Mesozoic or post-

Mesozoic rocks generally below 500 metres in altitude and are subject to markedly seasonal (monsoonal) rainfall pattern. They have a unique flora and flora and belong to the Zanzibar-Inhambane section of the Guinea-Congolian Phytogeographical region (Hamilton, *in litt*; White, 1983). They can be further regarded as Lowland Dry Evergreen Forest or Lowland Rain Forest, depending on the quantity and seasonality of their rainfall (Polhill, 1989).

Such coastal forests were more extensive in the past, but have been largely removed from the heavily populated coastal region to provide timber, fuelwood and farmland (Hamilton, 1981; Howell, 1981). Studies published on the remaining coastal forests show they support large numbers of endemic and near-endemic plants and animals (Collar and Stuart, 1985; 1988; Hawthorne, 1984; Howell, 1981; Lovett, 1985; 1988; 1989; Lovett *et al.*, 1988; Polhill, 1968; 1989; White, 1983). For example, the best studied Tanzanian coastal forest on the Pugu Hills *c.*25km to the west south-west of Dar-es-Salaam covers only 11km^2 but is thought to support 15 endemic or near-endemic plants, several endemic invertebrates, and 6 species and sub-species of bird confined to coastal forests (Collar and Stuart, 1988; Hawthorne, 1984; Howell, 1981; Mwasumbi, unpublished). Moreover, of 190 trees identified in the Zanzibar-Inhambane regional mosaic 48% are endemic (White, 1983). This high level of endemism and near-endemism is believed to have been caused by the existence of forest cover in the area since the late Cretaceous (80-100 million years), by the isolation of the coastal forests from other African forest blocks since the Miocene (30-40 million years) (Lovett *et al.*, 1988), and by the isolation of the remaining forest fragments by the more recent glacially induced climatic fluctuations.

Despite the high conservation importance of Tanzanian coastal forests, their status, distribution and biological importance is poorly known. Some relevant data have been compiled elsewhere (e.g. Bensted-Smith and Msangi-Msangi; 1989; Hawthorne, 1984; Howell, 1981; Polhill, 1968; 1989), but there is no overall synthesis of known information.

In this paper we present information on 16 areas of Tanzanian coastal forest, and where possible present an approximate calculation of the area of forest, summary of biological data, and an assessement of the the current status and threats the forests face. Our principal aim is to raise awareness of the importance of these forests and to suggest they require increased scientific investigation and protection.

CLIMATE AND GEOLOGY

The higher ground close to the eastern coast of Africa receives moisture from the Indian Ocean in the form of rain, mist or dew blown in from the prevailing easterly winds. This rainfall pattern has continued for many millions of years, in particular throughout the dry periods associated with the recent glacial events, and has allowed evergreen and semi-evergreen forest to survive in the wettest locations along the coast (Hamilton, 1981). As maximum rainfall tends to fall on the eastern side of any hills it is in such locations where the best developed coastal forest generally occurs, although they are also present alongside rivers (riverine forest).

Currently, the annual climatic cycle affecting these forests is controlled by the predictable and relatively stable monsoonal cycle, although the pattern of rainfall does vary along the coast. For example, around Lindi in southern Tanzania there is a single pronounced dry season from May to early October and a wet season from later October to late May. In comparison, around Tanga in northern Tanzania there are two rainy seasons, the 'long rains' from March to late May and the 'short rains' from late October to early December, with a long and short dry season inbetween (White, 1983). The pattern of rainfall in the Dar-es-Salaam area is intermediate between these two extremes. However, even in the dry season showers are common on the higher ground. The general rainfall of the coastal region is between 1,000mm and 1,200mm per annum (White, 1983), but rainfall in many of the forests located on the higher ground is almost certainly considerably higher than this.

The solid geology of the coastal strip of Tanzania comprises terrestrial and marine muds, silts, sands and limestones which mainly date from the Miocene to Pleistocene (30-2 million years before present). However, there are also outcrops of older Juarassic and Cretaceous marine silts and limestones, most notably on the Matumbi massif south of the Rufigi river and inland from Tanga. Moreover, immediately adjacent to the coast the sediments have generally been deposited within the last 1 million years. A generalised geological section of the Mesozoic and post-Mesozoic rocks from the recent coastal sediments to the Precambrian basement complex (east to west) is presented in Hawthorne (1984).

STUDY METHODS

Much of the information used in this review was gathered from early July 1989 to early October 1990 by the Frontier Tanzania TZ01 to TZ05 expeditions, a joint initiative of the Society for Environmental Exploration, UK, and the University of Dar-es-Salaam, Tanzania. Further data were obtained from published papers, unpublished reports and personal communication with experts in Tanzania, Kenya and the U.K..

For the purposes of this paper, coastal forest is defined as evergreeen or largely-evergreen forest forming part of the Zanzibar-Inhambane regional mosaic (White, 1983) subject to a monsoonal climatic regime and growing on the Mesozoic or post-Mesozoic rocks along the coastal strip of East Africa, generally below 500m altitude. Evergreen vegetation which has been heavily disturbed by man, but where it is evident that high forest has been present in the recent past, is included but all mangrove-dominated vegetation and deciduous woodland is excluded. Crude calculations of the area of the various forests were made from the 1:50,000 scale maps produced by the Surveys and Mapping division of the Ministry of Lands, Natural Resources and Tourism, Dar-es-Salaam, Tanzania. However, at all sites where expedition camps were established the extent of forest was checked by ground survey.

Summary data for each forest are presented in accordance with the format of the Internation Union for the Conservation of Nature and Natural Resources (IUCN) Directory of African Tropical Forests.

PRELIMINARY ASSESSMENT OF COASTAL FOREST RESOURCE

The position of the best-known Tanzanian coastal forest is presented on Figure 1. They are described below in a sequence from north to south.

1. **TANGA LIMESTONE FORESTS (approximately 5°0' South 39°0' East)**
Description: Forest patches are present on the Tanga Limestone, of Jurassic age, immediately inland of the coastal town of Tanga. Three forests are believed to remain. Two are located along the Mukulumuzi river valley, a) near the Amboni caves *c*.2.5km west of Tanga (2-3km^2 of forest) and b) further upstream, *c*.8km west of Tanga (3-4km^2 of forest). Another 1-2km2 patch of forest is located just north of the village of Amboni and the Sigi river, *c*.5km north-west of Tanga. Forest vegetation was probably previously present over more extensive areas in this region, but has been cleared from all the flatter ground and replanted with sisal, cassia *Cassia siamea* and teak *Tectona grandis*. It is possible that further areas of forest are located in remote areas.

Ecology: The irregularities of the landscape allow great variation in the forest-types and species composition in this area. The composition of the remaining river-valley forests is diverse, with moist forest in the valley bottoms, a drier evergreen forest on many of the slopes, and evergreen thicket of the ridge tops and plateau's. The forest in the valley bottoms is dominated by canopy trees such as *Lecaniodiscus fraxinifolius*, *Combretum schumannii*, *Sorindeia madagascariensis* and *Adansonia digitatia*. The drier slope-vegetation is typical of dry evergreen forest, with *Scorodophloeus fischeri* and *Cynometra webberi* as canopy dominants, and typical dry forest shrubs such as *Croton pseudopulchellus*, *Uvaria acuminata*, *Encephalartos hildebrandtii*, *Coffea pseudozanguebariae*, *Sclerochiton vogelii*, *Asteranthe asterias* and *Mildebraedia carpinifolia*. The plateau areas are dominated by thicket species, with a few forest shrubs and ruderals in more recently disturbed areas. The endemic species *Tricalysia elegans* has been recorded from the valley bottom of the Mukulumuzi river. Moreover, the Tanga Limestone forests are the type locality for the African violet *Saintpaulia ionantha* (Johansson, 1978), with two endemic species found in these forest-patches. Other rare plants which are also known in the Kaya forests of Kenya are *Allophylus zimmermannianus*, *Thecacoris usambarensis*, *Gynura colorata*, *Gigasiphon macrosiphon*, *Micrococca scariosa*, *Warburgia stuhlmannii* and *Chlamydacanthus lindavianus* (Beentje, 1988; Hawthorne, 1984).

There is little available data on the fauna of these forested areas.

Human use: Considerable clearance of the remaining forested patches for agriculture and replanting with non-native species of tree, and sisal was occurring in 1982 (Hawthorne, 1984). Moreover, all natural forest in the Steinbruch Forest Reserve to the south of Mukulumuzi river had been removed and replaced by non-native forest species by this time.

Conservation status: These three forest-patches are not formally protected as forest reserves and their proximity to Tanga must cast serious doubts over their long-term survival. However, the high diversity of plants, and

presence of endemic species enables the conservation importance of these forests to be regarded as high.

2. GENDA-GENDA FOREST (5^0 33' South 38^0 38' East)

Description: This forest is sub-divided into two forest reserves: Genda-Genda North and Genda-Genda South. These are separated by the main access road to Pangani and are located some *c*.30km southwest of Pangani and *c*.20km inland from the Indian Ocean. Recent (1987) maps of the region indicate that around 7.5km^2 of forest is present overall. The highest point in the forest rises to *c*.400m above sea level and is probably comprised of Miocene sandstones over Mesozoic strata, with many rocky outcrops on the steeper slopes (Hawthorne, 1984). However, the bulk of the forest forest is growing on lower terraine comprised of marine clays, mudstones and limestones of Miocene to Pleistocene age.

Ecology: The canopy of the lower and gentler slopes of the forest are dominated by *Cynometra webberi*, *Manilkara sulcata* and *Scorodophloeus fischeri*. On the steeper east-facing and more moisture-rich slopes over a clay-rich brown soil *Ludia mauritiana*, *Diospyros greenwayi* and *Manilkara sulcata* are dominant, with *Mimusops fruticosa*, *Uvariodendron kirkii* and *Psychotria riparia* also becoming more common (Hawthorne, 1984). No endemic plants have been identified (Hawthorne, 1984). Black and white colobus monkeys *Colobus polykomos* are present, but little else is known of the fauna. As this forest has received little detailed scientific study its ecological importance cannot be adequately assessed.

Human use: The local people have removed substanial areas of forest on the lower slopes for the production of charcoal. Moreover, disturbance as evidenced by entanglement of the forest-vegetation with lianas and a sparse canopy is typical of all areas close to vilages (Hawthorne, 1984).

Conservation status: The entire area is designated within the Genda-Genda north and Genda-Genda south forest reserves which were established before independence (before 1962). The main threats to these forests are cutting down all woody vegetation in small glades and burning it to produce charcoal, and the removal of timber and poles throughout the forest. Forest vegetation on the western facing slopes had been completely removed by 1982, but the vegetation of the steeper easterly facing slopes were largely undisturbed (Hawthorne, 1984).

3. MSUMBUGWE FOREST (5^0 32' South 38^0 45' East)

Description: This forest is located on low-lying land up to 200m above sea level, some 15km inland from the Indian Ocean and 24km south-west of Pangani. Forest vegetation presently covers 10-15km^2, as assessed from recent (1987) maps of the area, whereas Polhill (1968) gave the forest area as 25km^2 and Hawthorne (1984) studied old aerial photographs which showed considerable areas of forest to the south and immediately north of the Pangani river, which have now largely been removed. The landscape and flora of the remaining forest at Msumbugwe relects its proximity to the Pangani river as channels drain from the forest into the river. The bedrock comprises marine clays, mudstones and limestones of Pleistocene to Miocene age.

Ecology: The forest canopy of Msumbugwe is dominated by *Cynometra webberi* and *Manilkara sulcata*, with *Scorodophloeus fischeri* found on shallow ridges or hummocks (Hawthorne, 1984). Other trees present include *Hymenaea verrucosa*, *Bombax schumannianum*, *Brachylaena huillensis*, *Erythrina sacleuxii* and *Croton jatrophoides*. The evergreen tree *Stuhlmannia moavi* is present representing a monospecific genus endemic to the forests of this area, and other rare trees present are *Warburgia stuhlmannii* and *Haplocoelum trigonocarpum* (Beentje, 1988; Hawthorne, 1984). No data are available on the fauna. Due to the limited scientific study of this forest its ecological importance cannot be accurately assessed.

There are further forest patches in the immediate vicinity of Msumbugwe. For instance, forest is believed to still be in existence on the Bushiri estate on the other side of the river from Msumbugwe, where old collections have provided the type specimens for several species such as *Uvaria faulknerae* and *Cordia faulknerae*. There was also riverine forest in the Mwera and Kilimanguido sisal estates alongside the Pangani river, and near the village of Langoni on the Mwera estate (Hawthorne, 1984). The current size of these forests is not known.

Human use: The timber tree *Brachylaena huillensis* has been extensively removed from Msumbugwe. In addition, poles have also been cut throughout the forest and fires and charcoal burning have influenced the forest margins. Most areas have been heavily disturbed by these activities, with some areas being converted to woodland. Some trial planting of exotic trees also occurred within the forest reserve in 1963/4.

Conservation status: Msumbugwe forest falls entirely within the Msumbugwe Forest Reserve which was gazetted in the colonial era (pre 1962). Currently the main threats to this forest are fire and removal of timber and poles. In 1982 (Hawthorne, 1984) large areas had been heavily disturbed and some reduced to woodland. However, Benstead-Smith and Msangi-Msangi (1989) state there are still areas of undamaged forest in the reserve. The patches of forest at Bushiri and the Mwera estate have no formal protection.

4. KIONO/ZARANINGE FOREST (Between 6°6′ and 6° 10′ South and 38° 35′ and 38° 39′ East)

Description: Kiono/Zaraninge Forest is located some 15km inland from the Indian Ocean and 20km west south-west of the coastal town of Sadaani. The forest covers between 19km^2 and 22km^2, principally on a plateau which rises to 300m above sea level, and there is a permenent wetland within the forest. There are also many patches of forest and evergreen thicket in the area, some of which are 1km^2 or more in extent. The main forest is growing on a plateau of harder limestones and sandstones which may be as old as Jurassic, although they are poorly dated.

Ecology: The forest vegetation is fairly homogeneous over large portions of the areas visited in 1989 and 1990, with changes occurring in the interface between forest and woodland, and near an area of wetland within the forest. Discussion with local villagers indicates that the small stature of the trees in the forest is due to the synchronous death of many trees following drought in 1973 and 1974, with a cyclone felling many of the remaining

trees in 1976 or 1977 (Sheil and Burgess, 1990). The flora of this forest was largely unstudied until 1989 and collections have been subsequently made in the dry and wet seasons. These collections have shown the canopy is dominated by *Manilkara sulkata*, *Scorodophloeus fischeri*, *Bombax schumannianum*, *Cynometra* spp., *Erythrina sacleuxii*, *Ficus* spp. and *Ricinodendron heudelotii*. Many of the shrubs are similar to Pande Forest, including *Uvaria pandensis*, *Uvaria* sp. nov. and giant forms of the herb *Ecbolium umbrossus* which are endemic to coastal forests. These botanical collections are preliminary and have not received detailed study, however a probable new species of *Kalanchoe* and a possible new genus of tree were identified.

The avifauna has also received preliminary investigation (Burgess *et al.*, in press.), and 51 species of forest bird have been identified, including the threatened Sokoke pipit *Anthus sokokensis* and near-threatened southern banded snake eagle *Circaetus fasciciolatus*, plain-backed sunbird *Anthreptes reichenowi* and Uluguru violet-backed sunbird *A. neglectus*. Due to the presence of these scarce species this forest could be ranked as 55= out of the top 75 forests for bird conservation in Africa (see Collar and Stuart, 1988).

Small mammals occurring within the forest include blue monkey *Cercopithecus mitis*, black and white colobus monkey and smaller species such as galagos *Galago* spp., elephant shrews *Elephantulus* spp. and squirrels *Sciuridae*. A list of amphibians, reptiles and smaller mammals captured in this forest in early 1990 is provided in Sheil and Burgess (1990). The invertebrate assemblage is diverse.

Human use: It is local tradition to cultivate the margins of the forest as subsistence farmland. However, villagers from Gongo have recently been clearing substantial areas of forest in order to grow cash crops. Each family farm processess around 1ha of forest every 2-3 years using this farming method (Sheil and Burgess, 1990). Local people also take poles and some timber from the forest and set traps for ground-dwelling mammals. Commerical logging operations have been conducted since the 1950s and logging of valuable timber trees, particularly *Brachyleana huillensis* continued up until 1985.

Conservation status: Kiono/Zaraninge Forest falls within the Zaraninge Forest Reserve and there are plans to include it within the Sadaani Game Reserve which forms its eastern edge. Both these areas were gazetted in 1954, and the proximity of the forest to the Game Reserve has allowed game animals to survive in the forest, whereas they have been all but eliminated from the surrounding area. Despite over 50% of the forest showing evidence of logging there are areas of forest which appear to be in primary condition, and the presence of rare and possibly new species indicates this forest has a high conservation importance.

5. PANDE FOREST (6^0 42′ South 39^0 05′ East)

Description: Pande forest is located approximately 25km north-west of Dar-es-Salaam and 16km inland from the sea on ridge of clay-bound sands and gravels of Miocene to Pliocene age, which extend up to *c.*250m above sea level. Approximately 11km^2 of forest remains and the forested area slopes

gently off a central plateau area; nowhere are there any severe topographic features.

Ecology: The forest vegetation at Pande is highly heterogeneous, largely reflecting an extended period of human disturbance from logging, charcoal burning and fires. Extensive areas of closed-canopy forest exist in the forest interior, but the margins are highly crenulated with many glades and areas of secondary vegetation. Botanical collections have been made in the forest over many years (e.g. Hawthorne, 1984; Mwasumbi, unpublished), but are probably still incomplete. The canopy of the forest interior is dominated by *Scorodolphoeus fischeri, Cynometra webberi, Schefflerodendron usambarense, Manilkara sulkata, M. discolor, Drypetes arguta* and *Bombax schumannianum* (Hawthorne, 1984; Mwasumbi and Burgess, in prep.). Several plant species occur which are believed to be endemic to Pande: *Tricalysia bridsoniana* var.*pandensis*, *Sapium* sp. nov. and *Leptactina* sp.A. Moreover, *Uvaria pandensis*, *Uvaria* sp. nov., *Nesogordonia holtzii* and *Ecbolium umbrossus* are known from only a few other coastal forest sites (Beentje, 1988; Hawthorne; Mwasumbi, unpublished).

Preliminary work on the avifauna (Burgess *et al.*, in press.) shows that at least 37 species of forest bird occur in Pande, including the near-threatened plain-backed sunbird. However, the vulnerable Sokoke pipit, the rare east coast akalat *Sheppardia gunningi* and spotted ground thrush *Turdus fischeri*, and the near-threatened Uluguru violet-backed sunbird and southern banded snake eagle, which are present in the Pugu Hills only *c*.15km to the south, appear to be absent at Pande. Smaller Mammals at Pande include blue monkey, galagos, squirrels and elephant shrews, but most large mammals besides leopard *Panthera pardus* have disappeared due to over-hunting.

Human use: The population of the local village Mabwe Pande use the forest as a source of poles and timber. Indeed up to 70% of available poles have been cut from forest margins, with exploitation lower in the forest-interior (Hall and Rodgers, 1986). *Manilkara, Millettia usaramensis, Vitex* and *Scorodophloeus* are preferred for charcoal burning, whereas *Diospyros, Drypetes and Haplocoleum* are used for building poles and handles. More extensive timber removal is currently being undertaken and extensive areas are being clear-felled and burnt for charcoal to supply the domestic cooking-fuel market in Dar-es-Salaam.

Conservation status: Pande Forest falls within the Pande Forest Reserve, which was designated in the colonial era (before 1962). However, the entire reserve appears to have been recently sold to a commericial organisation who are logging the site and conducting an extensive charcoal burning operation. Further work is required on the invertebrates and small mammals of this forest in order to fully assess its conservation importance although the presence of several probably endemic plant species indicates it is high.

6. PUGU HILLS FOREST (6^0 54' South 39^0 05' East):

Description: The Pugu Hills Forest is *located c*.25km to the south south-west of Dar-es-Salaam on the Pugu Hills. The forest currently occupies about $10km^2$, although in 1970 it was believed to occupy $22km^2$ (Howell,

1981). The Pugu Hills are a dissected range of kaolinitic sandstones of Miocene to Pliocene age which extend up to 305m above sea level and receive around 1250mm of rainfall per annum (Howell, 1981).

This is the best studied coastal forest in Tanzania. The vegetation is extremely heterogeneous with characteristic ridge-top, valley-slope and valley-bottom vegetations, including both dry and moist forest stands (Hawthorne, 1984). Different areas of the canopy are dominated by *Scorodophloeus fischeri*, *Antiaris toxicaria*, *Malacantha alnifolia*, *Manilkara sulcata* or *Dialium holtzii*. Botanical collections have so far identified 15 plants which are believed to be endemic or near-endemic to Pugu, these are *Coffea sessiliflora* var.*mwasumbii*, *Humbertochloa greenwayi*, *Lasiodiscus holtzii*, *Alchornea engleri*, *Casearia holtzii*, *Baphia puguensis*, *Millettia puguensis*, *Rhynchosia holtzii*, *Diospyros engleri*, *Sapium triloculare*, *Grumilea rufescens*, *Tapinanthus longipes*, *Xylopia arenaria*, *Uvaria* sp. nov. and *Aspilia* sp. (Howell, 1981; L. Mwasumbi, unpublished). However, the taxonomic status of some of these is uncertain and with further work they may prove to be conspecific with other named taxa. Some of these species may also be found elsewere, e.g. *Xylopia arenaria* is probably present in Kenya (Hawthorne, unpublished). Additional rare species in Pugu known from coastal forests in Kenya are *Haplocoelopis africana*, *Haplocolelum mombasense*, *Nesogordonia holtzii* and *Vitex zanzibarensis* (Beentje, 1988).

The invertebrate fauna has also received some study and several species new to science have been identified (Howell, 1981). Furthermore, the avifauna of the Pugu Hills has been investigated over the past 50 years (Baker, unpublished; Collar and Stuart, 1985; 1988; Fuggles and Couchman, 1939; Howell, 1981; Mlingwa, unpublished). Around 65 species of forest bird are known from the site, including the threatened Sokoke pipit, the rare east coast akalat and spotted ground thrush, and the near-threatened Uluguru violet-backed sunbird and southern banded snake eagle. Moreover, an endemic sub-species of pale-breasted illadopsis *Trichostoma rufipennis puguensis* is present. This forest ranks as 32= in the top 75 forests for bird conservation in Africa (Collar and Stuart, 1988).

A variety of small mammals are known from this forest (see Howell, 1981 for details). Large mammals used to include lion, hippopotamus *Hippopotamus amphibius* and elephant, but these are no longer present.

Human use: The majority of the forest was logged in the colonial era and some areas were replanted with exotic species between 1959 and 1964. Since then, further areas of natural vegetation have been cleared by the Forest Department and re-planted with the exotic species of *Grevillea*, *Eucalyptus*, *Cassia* and teak, a policy being pursued as recently as 1982. Moreover, local people remove some poles, timber and charcoal from the forest. For example, around 50% of the available poles have been taken in accessible areas, with less than 20% in the forest-interior (Hall and Rodgers, 1986). The reserve also contains one of the largest deposits of kaolin in the world and a brick and tile industry are established, both of which require fuel-wood, and workers at these industries clear forest for smallholdings. A portion of the former Forest Reserve was de-gazetted to allow these operations to function. The loggers and workers from the kaolin mine also set snares in the forest to catch 'bush-meat' mammals such as duiker

Cephalophus spp., suni *Neotragus moschatus* and dik-diks *Madoqua* spp, thus reducing their populations. Currently, the whole forest is threatened by a project to expand the kaolin production.

Conservation status: The Pugu Hills Forest falls within the Pugu Hills Forest Reserve which was gazetted prior to independence (before 1962). It has recently been proposed that the area would make an ideal educational reserve for the students of the University of Dar-es-Salaam (Bensted-Smith and Msangi-Msangi, 1989). This is the best studied Coastal Forest in Tanzania and the precence of several endemic and rare species indicates the conservation importance is very high.

7. KAZIMZUMBWI FOREST (6^0 58′ South 39^0 3′ East)

Description: Kazimzumbwi Forest is located some *c*.25km to the south-south west of Dar-es-Salaam, and is only separated from the Pugu Hills Forest by a strip of land up to 1km wide alongside the Dar-es-Salaam to Zambia railway. Forest vegetation at Kazimzumbwi presently covers around $12km^2$ of the Pugu Hills as they strike south-west from Dar-es-Salaam. Kazimzumbwi Forest used to be the source of the water supply for both Kisarawe and Dar-es-Salaam prior to independence.

Scientifically Kazimzumbwi has been far less studied than Pugu because permission to visit has been difficult to obtain. As a consequence little is known about the plants, invertebrates, birds or mammals which live there. However, a recent visit in August 1990 has tended to confirm expectations that these may be similar to the adjacent Pugu Hills forest. In particular, the avifauna was found to be comparable in species-richness and rarity, with the scarce species East coast akalat, Uluguru violet-backed sunbird and southern banded snake eagle being recorded (Huxham, pers. comm.). Hippopotamus was present in Kazimzumbwi until about 10 years ago.

Human use: In common with Pugu, Kazimzumbwi has been extensively logged; in particular the south-west of the forest has large areas without any canopy above 3m. Much of the southern forest was replanted with exotic trees (*Cassia* and *Eucalyptus*) between 1961 and 1964, and therre is evidence of recent charcoal burning both on the forest margin and more than 1km within the forest. However, in the northern half of the forest there are areas of primary vegetation, which appear less disturbed than similar areas in Pugu (Huxham, pers. comm.).

Conservation status: The entire forest falls within the Kazimzumbwi Forest Reserve which was gazetted prior to independence. The forest vegetation is slightly better preserved than at the adjacent Pugu Hills forest. As the flora and fauna have received little study the conservation importance of this forest cannot be fully assessed, but it is expected to be similar to Pugu.

8. VIKINDU FOREST (6^0 59′ South 39^0 17′ East)

Description: This highly damaged forest is located about 17km to the south of Dar-es-Salaam and 0.5km north-west of the village of Vikindu. The main Dar-es-Salaam to Kilwa road passes directly through the forest, which

presently covers about 10km^2 of relatively low-lying and flat land over clay-bound sands and gravels of Miocene to Pliocene age. The majority of the forested area has been extensively logged and replanted with exotic trees so that native forest-vegetation now only exists along river valleys.

Botanical collections have been made in this site over many years but the flora has never been fully described. However, the possibly endemic *Warburgia elongata* and the rare *Tristemma schliebenii* have been recorded. Ornithological investigations were initiated in late 1989 and amongst a provisional forest-bird assemblage of 28 species a pair of the vulnerable Sokoke pipit have been recorded (C. Mlingwa, *in litt.*). The forest used to harbour lion but these are no-longer present.

Human use: The entire forest was logged and usable trees extracted before independence up to the early 1960s. Much of the area was replanted with *Eucalyptus* and *Cassia* siamea in 1956 and 1963/4 and these are now being logged. Some of the native trees and shrubs remaining along the rivers are removed by local people for timber, poles and charcoal. However, the surviving areas of natural vegetation are regenerating and if left will return to high forest as there is presently little agricultural encroachment.

Conservation status: The entire Vikindu Forest falls within the Vikindu Forest Reserve. Due to the lack of detailed study on the flora and fauna of this site it is not possible to fully assess its conservation importance. However, the presence of one possible endemic plant and the vulnerable Sokoke pipit indicates a high conservation importance.

9. KISIJU FOREST (7^0 24′ South 39^0 20′ East)

Description: Kisiju forest is located a few metres above sea level on an island adjacent to the sea and some 5km north of the coastal village of the same name. The main forest currently occupies some 2km^2, although other fragments are located on nearby islands and the mainland. The forest is growing on geologically recent alluvium and sands, hence it may not be as old as other coastal forests.

The natural forest is homogeneous with large canopy trees, a well developed shrub-layer and a sparse ground flora. However, there are many abandoned farm clearings which support secondary vegetation typified by the lack of large trees, and the tangle of lianas and ruderals. The flora has received some study; 90 species have been recorded and the two dominant forest trees were identified as *Baphia kirkii* and *Hymenaea verrucosa* (Hawthorne, 1984). Less prominent canopy elements are *Afzelia quanzensis, Albizia petersiana, Craibia zimmermannii, Dracaena usambarensis, Manilkara sansibarensis* and *Holarrhena pubescens*. Completely endemic species appear to be absent from this forest but notable elements of the flora are *Xylopia* sp. nov. and *Oxyanthus* sp. nov. B, the latter known from only one other site near Dar-es-Salaam (Hawthorne, 1984).

The avifauna received preliminary investigation in September 1989 (Burgess *et al.*, in press), and was found to comprise a depauperate assemblage of 13 species of forest bird, with no rarities. Black and white colobus, blue monkey and vervet monkey are also present in good numbers,

and bush pig *Potamochoerus porcus* and Galagos *Galago* sp. are common. A low diversity of terrestrial invertebrates was recorded.

Human use: In 1982 the majority of this forest was unused by man, except adjacent to the one small settlement on the island (Hawthorne, 1984). However, over the past 7 years many areas of the forest have been cut down and burnt to provide poor-grade agricultural land for subsistence farmers who move on after 2-5 years. At the present rate of destruction no primary forest will remain in 10-15 years time.

Conservation status: This forest has no formal protection. The preliminary studies on the flora and fauna indicate that the conservation importance of the forest is moderate.

10. FOREST IN THE RUFIJI DELTA AREA (centered on 8° 0′ South 39° 10′ East): Several small forests are present just north of the main Rufiji delta on the coast. These fall within Mchungu Forest Reserve and Kikale Forest Reserves (approximately 7° 45′ South and 39° 16′ East). Visits from August to September 1990 indicate that these forests are small and heterogeneous. There is a relatively depauperate avifauna, but some primary forest vegetation is present and the insect diversity is high. Permanent pools within the forest and in the woodland support a large population of Hippopotamus and there was evidence of recent use by African elephant. Further areas of forest are reputed to occur on older islands in the Rufiji delta, and the marginal vegetation inland of the mangroves is typical of riverine forest in being dominated by *Diospyros mafiensis*. However, the number, area and type of these forests is unknown. Much further work is required before the area, status and biological importance of coastal forest in this region can be fully evaluated.

11. KIERENGOMA FOREST (Between 8° 20′ and 8o 23′ South and 38° 54′ and 38o 58′ East)

Description: Kierengoma Forest is located on the Matumbi massif some 25km to the south-east of Utete and about 20km inland from the Indian Ocean. The total area of the Matumbi massif is some 400km^2, most of which is dissected by numerous eroding valleys in some of which forest vegetation occurs. There are undoubtedly several areas of forest on the Massif but a survey from October to December 1989 estimated that the Kiwengoma forest reserve supports between 10km^2 and 25km^2 of evergreen forest in the numerous valleys more than 600m above sea level (Kingdon, 1989; Sheil and Burgess, 1990). The complex topography of the Matumbi Massif is comprised of Jurassic and Cretaceous estuarine and marine shales and sandstones, which form sandy and rocky outcrops on the higher slopes. There are a wide variety of soils derived from these parent rocks.

During these preliminary investigations, around 500 species of plant were collected from the forest and surrounding area. These collections have demonstrated the second known locality for *Saintpaulia ionantha*, and the high moisture levels are indicated by the presence of *Impatiens* sp. and *Cyperus* sp..

Preliminary study of the avifauna has recorded 44 species of forest bird, including the near-threatened Uluguru violet-backed sunbird and southern banded snake eagle (Burgess *et al.*, in press). Of the mammals, African elephant *Loxodonata africana*, is common along with a diverse assemblage of other smaller species, including the rare lesser pouched rat *Beamys hindei* and five species of galago, including one possibly new to science. Also recorded were blue monkey and nine species of bat, including the newly discovered fruit bat *Myonycteris relicta* (Kingdon, 1989). Preliminary investigation of the diverse invertebrate assemblage has discovered 7 new genera of millipede, one new genus of spider and 1 new genus of Neuropteran. Many new species are undoubtedly present (Sheil and Burgess, 1990).

Overall the species recorded in this forest represent a mixture of East African endemics typical of the north Tanzania coast and more southern "Mozambique" types.

Human use: On the plateau tops virtually all the vegetation is secondary having been cleared and cultivated over the past 100 years, although most has regenerated since 1962 when the area became a Forest Reserve. Until 1986 there had been little logging since pre-independence times. However, since that time virtually all accessible *Khaya nyasica* and *Milicia excelsa* trees have been removed from the three main valleys. The remaining forest is used by local people for poles and temporary farmland.

Conservation status: The Kiwengoma Forest Reserve contains all the forest presently studied. However, there is unprotected forest elsewhere on the Matumbi massif, and there may also be forest within the other forest reserves in the area. Preliminary data on the flora and fauna suggest this forest has an exceptionally high conservation importance.

12. OTHER FORESTS IN KILWA DISTRICT

There are two further Forest Reserves in this District which are believed to contain evergreen forest: Ngarama Forest Reserve (9° 30′ South 39° 20′ East), and Pindiro Forest Reserve (8° 30′ South 39° 0′ East). Little scientific data appear to be available on these forested areas.

13. RONDO FOREST (10° 10′ South 39° 15′ East)

Description: The best forest in this area is believed to remain on the Rondo Plateau at some 870m above sea level, and in the Mchindiji valley at 10° 07′ South and 39° 12′ East. The plateau forest is about 4km from Rondo village, itself around around 60km west of Lindi, and covers 18 to 20 km^2 (Huxham, pers. comm.). The soil of the forest is sandy with a pH of 6.5, and is derived from terrestrial sands, gravels, calcretes and laterites of Miocene to Pleistocene age. This plateau receives around 1193mm of rain per annum (Procter, 1968).

The forest vegetation is very heterogeneous with logged areas, plantations, cleared glades and some regions of almost primary vegetation. Some large canopy trees such as *Milica excelsa* and *Ficus* sp. still survive in some areas, although extensive logging of the former has reduced its numbers considerably and is still continuing (Huxham, pers. comm.). Other

tree genera which occur are *Albizia, Xylia, Ricinodendron, Fernandoa, Rothmannia, Afzelia* and *Monodora*. Moreover, *Caloncoba welwitschii*, a tree species typical of sub-montane forest is present on this site. There are also large areas of plantation, particularly of *Pinus* species, teak, *Grevillea* and *Cuppressus*, some within the natural forest. Polhill (1968) presents a list of the plants which are believed to be endemic to this forest and the surrounding area, thesse are *Ipomoea consimilis, Xylopia collina, X. latipetala, Warburgia ugandensis* ssp.*longifolia, Dichapetalum macrocarpum, Vismianthus punctatus, Ipomoea flavivillosa, Diospyros eggelingii, Zimmermannia grandiflora, Homalium elegantulum, Vismia pauciflora, Bussea eggelingii, Mimosa busseana, Erythrina schliebenii, Millettia makondensis, Paropsia schleibeniana, Cuviera semseii, Heinsia bussei, H. parviflora, Leptactina bussei, Pavetta lutambensis, P. schliebenii, Vepris schliebenii, Solanum lamprocarpum, Cola discoglypremnophylla, Grewia meizophylla*. However, it is not known how many of these are present in the forest itself. Further preliminary collections made in 1988 recorded a new species of *Psychotria* indicating this area requires further attention.

Recent work on the avifauna (Holsten *et al, in press*; Bagger *et al.*, 1989; Bhatia, pers. comm.) shows that at least 55 species of forest bird are present, including the rare east coast akalat and spotted ground thrush, an endemic subspecies of green barbet *Stactolaema olivacea woodwardi*, and the near-threated Uluguru violet-backed sunbird, plain-backed sunbird and southern banded snake eagle. Spotted ground thrush may breed here, its only known locality Holsten *et al.*, in press.). The amphibians and reptiles have also received some study (Howell, 1981) and a new species of frog is present. African elephant, lion, leopard, bushpig, African buffalo, elephant shrews and galagos occur, along with vervet and blue monkeys.

Human use: This was the finest *Milicia excelsa* forest in East Africa before it was cut over in the late 1940s and 1950s. Moreover, in 1952 the Rondo Forest Project started and has so far planted 1100ha of hardwoods and 1700ha of pine, some at the expense of the natural forest (Procter, 1968). At the present time larger forest trees are being removed by legal logging operations. However, a more serious threat to the forest is posed by fires, some of which are started deliberately to drive out game for hunters, and to reduce the area of habitat for dangerous animals such as lion and elephant. Hardwood poles, timber and some charcoal is also removed by local people. The present level of forest-destruction is highly unsustainable.

Conservation status: All the Rondo Forest falls within the Rondo Forest Reserve. The limited studies on the flora and fauna of this forest suggest its conservation importance is extremely high.

14. **OTHER FORESTS IN LINDI DISTRICT:** There are several other forest reserves in Lindi District which may support coastal forest. These are Chitoa Forest Reserve (10° 02′ South 39° 20′ East), Ndiba Forest Reserve (9° 40′ South 39° 35′ East), Ruawa Forest Reserve (9° 55′ South 39o 35′ East), Matapwa Forest Reserve (9° 57′ South 39° 30′ East) and Litipo Forest Reserve (10° 02′ South 39° 29′ East). Litipo forest is known to support evergreen forest, but the other areas are extremely poorly known.

Litipo Forest is situated approximately 25km west of Lindi, on the estern side of Lake Rutamba, near the village of Rutamba. The forest grows on a steep hill just east of Lake Lutamba and north of the river Nghava, which runs east from the lake. The small areas visted suggest the forest is largely undisturbed and may cover up to 10km^2 (Bagger *et al.*, 1989). Additional forest has been seen to the north. Many botanical specimens were collected here during the pre-independence era, in particular by the German botanist Schlieben, and several type specimens are known from the forest, some of which may have since disappeared e.g. *Erythrina schliebenii*. Preliminary ornithological work in this forest in 1988 demonstrated the presence of at least 43 species of forest-bird, including the rare east coast akalat, spotted ground thrush and the near-threatened plain-backed sunbird (Bagger *et al.*, 1989). Elephant, leopard, elephant shrews, galagos and squirrels occur.

15. FORESTS IN MTWARA DISTRICT

Evergreen forest is believed to remain in two Forest Reserves: Chilangala Forest Reserve (10^o 33′ South 39^o 8′ East) and Mahuta Forest Reserve (11^o 0′ South 39^o 20′ East) (Bearder, pers. comm.). There appears to be little scientific data on these forests.

In general the south-eastern part of Tanzania has received little recent scientific investigation and much further work is required before a complete picture of the forest resource and its biological importance is available for this area.

16. FORESTS ON ISLANDS OFF THE SHORE OF TANZANIA:

The islands Pemba, Zanzibar and Mafia off the coast of mainland Tanzania were probably all formerly covered by forest-vegetation (Hamilton, 1981). Since colonisation by man these forests have been progressively removed until few remain today, and even these are under heavy presure.

ZANZIBAR: The best known patch of coastal forest on Zanzibar is the Jozani forest (6^0 15′ South 39^0 24′ East). This site lies about 35km south-east of Zanzibar town, and may cover around 4km^2 (Pakenham, 1979), although the area of undamaged forest may be as little as 1.3km^2 (Robins, 1976). The botanical composition of the forest is unlike other coastal forests on the mainland as *Calophyllum inophyllum* and *Eugenia* sp. are dominant, with *Pandanus* sp., *Vitex doniana* and *Elaeis guineensis* as sub-dominants. Jozani is mainly noted as the stronghold for the endemic subspecies of red colobus monkey *Colobus badius kirkii* (Zanzibar red colobus), but is also the only known site for Ader's duiker *Cephalophus adersi* besides the Arabuko-Sokoke Forest in Kenya. About 36 species of forest bird have been recorded from this forest (Pakenham, 1979), but none are notable. Jozani may be the only coastal forest remaining on Zanzibar (Polhill, 1989).

PEMBA: The largest surviving remnant of evergreen forest on the island is Ngezi Forest Reserve (4^0 55′ South, 39^0 42′ East) (Rodgers *et al.*, 1986; Pakenham, 1979). The forested area occupies around 14.4km^2 and is located at the base of the Kingomasha peninsula in north-west Pemba, astride the Konde to Ras Kigomasha vehicle track. Forest vegetation lies on rich

alluvium and sands of *c.*20 elevation above sea level and has a mean annual precipitation of 1900mm with only two dry months per year. Forest vegetation is being managed for timber production and areas have been replanted with exotics and native species. *Milicia excelsa* has been removed from the forest by logging and the undergrowth has been brashed to favour timber production (Rodgers *et al.*, 1986). The main forest is dominated by *Antiaris toxicaria, Odyendea zimmermannii, Bombax schumannianum, Blighia unijugata, Croton sylvaticus, Erythrophleum suaveolens, Macaranga capensis, Majidea zanguebarica* and *Terminalia sambesiaca*. A lower canopy layer has much *Uapaca guineensis, Syzygium cordatum* and *Pachystela* spp. Ngezi Forest contains good populations of the endemic palm *Chrysalidocarpus pembanus* as well as the near-endemic *Philippia mafiensis* and a giant aroid *Typhanodorum lindleyanum*. An endemic subspecies of the swallowtail butterfly *Graphium leonidas* is also present. Only 18 species of bird have been recorded in this forest despite many years study and these are all common (Pakenham, 1979). Ngezi forest was gazetted in the post World War I period and is well managed.

Another smaller forest is present on the coral rag at Mwitu Mkuu. This occupies around 2-3km^2 and although little appears to be known of the forest Pakenham (1979) recorded 14 species of birds there.

Forest is also present on islands off the coast of Pemba (Neve, pers. commm.).

MAFIA: There were extensive areas of coastal forest on this island in the 1930s, but possibly the last of these was destroyed in 1987/8 for the planting of coconuts (Greenway *et al.*, 1988). There still remain expanses of semi-evergreen forest along the coral rag of the eastern seaboard, but these have received little study.

SUMMARY OF DESCRIBED COASTAL FORESTS

This review has described the known resource of coastal forest on the mainland of Tanzania and the islands of Pemba and Zanzibar. Data are lacking in several areas, particularly south of the Rufiji River and the level of uncertainty here is high.

The total area of forest vegetation described adequately in this review occupies less than 200km^2. Moreover, less than half of this figure represents primary forest vegetation and almost all forests are being to be unsustainably overexploited for timber, charcoal and farmland, hence their long-term future seems unclear.

DISCUSSION

The coastal forests of Tanzania form a part of a continuous belt of similar forests extending from Somalia in the north and into Mozambique in the south.

Somalia: The coastal forests of Somalia have been the subject of a recent research project (Madgewick *et al.*, 1988; Wood, 1988). This survey

recorded some 14km^2 of forest in the Jubba Valley and Bu'aale to Fanoole (Madgewick, 1989) and data were collected on the mammals, plants and birds.

Kenya: The coastal forests of Kenya are rather better known having been the subject of a research programme for several years (Hawthorne, 1984; Kelsey and Langton, 1984; Roberston, 1987; Tetlow, 1987; Young, 1984). This work has shown there are at least 67 patches of coastal forest in Kenya. Two of these, the Arabuko-Sokoke Forest (*c.*170km^2) and forests on the Shimba Hills (130km^2) appear to be much larger than anything in Tanzania. Moreover, recent investigations on the flora of relict forest patches in sacred groves or kayas (Roberston, 1987) is producing botanically important data.

Mozambique: The coastal forests of Mozambique are more poorly known. Collar and Stuart (1988) note the presence of several small forest patches along the coast of Mozambique, all in Sofala province, and present preliminary data on their plants and birds. However, little other data appear to be available.

Tanzanian coastal forests therefore form part of a poorly known chain of forests supporting a globally important flora and fauna. All forests along this coast, especially those in Tanzania, Somalia and Mozambique, urgently require further scientific investigation to assess their true biological importance, and an increased level of protection and active conservation measures to preserve their biological diversity.

There are several forests noted in this paper which have not been visited by the authors and where data on their size, biological importance and status appears to be lacking. It is therefore important that the coastal forest research programme initiated in 1988 by the Wildlife Conservation Society of Tanzania and in 1989 by the Society for Environmental Exploration is continued. Aerial survey, or satellite imagery would produce accurate base maps of the distribution and area of evergreen forest along the coast. Once identified, site visits would enable the biological importance of these forests to be assessed.

CONCLUSIONS

The coastal forests of Tanzania are poorly studied but are rich in endemic and near-endemic plants and invertebrates, and rare birds, mammals, reptiles and amphibians.

The total known area of Tanzanian coastal forest in blocks over 2km2 is less than 200km^2. Other areas of forest are known to exist but their area, status and biological importance has not been documented.

Around 40% of the trees in these forest are known to be endemic to the coastal region, and this paper indicates that up to 45 species of plant are confined to a single forest, with many other species known from very few forest localities. Moreover, these forests are shown to support 6-7 species and sub-species of bird with global conservation importance, and assemblages of mammals, amphibians, reptiles and invertebrates of considerable global conservation importance.

The majority of the coastal forests described have been heavily damaged by man, and the level of damage appears to be increasing. At the present rate of destruction forest cover will eventually be completely removed from most sites recently visited, with the consequent extinction of many species.

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APPENDIX 5: SPECIES-LIST OF BUTTERFLIES COLLECTED IN PANDE AND KIONO

	Pande	Kiono
PAPILIONIDAE (Swallowtails)		
Papilio dardanus cenea	+	
Papilio dardanus ochracea f. hippocoonides	+	
Papilio demodocus		
Graphium leonidas	+	
PIERIDAE (Whites)		
?Anaphaeis creona	+	
Belenois creona		
Belenois creona severina	+	+
?Belenois thysa	+	
Colotis eucharis		+
Colotis eucharis evarne		
Colotis euippe	+	
Colotis regina	+	
Colotis evenina evenina	+	
?Colotis evigpe complexivus	+	
Colotis evigpe omphale		
Colotis sp.		
Eurema brigatta brigitta		+
Eurema hecabe	+	
Leptosia alcesta		
Leptosia alcesta inalcesta		
Mylothris agathina		
Mylothris chloris		+
Nephronia angia subsp. ?		+
Nephronia angia mhondana	+	
Nephronia angia/thalassina		+
ACRAEIDAE (Acraeids)		
Acraea encedon		
Acraea eponina		
Acraea natalica natalica		+
?Acraea pudorella pudorella		+
?Acraea quirina	+	
DANAIDAE		
Amauris niavus dominicanus		+
Danaus chrysippus		+
Bematistes epaea epitellus	+	
?Pardopsis punctatissima [fam?]	+	

NYMPHALIDAE (Nymphalids)

Bebearia chriemhilda		+
Bylbia anvatara anvatara		+
Bylbia anvatara acheloia		
Cyrestis camillus	+	
Euphaedra eleus orientalis	+	
Euphaedra neophron	+	
Euphaedra neophron/littoralis		+
Eurytela dryope	+	
Eurytela dryope angulata		
Hamanumida daedalus		+
Hypolimnas dubius dubius/drucei	+	
Hypolimnas missippus	+	
Neptis laeta		
Neptis mayottensis/saclava saclava		+
Neptis melicerta		+
Neptis trigonophora	+	
Precis natalica		
Precis orithya		
Salamis parhassus	+	
Sallya amulia rosa		

SATYRIDAE (Browns)

Bicyclus anynana		
Bicyclus safitza	+	+
Melanitis leda helena		+
Physcaeneura pione	+	
Satyridae sp.		
?Ypthima granulosa		+
Ypthimomorpha itonia		

LYCAENIDAE (Blues)

Euchrysops sp.		+
?Iolaus sp.	+	
Teriomima subpunctata		

HESPERIIDAE (Skippers)

?Tagiades flesus	+	
unknown sp.	+	