FRONTIER TANZANIA

COASTAL FOREST RESEARCH PROJECT

PRELIMINARY RESULTS OF BIOLOGICAL SURVEYS OF GENDAGENDA FOREST RESERVES AND THREE OTHER FORESTS OF TANGA REGION, TANZANIA

JULY TO DECEMBER 1991

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ABSTRACT

The Gendagenda forests comprise an almost continuous stretch of Coastal Forest type on a faultline escarpment edge running from the Msilwa River in the south to the Mkongore River in the north. The forest catches moist air from the prevailing south east winds blowing in from the coast 40 kilometers to the east. It is believed that forest has been continuously present on the site for over 30 million years and that the forest is host to a high and diverse number of species.

At the southern end of the forests the large twin peaked hills of Gendagenda dominate the surrounding landscape. Variations in altitude, precipitation, soils and rocks on the hill give rise to a number of distinct vegetation communities.

The Frontier Coastal Forest Research Project Expeditions TZ09 and TZ10 carried out the first full biological survey of these forests and have made the first known visits by scientists to the forest in the northern end. There, the globally threatened African Violets (Saintpaulia spp.) were found in significant numbers. Primary forest was found on ridgetops and higher slopes.

The eastern edge of the forests were accurately mapped although poor access to other areas of the forest prevented the complete boundary being drawn. the condition of the Gendagenda forest was assessed where possible.

Quantitative and semiquantitative studies were made of the forests flora and fauna. Transects were constructed in 10 areas of the forest and surrounding area to enable some comparison between the different vegetation communities. Plant specimens from these and other locations were collected in order to be able to add to the species list produced by Hawthorne (1984). In general, the forest was found to be in good condition, although encroachment had progressed at a fast pace around the village of Gendagenda.

Two forest reserves were gazetted in the general forest area by the Germans (i.e. pre-1916) for the purpose of conserving the forests and their water catchment areas.

Until very recently little or nothing practical has been done to protect the reserves.

Brief study visits were also made to Msubugwe Forest Reserve, to the east of Gendagenda and to small forested areas on Mkwaja Ranch to the south east. Surveys were made and data collected on aspects of their flora and fauna.

A three week visit was made to the small mangrove forest surrounding the Kama Estuary and its vegetation assessed

In addition, reconnaissance visits were made to Tanga Limestone Gorges, Kilulu Hill and Mount Tongwe to seek out areas of coastal type forest to the north of the Gendagenda Hills.

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1.0 INTRODUCTION

This report presents a summary of the findings of the Frontier TZ09 and TZ10 phases of the coastal forest research project (F-T CFRP) to the Genda Genda forests and to three other forests of the Tanga region, Tanzania, between July and December 19991.

General aims and justifications of the Frontier- Tanzania Coastal Forest Research Project are presented in a separate report (Dickinson and Burgess, 1991a)

1.1 Aims

The specific aims of these expeditions were to:-

a) Map the extent of the forest in and around the Genda Genda north and the Genda Genda south forest reserves and survey all aspects of its flora and fauna.

b) To assess the condition of the forest and its social and economic importance to the local people

c) To conduct brief surveys of the forest in the Msubugwe forest reserve and small coastal and mangrove forests in the Mkwaja area.

d) To visit other areas in Tanga Region possibly containing coastal forest.

1.2 Justification

a) The Genda Genda forest reserves had received scant scientific attention, the only notable visit being that of Hawthorne and Mwasumbi, who reported the unusual coastal forest type with areas that were undisturbed. The topography and location of Genda Genda suggested a diversity of plant communities within the general coastal forest habitat. No element of the fauna had yet been studied or collected.

The Genda Genda forests were known to contain some 15-20% of the total known area of coastal forest in Tanzania. They therefore rank highly within the coastal ecological unit.

b) Limited information was available on the flora and fauna of Msubugwe forest, and it was known to be rapidly losing areas of habitat due to logging practices.

c) The Mkwaja area was known to contain a number of small dry and mangrove forests that had not previously been studied.

d) More information was needed in general on the extent of coastal forest remnants in the Tanga Region.

2.0 EXPEDITION SCHEDULES

TZ09:

13 July: UK Research assisstants arrive in Dar es Salaam

17-19 July: Visit to Tanga to obtain relevant clearance letters
20 July: Clearance from Mgambo army base
26 July: Camp established at Genda Genda, 15 minutes walk from forest edge. This camp is the main expedition camp, small overnight camps made to various more distant areas.
12 August: Visit to Pangani for clearance to visit Msubugwe
18 September: Return to Dar-es-Salaam
21 September: End of expedition

TZ10:

1-3 October: Visit to Tanga to obtain relevant clearance letters
5 October: UK Research assistants arrive in Dar-es Salaam
11 October: Visits to district H.Q. (Handeni) and Mgambo Army Base to obtain clearance
13 October: Camp established at the TZ09 site
25 October: Visit to Pangani for clearance to visit Mkwaja
28 November: Charles Mlingwa arrives for bird-netting
9 December: Return to Dar es Salaam
14 December: End of expedition

Details of work done are shown below (Table 2.1), with localities shown on the map (figure 2.1).

Table 2.1 Time spent at various sites by expeditions TZ09 and TZ10

SITE	DAYS VISITED	No.OF PERSON DAYS
Genda Genda Forests	26 July - 16 September (TZ09)	804
	13 October - 9 December (TZ10)	960
Msubugwe Forest	20 August - 22 August	8
	22 November - 24 November	15
Mkwaja Forests	18 November - 20 November	18
DSM	Various	50
Tanga Forestry activities	28 August	2
Tanga Limestone Gorge and Kilulu Hill	3 December - 7 December	12

3.0 PERSONNEL

Field director: A Dickinson
Frontier CFRP coordinator: Dr. Neil Burgess, SEE/RSPB

TZ 09 : Camp Leader G.P.Clarke
Camp Coordinator L.J.Thorburn

Botanical Collection : Frank Mbago, Haji Suleman, Herbert Lyaruu, Peter Lovett, The Herbarium, UDSM

Research Assistants : (UK)

E.H.Axton	A.M.Hart
L.G.Cadbury	A.C.Malkin
F.M.Clarke	T.J.Mason
C.Eng	E.J.Mead
C.Gilliam	S.H.Morton

R.S.Gooday C.R.Turner
R.L.Gunning

Research Assistants : M.Jackson F.Tarimo
(UDSM)

Driver : N.Salim

TZ 10 : Camp Leader : C.Ansell
Senior Science Officers : G.P.Clarke
A.Cockle
Science Coordinator : P.Matthews
Bird Netting : C.Mlingwa (UDSM)

Research Assistants : (UK)	M.Brewin	S.Perry
	D.Emlyn-Jones	A.Plunkett
	S.Gammon	S.Scanlan
	J.Goddard	D.Smith
	A.Grand	J.Smith
	A.Lowe	M.Smith
	J.Metcalfe	P.Smith
	B.Payne	G.Stunnock

Drivers : S.Mapambe

Details of participating institutions and taxonomists are given in Dickinson and Burgess (1991a)

4.0 THE GENDA GENDA FORESTS - PROJECT REPORTS

General aims and methods of all projects are described elsewhere (Dickinson and Burgess (1991a). Detailed descriptions of field methodologies are given in Dickinson and Burgess (1991b). An orientation map with camp and study sites marked is given in Figure 4.1. A site logistics report isavailable from The Society For Environmental Exploration office, as is raw data.

4.1 SURVEY AND MAPPING

Trips were made from the main camp site, as well as from more distant overnight camps to survey as much of the forest within the Genda Genda reserve as possible. The eastern forest border was mapped on foot and found to largely agree with that depictedon the Ordnance Survey maps (1:50,000, series Y742, sheets 130/3 and 149/1), although did not extend as far south as these maps suggested. The western border proved more difficult to map, as the forest body fragments into forest/thickey/woodland complex on the western side of the hills and no clear boundary can be determined. The border shown on the Ordnance Survey maps was thus adopted as a fair approximation of forest extent on this side.

We took the Genda Genda South forest reserve boundary as being that surveyed originally by the Germans in 1910, and the Genda Genda North forest boundary as being that surveyed in 1966. The two boundaries overlapped one another, and did not match the interpretation of the reserve areas shown on the Ordinance Survey maps. The Genda Genda North Boundary however was in the process of

being resurveyed during our visit as part of the catchment forestry programme.

Forest reserve boundaries (1910/1966) and forest borders (Ordinance Survey/Frontier) are shown in figure 4.1.

Disturbance levels throughout the areas visited in the forest were noted (i.e. clearing for charcoal, agricultural encroachment, snares set for game, logging activities and pole removal). Disturbance by logging and poling was also assessed quantitatively (section 4.1.3). In addition the local people were questioned on their interactions with the forest in an extensive socio-economic project (see appendix 5 for full results of this survey).

A visit was made to the regional office for Natural Resources in Tanga and the files accessed for historical information on the Gendagenda Reserves.

g) HUMAN POPULATION

Gendagenda village, to the south east of the hills comprises some 1800 inhabitants and is the main source of anthropogenic disturbance to the forest. There is also a large cultivated area at Mgambo and a further village at Kwedihwahwala.

h) RESERVE AREA

Gendagenda south forest reserve encompasses 19.2 square kilometres and Gendagenda north forest reserve 8.9 square kilometres. The two reserves overlap so that about 1 square kilometre is common to both and the total area within the reserves is 27.1 square kilometres (see figure 4.1).

i) HYDROLOGY

The Gendagenda forests lie entirely within the Pangani River Basin. the escarpment and hills attract a higher amount of precipitation than the surrounding plains and this gives rise to a number of seasonal streams and rivers.

The Gendagenda hills receive extra mist effect precipitation. The hills are composed of porous rock and are an important source of ground water, feeding wells in the area.

The permanent Mkongore River flows through the northern end of the forests.

4.1.1 DESCRIPTION

a) LOCATION

The Gendagenda forests lie on the eastern edge of the Handeni District (Tanga Region) in Tanzania, from 5 deg. 27' to 5 deg. 35' south and from 38 deg. 37' to 38 deg. 40' east. The forsets lie 50 kilometres to the south of the Usambara Mountains, which are noted for their high levels of species diversity and endemism.

b) TOPOGRAPHY

The forests are situated on the edge of a faultline escarpment, or endocline strike ridge (Hawthorne, 1984). along the escarpment the twin peaks of Gendagenda dominate the landscape, rising to 545

metres above the 80 - 100 metre altitude of the plains. Forestis present at all these altitudes, and the escarpment levels off at 280 - 360 metres.

The Pangani River drains off the escarpment to the north of the Gendagenda forests, reaching the coast 35 kilometres to the east.

c) VEGETATION

d) CLIMATE

No precise climate data is yet available for the Gendagenda forests, nd a significant variation will occur in the area due to the large range of altitudes covered. The absence of the deciduos sterculia appendiculata on the south east faces of the hills indicates areas of greater wetness on the slopes which catch the prevailing south easterly winds.

The forestry records written in 1966 for Gendagenda north notes 30" +/- 10" rainfall per annum (762 +/- 254mm). The NORAD / catchment forestry paper on Gendagenda south forest estimates rainfall to be 1300mm over the forest and 1000mm over the surrounding woodlnd, with a 2-3 month dry season.

A 1960's geographical atlas of Tanznia gives an area rainfall of 1000 to 1300mm distributed over 125-150 rain days.

Annual rainfall measured at Mkwaja ranch (30km to the SSW) varied from 500mm to 1700mm with a mean of 1600mm. Altitude of the ranch is approximately 120 metres (see appendix 4 for full figures, also section 4.2.2).

e) GEOLOGY

The Gendagenda hills consist of miocene sandstone over mesozoic strata and Neogene sediments over Magnic strata (Hawthorne, 1984).

f) SOILS

The lower slopes of the escarpment consist of marine clays, mudstone of Miocene to Pleistocene age. These are blanketed by terrestrial sands, pebble beds and clays which are frequently overlain by red sands of Quaternery age. On the upper ridges the soil is brown to black with humous. There are areas of bare rock outcrops (hawthorne, 1984).

We found pH's in the forest to vary from 6.1 to 6.85, and organic matter content to be 10-15% in areas sampled (see section 4.2.3).

4.1.2 HISTORY AND STATUS

The Gendagenda forests comprise some 20 square kilometres of forest, most of which has a continuous closed canopy. Theforests on the steeply sloping sides of the Gendagenda hills as well as that to the south of the hills are in very good condition. On the flatter plateau away to the west the forest appears to have been degraded in the past but is now regenerating and a complete canopy cover has been re-established. This area contained dense liana tangles and few large trees, although patches of undisturbed forest

with tall trees were present.

No forest is present o one side of the north peak of the hills or on the sides of the escarpment around the Tongwe level crossing. This latter finding can be attributed to the former presene of a large at Tongwe where encroachment and shamba burning would have taken place in the past.

a) LEGAL STATUS

Two forest reserves have been gazetted within the Gendagenda forests, named respectively Gendagenda North and Gendagenda South. By transferring the reserve maps onto the ordnance survey maps, some overlap between the two reserves was found.

i) Gendagenda South Forest Reserve (Central Government Forest Reserve)

Constitution: 1947 Tanganyika laws Cap 132
German selection gazetted ex-German
Boundary description see Cap 389 supp.59

RESERVE HISTORY

1910: Surveyed, Boundary markers put in

1959: Forest taken over by the assistant Conservator of Forests, Tanga (possibly from the assistant Conservator of Forests, Lushoto), Forest Ranger at the Handani District office told not to patrol the reserve any more.

1964: First boundary impovement since original survey. No forest guard had been patrolling. Two Forest Rangers were sent to resurvey that area. Beacons were erected on an 8-10 mile distance of the boundary. Work done by Pangani Forest Ranger.

1966: Boundary maintained.

1967: General manager of neighbouring estate, Mgambo Sizal Estate, requests permission from the Ministry of forests, DSM, to build an all weather road from the estate to the station at Gendagenda. Permission for this was granted, but the road was never built.

1991: Senna Simea Nursery established.

Border Map JB 785

Genda Genda South is included in the NORAD / catchment forestry programme.

ii) Genda Genda North Forest Reserve

Constitution 1947 Tanganyika Laws Cap 132

Gazetted ex-German

Reserve History

1959: Forest taken over by the Assistant Conservator of Forests,

Tanga (possibly from the Assiststant Consevator of Forests, Lushoto). Forest Ranger at the Handeni District office told not to patrol the reserve any more.

pre 1966: Reserve resurveyed and demarked.

1966: Boundary cleared and direction trenches reopened.

1991: Boundary resurveyed in preparation for Senna Simea planning.

Border map

ii) Gendagenda North Forest Reserve

Constitution: 1947 Tanganyika laws Cap 132
Gazetted ex-German

RESERVE HISTORY

1959: Forest taken over by the assistant Conservator of Forests, Tanga (possibly from the assistant Conservator of Forests, Lushoto). Forest Ranger at the Hadeni District office told not to patrol the reserve anymore.

Pre-1966: Reserve resurveyed and demarkated.

1966: Boundary cleared and direction trenches reopened.

1991: Boundary resurveyed in preparation for Senna Simea planting.

Border Map JB 526

Gendagenda North is included in the NORAD / catchment forestry programme.

ii) Genda Genda North Forest Reserve.

Constitution: 1947 Tanganyika Laws Cap 132

Gazetted ex-German

Reserve History

1959: Forest taken over by Assistant Conservator of Forests, Tanga (possibly from the Assistant of Forests, Lushoto). Forest Ranger at the Handeni District office told not to patrol the Reserve any more.

pre 1966: Reserve resurveyed and demarkated.

1966: Boundary cleared and direction trenches reopened.

1991: Boundary resurveyed in preparation for Senna Simea planting.

Border Map JB 526

Genda Genda North is included in the NORAD/catchment Forestry Programme.

b) Plantations

According to the 1910 map of the Genda Genda South Forest Reserve, there used to be a small rubber plantaion on the escarpment edge above the Tongwe level crossing. The villagers knew nothing of this plantation, and no rubber trees could be found, although the plantation would have fallen into disuse after the British invasion of 1916. Cheaper rubber was at that time available from Malaya.

A large coconut and mango plantation is present on the edge of the forest near Tongwe level crossing, on the site of the former village of Tongwe.

The land to the immediate west of Genda Genda south Forest Reserve was a sisal plantation under the kari jee Jianyee Estates Ltd. until at least 1967, after which the army took it over.

c) Logging

The exact extent of past and present logging is difficult to determine; Hawthorne (1984) describes the whole western side of the Genda Genda Hills to have been extensively logged, although the villagers deny that this ever happened. Only a smal part of this area was visited, but the logging appeared recent and was not extensive.

Two villagers have been issued with licences to log the forest (issued by Handeni District) although only one is currently actively engaged in the logging. He employs six people, who ofen spend a couple of days at a time in the forest. The timber and logs are cut by hand-saws and carried by hand to Genda Genda station from which they are transported by rail to their market in Dar es Salaam.

Saw pits were found on the Genda Genda hills themselves although most of the logging is done on the flatter areas south of the hills.

The villagers said that the army was logging the forest to the north-west of the Genda Genda hills.

No logging trails (for tractor or lorries) were found in the forest.

The trees prefered by the loggers were:- Mvule (Milicia exetria)
- (Diospyros Spp.) (Ebony)

d) CHARCOALING

Hawthorne (1930) mentions that the Gendagenda forests are being "progressively eaten away for charcoal". However, little direct evidence for this was found.

Patches of charcoal were found on the edge of the forest, although it is unclear whether they were the remains of bush fires of of charcoaling.

e) FIREWOOD COLLECTION

The villagers of both Gendagenda and Kwadihwahwala collect irewood from the forest but the effects of this are limited to the areas close to human habitation. Much firewood isalso collected from the surrounding woodland. This practice is not significant enough in the forest for its effect to be measured.

f) HUNTING

A large number of villagers in Gendagenda practice hunting, often with guns. This activity is carried out predominantly in the open savannah woodland and grassland on the plains to the east of the Gendagenda forests. This is where the majority of the game may be found, Bush Pig (Potamochoerus porcus), Sable Antelope (Hippotragus niger), Buffalo (Syncerus caffer), Impala (Aepyceros melampus), Waterbuck (Kobus ellipserymnos), Gazelle (Gazella Spp.) are all hunted. At least one kill is made daily, and the meat sold for 100/- per kilo

Porcupine (Hystrix Spp.) is hunted for meat in the forest

Many snares were found in the woodland savannah areas immediately adjacent to the forest, particularly along the railway line. This consisted of a small ring of thatch with sugar Cane in the middle as bait. A snare would be set across the entrance. The snares were set for the Cane Rat (Thryonomys Spp.) which the locals eat.

No snares were found in the forest itself.

g) FARMING

Farming is becoming more important to the villagers as hunting becomes more difficult. The area under cultivation is growing rapidly, and clearing of the forest was progressing during our visit.

A letter from the Forest Division in Panganito the assistant Timber Marketing Officer in Tanga in 1984 mentions that about 5 people had opened new shambas within the Gendagenda South Reserve, but had agreed to stop cultivation after they had harvested their crops. Encroachment today is on a far larger scale, particularly around Gendagenda village. 30-50 families are encroaching on the forest now compared to the 5 in 1964.

About 1 square kilometre has been cleared entirely within the forest. Unless this is stopped now the whole of the forest south of Gendagenda will be destroyed in 10 years, if clearance continues at the same rate.

h) SPIRITUAL SIGNIFICANCE

There is a cave at the foot of the cliff on the south side of the hill in which the village people leave offerings in times of trouble to the spirits which are believed to inhabit the cave. We were told that we could visit the cave , but on no account were we to remove anything. The punishment for this was believed to be blindness and attack by army ants, bees or wasps. Even the taking of animal or plant specimens was forbidden.

Pots were also found on an outcrop on the north east side of the south peak. We were told that these also had been placed for spiritual reasons.

i) FRUIT, MUSHROOM AND POTATO COLLECTION

Potatoes are found in the forest and collected, it has not been possible to quantify how much is being taken and what effect this has on the forest ecology. The potatoes were Mdiga (Aioscorea dumetorum).

Edible fruits include Mkogho (Caton sylvaticus), Mghobe (Phageolus lunatas), Mkwamba (Phyllanthus guineansis), sazi (Manilkora sukata), Mkwingina (Sorindeia obtusifoliate).

j) MEDICINE COLLECTION

Most medicines taken from the bark of roots of trees, and such practice damages the trees.

3 witchdoctors practice in Gendagenda, there is neither a dispensory nor a hospital, and traditional medicine is still important in the community. One witchdoctor admitted that her remedies were not always successful.

Most of the medicinal plants are found in the surrounding woodland, rather than the forest.

k) LOCAL ATTITUDES TO THE FOREST

The extensive encroachment into the forest for agricultural land, when so much alternative land exists in the surrounding woodland indicates little concern amongst the people of Gendagenda for the forest.

Some of the local people interviewed in the socio-economic survey believed that the falling rainfall observed over the last few years was due to the disturbance of the forest. This worry is not however enough to halt the rate of distruction.

l) MINING

No mining activities are presently being carried out, although there are rumours that Garnets can be found on the western side of the Gendagenda hills (pers. comm.- geologist)

m) EDUCATIONAL VALUE

The Gendagenda forests contain a wide diversity of coastal forest types within the standard classification of Zanzibar Inhambane Undifferentiated Forest. The majority of this forest is in good to extremely good condition and interesting areas of recolonising and regenerating forest are also present.

The easy access to the forest provided by the train, combined with the factors listed above make its educational value very high.

n) IMPORTANCE IN WATER CATCHMENT.

The importance of the Gendagenda hills as catchment areas has long been recognised.Many seasonal streams originate on the hillsides,and their porous rock maintains a high groundwater level all year round in the plains below.Villagers sink their wells into these underground streams.

The reserves were set up to ensure that forest cover was maintained on the hills and surrounding areas. NORAD\Catchment Forestry have just begun work to plant a protective border of Senna Simea around the forests. By supplying the locals with a more accessible source of poles and firewood it is hoped that further incursion into the forest proper will be prevented.

The rivers in the Gendagenda area are shown in figure 41.

o) HONEY.

One large tree was found to have been felled in order to access the honey in it. Dombeya Gilgiana was often felled as bees often live in holes in this tree species.The local people believed that the honey was ready when the tree flowered.

p) ALTERNATIVE SOURCES OF FOREST PRODUCTS\REVENUE.

Large areas of savannah woodland are present to the east of the Gendagenda forestsall of which are uninhabited (at least 600km2). These could equally well provide land for cultivation and wood for fuel, but would be harder to fell. The soils are heavier, and precipitation a little lower.

The woodland trees do not grow straight enough for producing poles, so the villagers at present need the forest for their poles. A pole plantation might be a feasible option to solve this problem.

4.1.3. OTHER FEATURES.

A further forest reserve is located at Msumbugwe, 10km to the east, on the lowland Pangani plain. This forest was visited briefly during the course of the expeditions (see section 5.0)

Numerous other unsurveyed and ungazetted patches of coastal forest are also present on the Pangani plain, occurring interdigitated with savanna woodland and forest-thicket.

4.1.3. DISTURBANCE SURVEY.

AIM: To assess logging and poling activity on the forested south peak of Gendagenda mountain.

METHOD: Fifteen transects (5mx250m) were marked out in the forest,five on the western mountain slopes, five on the eastern slopes and five on the southern slopes, (see figure 4.3).

Within each transect, DBH (diameter at breast height) measurements of all vegetation greater than 3m tall and all stumps (cut or natural fall) were recorded.

Numbers of trees (>= to 10cm DBH) , cut poles (< 10cm DBH), cut logs (>= 10cm DBH) and natural pole\log falls were measured and expressed as a percentage of total vegetation (within the limits already defined) .

A possible correlation between poling frequency and forest proximity to pathways and shambas was investigated.

RESULTS: see overleaf.

Figure 4.3 :
Disturbance Transect, Location Genda Genda South Peak.

Figure 4.4 :
Poling Activity In Relation To Sapling Proximity To Pathway.
(Transect South East).

RESULTS: TABLES AND FIGURES.

Table 4.1 TRANSECT SET EAST

	mean	s.d.
saplings (<10cm DBH)	56.1%	5.6
trees (>/= 10cm DBH)	24.8%	3.8
poles cut (</=10cm DBH)	7.7%	3.7
logs cut (>/=10cm DBH)	1.4%	1.2
natural falls	10.0%	2.2

Table 4.2 TRANSECT SET WEST

	mean	s.d.
saplings (<10cm DBH)	64.8%	7.0
trees (>/= 10cm DBH)	16.7%	2.7
poles cut (</=10cm DBH)	13.6%	5.0
logs cut (>/=10cm DBH)	0.1%	0.1
natural falls	4.8%	2.5

Table 4.3 TRANSECT SET SOUTH

	mean	s.d.
saplings (<10cm DBH)	64.7%	5.7
trees (>/= 10cm DBH)	17.9%	2.3
poles cut (</=10cm DBH)	4.7%	3.3
logs cut (>/=10cm DBH)	0.5%	0.4
natural falls	12.2%	1.6

Table 4.4 OVERALL RESULTS

	mean	s.d.
saplings (<10cm DBH)	61.9%	5.0
trees (>/= 10cm DBH)	19.8%	4.4
poles cut (</=10cm DBH)	8.7%	4.5
logs cut (>/=10cm DBH)	0.6%	0.7
natural falls	9.0%	3.8

RESULTS: In the areas of the forest surveyed, the total number of poles (dia.<10cm) cut down amounted to 8.7% of the total vegetation measured. Of the total number of saplings counted, 12.3% have been cut down. Logging activity was considerably lower with the total number of trees (dia.>/=10cm) felled equalling 0.6% of total vegetation measured and 2.9% of total trees present. Natural sapling and tree falls combined amounted to 9% of total vegetation measured,(see Table 4.4).

The relationship between frequency of poling and proximity of forest to paths and shambarwas investigated in transect sets East and South. Transect Set East was bisected by a path and the results (Figure 4.4) show that poling incedence was greatest nearest the path and decreased with distance from the throughfare. A similar tend was seen in Transect Set South (Figure 4.5) where, with the exception of Transect 4, poling activity decreased with distance from the shambar. Transect Set West, furthest from Genda Genda village, shambar and access paths showed a greater incidence of poling (Table 4.4, 13.6%) than either Transect Set East (Table 4.1, 7.7%) or Transect Set South (Table 4.3, 4.7%).

DISCUSSION: The total number of poles and trees cut down in the areas surveyed on Genda Genda south mountain amounted to 9.3% of the vegetation measured. No attempt was made to quantify the timescale of logging / poling activity as stumps old and new were all counted. Furthermore there was no information available regarding sapling growth rates and thus forest regeneration time. It is therefore difficult to accurately assess the longterm effects of this level of poling / logging activity on the forest. However the fact that the loss of saplings and trees due to mans activities is equal or greater than that caused by natural causes (9%) suggests that this level of logging / poling is unacceptably high.

The prevalence of young trees in all the areas of the forest surveyed (Table 4.4, saplings 61.9%, trees 19.8%) may indicate that poling activity is altering the age structure of the forst. However without any totally undisturbed forest for comparison it is not possible to draw any definite conclusion with regard to this effect.

It was hoped that the frequency of logging / poling and forest access (i.e. proximity to the village, shambar and paths) would be indicative of wether such activities were causal (i.e. carried out by people in the vicinity for domestic use) or systematic (i.e. arried out on an organised commercial basis). In the case of Transect Set East (Figure 4.4) poling activity is greatest near the path suggesting that poling in this area may be causal, however the greater activity near the path may be due to path clearing rather than collection. Transect Set South (Figure 4.5) shows a general trend of greater poling activity closest to the shambars, again suggesting unorganised causal poling by people working or living in the shambas. however transect 4 in this set shows considerable poling activity despite its distance from civilisation. In addition ,Transect Set West (Table 4.2) has been heavily poled regardless of its inaccessibility. This data suggests that systematic poling, probably governed by forest type and tree species rather than accessibility, has taken place in the forest.

The high incedence of poling in Genda Genda forest in all the ares surveyed is worrying. The fact that no transect areas were completely undisturbed suggests that the forest is being Systematically poled. Further information is needed with regard to

the sustainability of this amount of cropping and the possible long term effects (e.g. on forest dynamics) of thier activitiy.

4.2 PHYSICAL ENVIRONMENT.

Daily rainfall was monitered between the 2nd of August and the 12th of September and between the 23rd of October and the 5th of December. Maximum and minimum temperatures were taken during the ???? period, and velosity and wind direction during the latter. Results of these measurements are shown graphically in Figures 4.6 and 4.7.

4.2.1 Rainfall.

Daily rainfall measurement began at the end of the long rains and ended (with a short break) at the onset of the short rains. Thus, 30 mm was recorded between 10th and 11th August and only small readings obtained until 10th November when 33.3 mm was recorded. Readings over 60 mm were taken twice in the ensuing period (25th November and 4th December) as the short rains set in.

Mean monthly rainfall measured at the weather station on Mkwata Ranch, 30 km to the SSW, are included in Appendix 4. The ranch is on the coastal plain, where rainfall would be expected to be lower than in Genda Genda forests.

4.2.2 Humidity and Temperature.

Maximum daily temperature in the forest varied from 25 degrees centigrade to 34 degrees centigrade, and minimum between 23 degrees centigrade and 18 degrees centigrade. Mean maxima and minima were 31 degrees centigrade and 20 degrees centigrade. Over the study period, minimum temperatures remained relatively stable, while maximum temperatures showed a slight upward trend.

A 24 hour climate study conducted on the ridgetop between the two peaks on 6th/7th November recorded a maxima of 31 degrees centigrade at 12.30 hours and a minima of 22 degrees centigrade at 0500 hours (1 m above ground, 350 m altitude). Humidity of over 90 % was recorded between 22.00 hours and 06.30 hours, dropping rapidly after 08.00 hours to a minimum of 50 % at 12.30 hours (1m). Temperature and humidity were not found to differ greatly at 5 m from readings at 1 m. Those results are expressed graphically in Figure 4.8.

Mean monthly maximum and minimum temperatures recorded at the Mkwata Ranch weather station are included in Appendix 3.

Genda Genda South Forest Reserve,Handeni District, Tanzania.

Figure 4.6 Rainfall and the maximum and minimum temperatures from 2nd August to 13th September 1991.

Figure 4.7 Rainfall and Cloud Cover 23 October to 5 December.

Figure 4.8 Climatic Study of Ridgetop of Genda Genda Forest (6th/7th November 1991).

4.2.3 Soils.

Five soil samples were taken from within each vegetation transect (section 4.3.5) and analysed for pH and combustable organic matter content.

Forest soils were loamy, with pHs ranging from 6.35 to 6.85 and combustable organic matter content ranging from 10 to 15 %. Soils of riverine areas were found to be slightly more acidic (pH 6.1 to 6.5) with organic matter less variable (11.5 to 12 %). Riverine soils were of sandy loam.

Samples taken from surrounding woodland gave pHs from 6.4 to 6.6 with combustable organic matter ranging from 8 to 12.5 %.

Means of these two parameters at each site sampled are given in Table 4.5. Sites are shown in Figure 4.9 and vegetation described in section 4.3.5.

Table 4.5: Summary of soil analysis at each vegetation transect site.

4.3 Botany.

No complete botanical collection has yet been carried out in the Genda Genda forests, although Hawthorne mentions the work of Tanner, who collected a few specimens there, as well as Procter (Hawthorne, 1984).

Hawthorne and Mwasumbi identified 80 plant species during their visit in 1982. These are predominantly tree species, and are listed in Appendix 3.

A botanical collection was also made during the course of the expedition by Peter Lovett, Frank Mbago, Haji Suleiman and Herbert Leroy, all of the University of Dar es Salaam Herbarium. This collection was seperate to that of the expeditions.

4.3.1 Herbarium Collection.

285 fertile plant specimens were collected (numbers 2375 to 2660). An African or Usambara violet was found, and all specimens are awaiting identification by Kew Gardens, U.K. The violet was found in large numbers on what appeared to be volcanic rocks at between 130 and 200 m altitude. Only 4 lowland Saintpaula species are known and all are extremely threatened by destruction of their habitat.

4.3.2 Further Species Collection.

383 sterile specimens were collected whilst constructing tree profile diagrams and vegetation plots (numbers Genda 1 to Genda 383). These specimens are awaiting identification by Kew Gardens, U.K.

4.3.3 Ethnobotanical Survey.

Both the sterile and fertile specimens collected were taken to a local herbalist in Genda Genda who would then identify them by their name in the Kisiqua language. The medicinal or other uses of the plants were described, along with methods of preparing the plant for use.

A list of medicinal and other useful plants is included in Appendix ?.

4.3.4 Bryophyte and Lichen Collection.

27 bryophyte and 4 lichen specimens were taken from a variety of microhabitats and are awaiting identification.

4.3.5 Tree Profile Diagrams.

(Phil)

Figure 4.9: Locations on ? Plot and Forest Transects.

Figure 4.10 Transect A.

Figure 4.11 Transect B.

Figure 4.12 Transect C.

Figure 4.13 Transect D.

Figure 4.14 Transect E.

Figure 4.15 Transect F.

Figure 4.16 Transect G.

Figure 4.17 Transect H.

Figure 4.18 Transect I.

Figure 4.19 Transect J.

Figure 4.20 Transect K.

4.3.6 Vegetation Plot.

A 50*50m plot was constructed on Genda Genda Hill, in the dominant Combretum-Sterculia forest type in order to quantitively compare this with other coastal forest vegetation communities (plots had alresdy been constructed in 3 other coastal forests by Frontier Expeditions.

The plot is permanently marked with yellow posts at each point on the grid and the trees marked with aluminium tags. Specimens of trees, shrubs and herbs within the plot were collected and are awaiting identification. Trees which were not fertile at the time or were too tall for samples to be taken were not collected and await future identification.

A comparative analysis of plot data gathered at different coastal forests will appear in a future publication.

Table 4.6 : Summary of Vegetation Plot Data, Genda Genda South Forest Reserve (Means with standard errors)

Horizontal Density: (N=12)	Half-Sighting Distance (m) at Height	0.2m	1.5m	2.1m
	mean:	7.43	9.47	8.05
	S.E.:	+/-0.5	+/-1.1	+/-1.2
Vertical Density: (N=36)		Canopy Density (% cover)	Shrub Density (% cover)	Herb Density (% cover)
	mean:	50.8	21.9	10.7
	S.E.:	+/-3.0	+/-3.7	+/-2.1
Vegtation Heights: (N=36)		Canopy (m)	Shrubs (m)	Herbs (m)
	mean:	13.3	2.87	0.56
	S.E.:	+/-0.9	+/-0.6	+/-0.04
Tree Measurements: (N=114)		DBH	Canopy Height	Bole Height
	mean:	25.8	9.9	5.8
	S.E.	+/-1.1	+/-0.4	+/0.5

Location of the plot and Transects are shown in Figure 4.9.

4.3.7. Gap Study

A plot was used to describe the tridimensional structure of a gap left by a natural treefall, in the hope of finding any species specialising in gap colonisation. No particular specialist was found, instead the shrub layer was found to be made up of a diverse range of mostly canopy species. Nevertheless, some interesting information was gathered on the distribution of species in the lower strata of a gap.

A draft paper appears in appendix 14.

4.4 Vertebrates

No vertebrate collections or observations had been made prior to the TZ09 and TZ10 expeditions. A profusion of game exists in the savannah and woodland areas around the forest, but little enters the forest itself.

4.4.1 Mist-Netting: Birds

Due to lack of time, little bird-netting was carried out in the Genda Genda Forests. Extensive observations, did, however, yield a good list of the avifauna present in the forest and surrounding area.

Included in this list are three red data book species, namely the Southern Banded Snake-Eagle Circaetus fasciolatus, the Uluguru Violet-Backed Sunbird Anthreptes neglectus and the Plain-Backed Sunbird Anthreptes reichenous.

Also, two species were noted that were previosly thought to be confined to montane habitats during the summer months; the Berred Long Tailed Cuckoo, Cercococcyx montanus and the Mountain Wagtail Motacilla clara.

For a full species list, see Appendix 6.

4.4.2 Mist-Netting : Bats

A total of 4146 net-metre-hours of bat-netting were carrried out in various locations in the Genda Genda Forests. Nets were placed in a variety of habitats, including disturbed forest, undisturbed forest and over water. Bats of at least 14 species were caught.

Notable catches included a likely specimen of Myonicteris relicta, netted in riverine forest; if confirmed this will constitute the sixth site for this rare species, and the fith in Tanzania.

Two bat roosts were discovered; in a cave on the ridge betwen the two Genda Genda peaks (Altitude 360m) from which it proved possible to take specimens; also from a tree 1km to the northwest of Genda Genda Hills. 3 specimens of Nycteris grandis were taken from this. The cave species was identified by sight to be Nycteris macrotis.

In addition four Kerivoula sp were caught by hand in forest-thicket to the west of the hills, animportant find as they are rarely netted.

A full account of the bat netting, including a preliminary specis list, is contained in Appendix 7. Collecting sites are shown as well.

4.4.3 SMALL MAMMAL TRAPPING.

Small mammal trapping was carried out in several habitats, including the ridgetop (350m), riverine forests (approx 200m) and wooded grassland outside the forest.Three captures were made in 699 trap nights, large and small break-back traps were used mostly, but 7 live traps were set for 6 continuous nights with no success. A variety of baits were used, namely, petfood, peanuts, jam, plantain, maize, beans, banana and mango.

The three captures were of different species:-

TABLE: SMALL MAMMAL TRAPPING CAPTURES.

SPECIES 4.7	LOCATION	BAIT	TIME
THAMNORYS DOLICHORUS	Thick forest 200m	Petfood/nuts	Dawn.
CRICETOMYS EMINI	Slope 350m	Petfood/nuts	Dawn.
GRAPHIURUS MURINUS	2M above ground in tree.	Petfood/nuts	Dusk.

Mammal trapping sites are shown in figure 4.21.

4.4.4 PITFALL TRAPPING.

Vertebrate catches in the pitfall traps (sections 4.5.1, 4.5.2) consisted of a Shrew (Crocidura sp) caught on the south peak, two Thread snakes (Leptotyphlops sp) caught on the lower slopes of the main forest, and 18 leaf litter frogs (Arthroleptus sp). As would be expected, more Arthroleptis sp were caught in the moister riverine forest than from any of the other six sites sampled in the dry forest.

Two larger pitfall arrays, using 15 litre containers, were set up but were unsuccessful in catching vertebrates.

Pitfall trap sites are shown in figure 4.2.2

4.4.5 OTHER CAPTURES AND OBSERVATIONS

Stomach contents, ectoparasites and endoparasites were taken from all captures. Results will be discussed in a future report.

(i) Reptiles and amphibians

Reptiles and amphibians were observed wherever seen and caught (by hand or using a grabstick for snakes) whenever possible.

Eight species of snake were caught (9 specimens) including a Boomslang, Dispholidus typus, that was brought in by locals. A further two species were identified from observations, one of them being the seldom seen African Rock Python, Python sebae, that was observed in the dry Msilwa River in the south of the forest. Water snakes were seen in the Mkongore River to the north.

Eight species of lizard were included in 52 captures. The Nile Monitor, Varanus nicoticus, was observed on 7 occasions. Captures included an unidentified Lygodactylus species and possible specimens cf Lygodactylus howelli and Leptosiaphos rhomboidalis. If confirmed, these captures will increase the known range of these

species.

Other reptiles included a Kenya Pigmy Chameleon, Rhampholeon kerstenii kerstenii, and two Terrapins, Pelusios spp seen in the Mkongore River. Two Hinged Tortoises, Kinixys belliana, were found. One was captured but subsequently escaped from camp.

At least 14 species of frog were included in 65 specimens (4 unidentified). Tree frogs were only found in Riverine Forest, probably due to the damper conditions. Xenopus spp were caught in the still pools of a seasonal river. A specimen of Caecelian was also collected.

(ii) OTHERS

During our stay a Pangolin, Manis temmincki, was snared by locals in the woodland surrounding Gendagenda and was brought into camp.

A Marsh Cane Rat, Thrynomys swinderianus, was also captured by locals and was taken as a specimen (KMH 6505).

Elephant Shrews of at least two species were observed in the forest. These were: Rhynochocyon petersi, (Giant black and rufous Elephant Shrew) and Petrodromus tetradactylus (Four-Toed Elephant Shrew). A Red Bellied Bush Squirrel, Paraxerus palliatus, was also seen.

Four species of primate were identified in the forest: the Yellow Baboon, Papio cynocephalus, Sykes' Blue Monkey, Cercopithecus albogularis, The Angolan Black and White Colobus, Colobus angolensis palliatus and the Vervet Monkey, Cercopithecus pygerethrus. Vervets were usually seen in woodland but were found to enter the forest on occasion.

A Porcupine, Hystrix sp was seen, and quills found at the foot of outcrops and in cave entances. Large (2 cm diameter) balls of dung were found in these locations containing large millipede exoskeletons.

Red Duiker, Cephalophus natalensis, were seen on several occasions in the forest. Possible other Cephalophus spp were seen but full identifiations were not made.

A possible sighting of a Giant Forest Hog, Hylochoerus meinertzhageni, was made at a pool in the Msilwa River in the south of the forest, though this may just have been an unusually large and dark form of Bush Pig, Potamochoerus porcus.

Evidence of **Buffalo was found in the western forest margins. It seemed that they entered the forest to drink but largely inhabited woodland areas further afield.**

4.4.6 COLOBUS ANGOLENSIS : BEHAVIOUR STUDY

An indigenous troupe of Angolan Colobus, Colobus angolensis palliatus, was observed in detail during the study period. Faeces and leaf litter samples were taken from their territory to determine precise feeding habits. In addition feeding trees were

identified to species level. Diet was found to change from wet to dry season; Diurnal behavioural patterns also varied according to season. It was found that the troupe were generalist as opposed to specialist feeders.

A full report of this study is in preparation, a preliminary draft appears in Appendix 8.

4.4.7 HERPTILES OF GENDAGENDA.

DNA samples from all reptile and amphibian specimens were taken for future analysis. Biometric data for captures was compiled, and distribution maps of different species in the forest were prepared.

The precise distribution of HEMIDACTYLUS spp geckos was analysed in an attempt to find general trends in habitat references.

Full results of this work are given in appendix 9.

4.5 INVERTEBRATES

4.5.1 GENERAL COLLECTION

No invertebrate collection had been undertaken in the Gendagenda forests prior to the expeditions.

Collecting was done according to the methods described in Dickson and Burgess (1991a) and the following time spent for each method:-

TABLE 4.8 : METHODS AND SAMPLING EFFORT
(INVERTEBRATE COLLECTION)

METHOD	TRAP/MAN DAYS	SITES
PITFALL TRAPPING	208	8
MALAISE TRAPPING	208	7
U.V. LIGHT TRAPPING	114.5	7
BEATING, SWEEPING	3	3
BUTTERFLY NETTING	20	THROUGHOUT
BUTTERFLY TRAPPING	112	3
OPPERTUNISTIC CAPTURE	CONTINUOUS	THROUGHOUT

Butterflies and moths were abundant in the forest, particularly along the dry watercourses of the Gendagenda hills. A butterfly species list is included in Appendix I.

Diplopoda spp were collected extensively as part of the quantitative distribution study (Section 4.5.3).

Odonata spp were also abundant along watercourses and a good collection was made.

General collection concentrated largely on ground dwelling invertebrates, although some canopy flying insects were collected as part of a semi-quantitative comparison with ground flying insects (Section 4.5.2). Further collection of canopy invertebrates (perhaps by fogging) would probably encounter groups underrepresentd in this collection.

All specimens collected are with the relevant taxonomists and identifications are pending.

Sites used for light trapping are given in figure 4.22, and sites for Malaise trapping are shown in figure 4.22.

4.5.2 SEMI-QUANTITATIVE COMMUNITY STUDIES

(i) COMPARISON OF GROUND AND CANOPY-FLYING INSECTS

A semi-quantitative comparison of flying insects present at ground and canopy levels was made using Malaise traps st at ground and 15m at the same location. Thse were collected daily and the catch sorted to group level. Results showed that significantly more individuals were caught at ground level (over the whole period) and that there was a difference in the groups comprising the catch at each level. Orthoptera andymenoptera were significantly more abundant at ground level. Homoptera spp were found to be rather more abundant in canopy. Comparisons of the climatic conditions and the cath on each day revealed no discernable trends.

A draft paper appears in Appendix 11.

(ii) COMPARISON OF GROUND INVERTEBRATE PITFALL CATCHES BETWEEN SITES AND BETWEEN SEASONS.

Pitfall traps carried out in exactly the same locations at different times (August and November) allowed comparisons of catches obtained during dry and wet seasons. The gross number of specimens caught in the wet season was found to be much higher than in the dry season (34 individuals/day as opposed to 8 individuals/day). Proportions of Isopoda in the catch were significantly higher in the dry season. Conversely, the proportion of Hymenoptera caught in the wet season was higher in the dry season. Generally, there was a greater variation in the wet season catches, with more orders represented.

It was found that comparisons between ridge, foot of the hill, and riverine sites were not possible as a control array 10m from one of the test arrays revealed a high level of intrasite variation, suggesting that microhabitat is as important as macrohabitat in determining catch content.

A report appears in Appendix 10.

4.5.3 QUANTITATIVE COMMUNITY STUDIES

(a) LEAF LITTER INVERTEBRATES

A comparison was made between the leaf litter fauna of two forest types : moist riverine forest and dry ridgetop forest. It was observed that a significantly larger number of individuals were found in the riverine site (average 454 per sample compared to 205 for the ridgetop). Moisture levels at this site were over 5 times those of the ridgetop.

At both sites, mites were the most abundant, followed by springtails. Similar biovolumes of Coleoptera (15%) and Orthoptera (10%) were observed between the two sites. Larger proportions of Hymenopters, Isopods and spiders were found on the ridgetop in comparison with the riverine samples. Diptera larvae and mite biovolumes were larger in the riverine samples.

A draft paper appears in Appendix 12.

(b) DIPLOPODA DISTRIBUTION STUDY

Quantities of Diplopoda species and numbers were compared between and within sample plots on the ridgetop and at the foot of the hill. More individuals and a greater range of species were found on the ridgetop, suggesting that climate and/or habitat preferences influence Diplopoda distribution within the forest.

A draft paper appears in Appendix 13.

In addition to this study, a millipede key was compiled which will facilitate future field identifications.

4.6 SUMMARY

This report details the preliminary findings of the first extensive biological investigation of the forests of the north and south Gendagenda reserves. The forests appear to contain areas that have remained almost completely untouched, retaining the high even canopy and high diversity of species characteristic of primary dry coastal forest. A range of quite discrete floral have been found to occupy different areas of the forest, setting them apart soewhat from other more uniform forests in the same bracket.

The forests play host to four species of primate, some rare and unusual bat and reptile species and at least three globally endangered birds. Rare lowland African violets have been found in their moist river valleys. The international importance of these forests is thus already clear - and should become even clearer as the work outlined here is consolidated.

The role played by the forests in maintaining an extensive catchment area is recognised and preparations are underway for a border plantation aimed at protecting the areas within the reserves. There is a need to ensure that this measure is effective in halting the various forms of anthropogenic disturbnce that have in the past reduced the forests extent and disrupted its natural structure.

The variation in vegetation types in the forest lends itself to comparitive floral and faunal studies. Some shorter term projects have been described here but there is great scope for further more ambitious studies to be under taken in future.

The forests have excellent potential educational value and this should be exploited to the full if we are to bring their importance to the public's attention.

5.0 MSUBUGWE FOREST RESERVE - PROJECT REPORTS

General aims and methods of projects are described elsewhere (Dickinson and Burges 1991a). Detailed descriptions of field methodologies are given in Dickinson and **urgess (1991b). Raw data is available from the frontier office.**

5.1 SURVEY

The forest lies at 38 degrees 46'E and 5 degrees 31'S. It was surveyed during a two day visit by 3 members of expedition TZ09 on ******DATE?******* and during a three day visit by 5 members of expedition TZ10 between 22nd and 24th November. See figure 2.1 for the forests position.

5.1.1 HABITAT AND VEGETATION DESCRIPTION

Hawthorne (1984) describes the vegetation of Msubugwe as being "Cynometra - Manilkara dry evergreen forest". The forest is located on a small rise in the coastal plain and numerous seasonal streams drain off it into the Pangani river basin.

The forest is located at approximately 130m altitude and must recieve a similar rainfall to that of the Mkwata weather station (see Appendix 4). During a 24 hour climate study conducted between 23rd and 24th November the average temperature was found to be 26 degrees C with a variation of+/- 5 degrees C. This is comparable to the monthly averages measured at Mkawa (see Appendix 4).

Soil in the forest is red with a high sand content.

5.1.2 EXTENT AND STATUS

The 1:50 000 Ordinance Survey maps give the extent of the forest to be about 15km . The forest has been very heavily logged (logging trails form a dense labyrinth through the forest) although areas of

which were completely undisturbed, though many small areas are neglected by logging presumable as they contain commercially unviable trees.

Msubugwe is a districy controlled forest reserve, though little at present is being done to check the level of logging, pit sawing or pole cutting carried out in the forest.

5.1.3 HUMAN INFLUENCES

Msubugwe is about 10km from the nearest human settlement and therefore little visited except by hunters who often camp by a small pond 1km to the east of the eastern edge of yje forest.

Logging is still continuing on a large scale, preferred trees being Brachylaena huillensis, Bombax rhodognaphalon and Pterocarpus angolensis (Faldborg et al, 1990). Our survey found damage caused by pole cutting and pit sawing, as well as extensive disruption to the forest caused by the felling and removal of timber trees. In many areas this had lead to large gaps in which heliophilous woodland species were proliferating.

5.2 PHYSICAL ENVIRONMENT

Temperature and humidity at 1 and 12 metres and soil temperature at 10 and 30cm were measured hourly over a 24 hour period between 23rd and 24th November. Results are summarised in Figure 5.1. Maximum air temperature at 1m, 31.5 degrees C, was recorded at 13..hrs and 15.00hrs. The minimum, 23 degrees C, was recorded between 22.00hrs and 04.00hrs, and again at 06.00hrs. Maximum canopy temperature, 31.5 degrees , was recorded at 14.30hrs, and minimum, 23 degrees C, was recorded at 22.30 - 23.30hrs, 01.30 - 02.30hrs, and 04.30 - 06.30hrs.

Humidity, both on the ground and in the canopy, remained a fairly constant 91-92%. Between 19.30hrs and 11.30hrs, but dropped sharply after midday to a minimum of 65% at 1m (16.00hrs) and 54% at 12m (15.30hrs).

Soil temperature at 10cm averaged 27 degrees centigrade with a variation of +/- at 30cm. Temperature also averaged 27 degrees centigrade with a variation of +/- 2 degrees centigrade.

5.3 BOTANY

A 60m long permanently marked transect of 5m width was constructed in a relatively undisturbed area of forest with a canopy cover of around 60%. The tree profile diagram is shown in figure 5.2. Several poles had been removed from the transect and in one place a gap created by a logged tree nearby.

Specimens of tree and shrub species in the transect were taken and await identification; results will appear in a future report.

5.4 VERTIBRATES

5.4.1 MIST-NETTING:BATS

A total of 15.5 net-metre hours was carried out between 22nd and 24th November. Three bats of two species were caught. For a discussion of results, see appendix 7.

5.4.2 OTHER OBSERVATIONS

A group of five Green Wood Hoopoes Phoeniculus purpureus were observed in the forest; the trumpeter hornbill, Bycanistes bucinator was seen and heard several times.

Tracks of Sable antelope and genet were seen on the road through the forest. Possible leopard spoor was also found.

A civet Viverra civetta and a group of Buffalo Synchrus caffer were seen just outside the forest; Buffalo spoor was also found on the forest road.

Faldberg et al (1991) report of the presence of elephant in the forest; no evidence of them was found during our visits.

Figure 5.1 24hr Climate Study - Msubugwe Forest

Figure 5.2 Msubugwe - Forest vegetation profile

5.5 INVERTEBRATES

5.5.1 GENERAL COLLECTION

Invertebrate collections, mainly of ground species, were made during each visit and are awaiting identification.

5.5.2 LIGHT TRAPPING

U.V. light traps were run for approximately 10hrs on each visit. The first session collected exclusively Microlepidoptera. The second, due to the wetter weather, collected a greater variety including several large Sphingidae and some Saturnidae (chiefly Pseudobunaea Spp). Specimens await full identification.

5.6 SUMMARY

Msubugwe is badly disturbed; according to one district forestry official it may be beyond redemption in 5 to 10 years (Faldberg et al, 1991). The practices of logging, pit sawing and polecutting need to be halted immediatly to allow the forest a chance to regenerate. Degradation of forest borders is also making the forest more susceptable to fire damage; another factor that would need to be controlled to prevent loss of habitat.

The Forest's relative isolation means it still harbours an abundance of animal life. What botanical work has already been done there has already identified some uncommon species (Hawthorne, 1984). Given the Forest's threatened status a full zoological and biological inventory is clearly an urgent priority.

6. MKURAJA FORESTS PROJECT REPORT

The forest types situated inland from Mkuraja were discovered and partly surveyed during a previous expedition, (Cockle and Dickinson, 1991).

Five R.As and a science coordinator went this time on a two-day expedition (18th-20th November, 1991) from Genda-Genda into the most northern and central parts of the Ranch. Two additional forest bodies were thus able to be surveyed: a hilltop dry forest west of the Ranch's headquarters (Koroti forest, 38°45'E, 5°43'), and a riverine forest situated immediately south of the Ranch's headquarters (38°47'E, 5°44'S).

Maps used were Ordnance Survey topographical maps, 1:50,000, 149/1 ("Genda Genda") and 149/2 ("Sakura"), series Y 742.

6.1 SURVEY

Hilltop forests were searched for with binoculars from a vehicle, then reached and explored by foot. Attempts were made to localize on the ground forests noted during the aerial survey made in September 1991 (Cockle & Dickinson,1991) and thought to lie around 38°44'E, 5°40'S, but these were not reached. Another one, localized from the road, was successfully reached by foot and examined.

The riverine forest had already been located (G.Fox, pers. comm.) during the previous expedition, but no collections had been made on the site.

6.1.1 EXTENT AND STATUS

The dry hilltop forest was found to be extremely small, covering an area of approximately 0.25Km square. This is still within the size range of the similar forests surveyed previously (0.25 - 1Km square). Typically, it caps the flat summit of a small hill, at about 70m in altitude. Its situation, 13Km from the sea, is further than the ones studied previously (7Km), but other small forests of similar type have been sighted almost 60Km inland, north of Mkata.

The riverine forest was discovered to rapidly merge into a very low canopy thicket, leaving only about 0.5Km square of structured forest with a minimum of 20% 15-20m canopy cover.

The status of both forests located on the Ranch has been discussed in another report (Cockle & Dickinson 1991).

6.1.2 VEGETATION

The vegetation of the dry hilltop forest surveyed this time was found to be very similar to, although less developped than the other hilltop forests surveyed previously. Specific diversity was found to be quite inferior than the very similar Buyuni forest studied further south, and neither the Cycad Encephalartos hildebrandti nor epiphytic orchids were sighted. Dominant trees however are characteristic, forming a semi-evergreen 70% 12m very regular canopy layer, comprising four species, one being widely more numerous than the others. Also characteristic is the sparse understorey vegetation, a fair amount of which is formed by canopy tree species saplings indicating sound regeneration.

A 60m permanently marked vegetation profile transect was established and specimens of each species therein collected (identifications are pending), see figure 6.1 for profile diagram.

Figure 6.1 Mkuraja dry hilltop forest - vegetation profile

The forest is surrounded by very dense low dry thickets of the slopes of the hill, merging 10-100m below into patchy scrub woodland. The transition from thicket to forest is extremely sharp and occurs right on the edge of the 'plateau'. In some places however, breaks in the forest canopy caused by tree falls have been partly colonized by scrub species. This secondary vegetation remains far less dense than the slope's thickets and may only be transitory.

The riverine vegetation of the surveyed forest showed an evergreen high 25m full canopy only at the head of the valley. It then degraded rapidly into a 5m canopy thickety forest, even along the riverbed.

Specimens of flowering plants were collected.

6.1.3 HUMAN INFLUENCES

The hilltop forest showed absolutely no signs of human disturbance, and not even footpaths were found across it or leading to it through the thickets. However, a Tsetse fly trap has been installed at mid slope, between the lower strands of thickets and about 30m from the forest itself.

The riverine forest by contrast showed evidence of being heavily logged and poled, especially further downstream and on the upper banks. This seems in direct correlation with the proximity of an inhabited area, the Ranch's headquarters, and the easy access from there to the forest. A snare was also found on one of the banks, probably for Duiker, Suni or Elephant Shrew.

6.2 INVERTEBRATE COLLECTION

Collection was udertaken in both forests, using nets, pooters, tweezers, etc...

Moreover, a UV light trap was set up and kept running all night in the riverine forest, permitting the capture of a quantity of micromoths, moths, and various other Anthropods attracted to the trap.

The specimens collected will be sent to their respective taxonomists for identification.

The following approximate man-hours were spent collecting:

Hilltop forest	10
Riverine forest	51

6.3 VERTIBRATE COLLECTION

Two lizards (a gecko, Hemidactylus mabuya and an unidentified Skink) were collected in the dry forest. An antelope's skull (probably Bushbuck, awaiting confirmation) was found, as well as Buffalo remains. Elephant Shrew droppings were common as well as elephant traces (abundant faeces averaging one every 30m, and numerous saplings freshly broken at 2m). Important diggings were found at the edge of the forest, maybe made by Aardvark.

The riverine forest yielded sightings of the Giant Elephant Shrew (Rhynchocyon petersi), Syke's Monkey (Cercopithecus albogularis), Tanzanian Black Colobus (Colobus angolensis ssp palliatus). The Snouted Night Adder (Causus defilippi) and the Tree Frog (Hyperolius argus), were collected from the same forest. Bat-netting (48 net-hours) only yielded one animal, Wahlberg's Epauleted Bat (Epamophorus wahlbergi), a common frugivorous species in the area.

Of these, Hyperolius argus is a new record for Mkwaja Ranch.

7.0 KAMA ESTUARY MANGROVE FOREST - PROJECT REPORTS.

General aims and methods of projects are described elsewhere (Dickinson and Burgess 1991a). Detailed descriptions of field methodologies are given in Dickinson and Burgess (1991b). Raw data

is available from the Frontier office.

7.1 SURVEY

The map used was the 1987 1:50,000 ordinance survey map, series Y742, sheet 149/4. An enlargement of the Kama Mangrove Forest taken from this map is shown in figure 7.1. The forest is situated at 38degrees 48'E and 5 degrees 53'S. For the position of the studied site in Tanzania see figure 4.1.

The forest was surveyed by foot over a three week period by six members of the expedition. Additional information for the project was provided by a socio-economic survey conducted in Buyoni Kitoponi village on the 9th November.

7.1.1 HABITAT AND VEGETATION DESCRIPTION

Estuarine Mangrove forest stretches around the mouth of the Kama river and various subsiduary channels opening out into the Zanzibar channel. The estury is protected by a sandbar projecting some 200m out to sea on the northern side, and by a further large sandbank some 1km offshore running north to south. The forest is inundated during high spring tides in the dry season and permanently flooded during and after the long rains (May to July). The Kama river is highly seasonal with a source only 2.5 km inland.

Soil in the forest varies from almost pure sand to the sulphorous-smelling fine black mud characteristic of the mangrove swamp, with pH values ranging 6.49 to 8.71, possibly correlated with proximity to tidal channels, though this is bound to fluctuate according to tide level and extent of salt water inflow. Tidal range of spring tides at the estuary mouth was found to be approximately 4.

Average annual rainfall on Mkwaja Ranch (10km to the south-east) is 1000mm. Temperatures at the same site are highest during March (maximum 32.2 C, minimum 28 C) and lowest in July and August (maximum 28 C and minimum 20.5 C) A 24hr climate study on 10/11 November gave a maximum of 31 C and a minimum of 24 C at 1m in the seaward fringe of the forest (figure 7.2).

Vegetation is dominated by the Rhizophoraceae Cercops tagal and Rizophora mucronata with at least four other common mangrove species present.Maximum canopy height is 12-15m though the majority of the trees are around 4m. The tallest trees tend to fringe the tidal channels. An estimate of the density using information gathered for vegetation ------ gives a figure in the region of 2,300 to 3,400 trees/Ha (trees over 2m). A bare mudflat some 400m wide seperates the landward edge of the forest from the terrestrial scrub beyond.

Nearest population centres are Mkwaja (population approximately 2,000) 12km to the north and and Buyum Kitopeni (population approximately 300) 10km to the south.

7.1.2 EXTENT AND STATUS.

The Kama estuarine forest covers an area of approximately 170Ha (ordinance survey map). It thus represents only a small fraction of the mangrove forests of Tanga region(10,700Ha in total).

All areas of mangrove forest in Tanzania have been designated forest reserves and unlisenced wood removal and other exploitation is prohibited. Lack of resources, however, means that the legislation is rarely enforced.

Evidence of extensive disturbance by pole removal was found in the Kama forest, particularly on the landward side of the forest, where removal of Ceriops tacal approached 50% in some areas.

7.1.3 HUMAN INFLUENCES

Potential threats to the Kama mangroves are posed by (i) pole cutting for building and firewood and (ii) salt production.

(i) Pole Cutting

Ceriops tacal and to a lesser extent Rizophora micronata are cut for building poles. Bruguiera gymnorrhiza and Scnneratia alba are cut only for firewood. Xylocarpus granatum is used to make furniture. Auicenna marina is cut for firewood and is also used in boat building.

According to sources at Boyoni Kitopeni no poles from the Kama forest are exported; trees are cut exclusively for local use. This claim was not wholly supported by our survey, which found more recent cutting than would be needed to supply the building needs of one village.

(ii) Salt Production

Six permanent and many temporary solar evaporation pans are operating in the mudflats just behind the forest. Mangrove areas are favoured by salt workers due to the high salinity of the water (IUCN/RNRO report). Salt production only occurs in the dry season as the mudflats are permanently flooded in the long rains.

Salt production by solar evaporation does not at present pose a great threat to the forest as it is practised outside the forest border. Increases in land requirements (i.e. more pan operators) has however led to the cutting of peripheral Avicenna marina trees and bushes and may lead to further incursion in the future. Also the exsistence of a track leading from the main road to the forest may be enabling illegal pole removal on a scale that would not otherwise have been possible.

7.1.3 OTHER FACTORS

Mangrove forests are widely recognised for their importance to fish communities. The Kama estuary is no exception and provides a rich and varied catch for local fishermen. In addition commercial trawling for prawns is practised outside the estuary mouth (this was occuring during our visit). The estuary is also rich in edible crabs though it is thought that these are not exploited by locals.

A further estuarine mangrove forest exsists 4km to the south around the mouth of Mnyusi river, similar in extent to the Kama forest. This forest was not investigated by the expedition, but may show comparable disturbancegiven its proximity to the Buyuni

settlements.

7.2 BOTANY

Vegetation is dominated by the stils-rooted Rhizophora micronata growing to a maximum height of 6m, forming a dense monospecific ----- in many areas. Ceriops tagal is also common, particularly towards the landward side, again often forming an exclusive "zone " of vegetation. Landward and seaward fringes tend to be more mixed, including scattered trees of Bruguiera gymnorrhiza and Xylocarpus granatum. Avicenna marina bushes form a thin zone in most parts of the forest bordering the mudflats, and grows to trees of 10m in areas opening out onto the sea. Sonneratia alba was found to be a rare constituent of the forest, unlike other locations where it frequently predominates (Semesi 1986). Most of the tidal channels are bordered by Rhizophora micronata, their complex roots protecting them from tidal erosion. Typically for mangrove forests no understory was present, though several ares of Ceriops tacal regeneration were found (see vegetation profile 2) with seedlings of approximately 80cm growing thickly beneath dead trees.

7.2.1 TREE PROFILE DIAGRAMS

Three five metre wide vegetation transectss were constructed to illustrate vegetation changes from mudflat through to channel or from seaward border inland. Transects were of variable length and positions are shown in figure 7.1. Trees were easily identified using Lewis ( ) and Semesi (1986), and the results are shown below. Soil samples were taken at key points on the transects, results are displayed with the profile diagrams.

PROFILE 1: MUDFLAT SOUTH TO MAIN CHANNEL (FIGURE 7.3)

0-20m : Avicenna marina belt dominates mudflat border
30-45m : Rhizophora micronata zone.
45-55m : Bruguiera gymnorriza dominates on a short rise of drier , sandier soil type.
120-130m: Dense tall Rhozophora micronata at the channel edge.

Topsoil fairly neutral along this transect, becoming slightly acidic with proximity to channel.

FIGURE 7.3

PROFILE 1: VEGETATION CHANGE FROM MUDFLAT SOUTH MAIN ESTUARY CHANNEL

PROFILE 2: WESTERN BORDER (MUDFLATS) TO kAMA RIVER (figure 7.4)

0-40m :Ceriops tacal (except for thin band of Rhizophora at 13-20m). Dense seedling growth below live and dead parent tree. Dead trees not marked, though present throughout.
40-130m :Area of heavy pole cutting (to 33% of trees present). Very few seedlings.
140-165m :Reduction in cut trees and corresponding increase in seedling presence.
185-190m :Logged Xylocarpus granatum. Presumably removed via river. Damage to surrounding vegetation.

pH neutral becoming slightly more acidic towards river. Organic matter much lower in topsoil of poled area than in areas of good regeneration.

PROFILE 3: SEAWARD BORDER EASTWAARDS (figure 7.5)

0-40m, 55-90m :Mixed bushland with Rhizophora bands.

45-50m :Avicenna marina predominates on small ridge.

90-105m :Tall, dense Rhizophora micronata monospecific zone extending into forest.

More alkaline pHsnear beach and on ridge suggest a relationship with the drier more sandy soil typesfound there.

PROFILE 2: VEGETATION CHANGE FROM THE WESTERN BORDER (MUDFLATS) THROUGH TO KAMA RIVER