

FRONTIER

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1. Introduction

The coastal forests of Eastern African, in particular those found in Tanzania, are recognized as important hotspots for biodiversity (Myers et al., 2000). These regions are vital as they contain a vast majority of Africa's endemic species, with a considerable amount of these found in Tanzania and neighbouring Kenya and Mozambique (Mittermeier et al., 1998).

Tanzanian coastal forests are fragmented, small and surrounded by poor communities that heavily depend on these areas for land and forest resources. Burgess and Clarke (2000) argue that even though these coastal forests are of a significant cultural and traditional value for local communities, they are not being adequately managed by the relevant government authorities and international conservation institutions.

Forests in Tanzania cover approximately 42 million ha, about half the total land area of the country, with the other half occupied by rough grazing lands. The forested areas consist mostly of natural miombo woodlands, which are sparsely areas dominated by the genera *Brachystegia* and *Julbernedia* and populated with a variety of species (Makundi and Okiting Ati, 1995). The remaining forest area is composed of a small expanse of closed forests, mangrove forests and human-grown plantations. Given the notable levels of fragmentation in these forests, habitat loss is threatening endemic species making them more vulnerable to extinction. The main threats to habitats in this region are the expansion of agricultural land, timber extraction and charcoal production, while all of these factors are coupled with weak governmental management and community input (Iddi, 1997). Coastal forests of Tanzania are distributed over six regions of the Tanzania mainland covering 17 districts, as well as Unguja and Pemba in Zanzibar. These coastal forests cover a total of 333,412 ha of which 263,932 ha are Central Government Forest Reserves (79.2%) and 66,950 ha (20.0%) are under public land. In addition 2,530 ha (0.8%) are under Game Reserves/National Parks (Kaale, 2004).

Ngusaru and his colleagues (2001) argue how degradation is occurring in both government Forest Reserves and in forests located on public land. Furthermore, there has been observable decline over the past two decades in the government's ability to police Forest Reserves, chiefly those located on mainland Tanzania. This is due to a reduction in manpower and funding, which is causing a severe decline in coastal forests.

2. Area Overview

The Frontier Tanzania Forest Research Programme (TZF) is located on Mafia Island, off the coast of mainland Tanzania, East Africa (Figure 1). Mafia Island is part of the Tanzanian Spice Islands, together with Unguja and Pemba. It is the largest of a group of about 15 small sandstone and coral rag islands in the Indian Ocean, with a total surface area of 394 km², measuring approximately 50km in length by 15km across at its widest point. Large parts of the island and surrounding sea are part of the Mafia Island Marine Park (MIMP), which covers an area of 822 km² (Goossens et al., 2006). Several of these islands are inhabited, with a total estimated population of around 41,000 as of 2002 (Caplan, 2011). Individuals living on this archipelago are mostly smallholder farmers involved in mixed farming and fishing. The main agricultural practices are coconuts and cassava, rice, pigeon pea, pineapples, cashew and mango trees (Goossens et al., 2006). As one of the six districts of the Pwani Region, Mafia Island is governed from the mainland, not from the semi-autonomous region of Zanzibar, of which it has never been considered a part (Chami, 1999). As with other coastal forests in Tanzania, Mafia Island's forests and rich biodiversity are threatened by an increased pressure on these resources due to the same lack of government resource management, increased poverty and limitations on financial and human resources for conservation (Chami, 1999). Habitat destruction is one of the main drivers of species extinction worldwide, and recent reports have recognized the need for greater effort in studying the threatened biodiversity of tropical hotspots (Mittermeier et al., 1998). This is especially important considering that coastal Tanzanian forests support an estimated 75 endemic plant species and 6.1 endemic vertebrate species per 100 km² of forest area (Myers et al., 2000).



Figure 1 - Map showing the location of Mafia Island

2.1. Mafia Island coastal forests

There are records from the 1930s of extensive coastal forest on Mafia Island, but the last of this was destroyed in the late 1980s in order to make room for coconut plantations (Greenway et al., 1988). By the early 1990s some small patches of coastal forest thicket had become established along a 40 km by 1 km strip of coral rag along the eastern side of the island. Burgess and his colleagues (1992) reported the occurrence of previously undescribed species and genera of butterflies, toads and millipedes in these forests at the time of their study, but there is currently no further information about whether these species have been systematically identified.

The thicket described in these publications has persisted as one main forest (Mrora) on the southeast side of the island. This area is characterised by localized areas of brush such as the Mkamba thicket on the western side of the island, while remaining vegetation consists of swamps and mangrove forest, many small forest/thicket pockets and coconut plantations (IAEA, 1999 in Goossens et al., 2006).

Natural vegetation on Mafia ranges from tidal mangrove thickets and scrubby coastal moorlands to palm-wooded grassland and lowland rainforest. Also noticeable are baobab trees and native *Albizia* trees and shrubs (Swai et al., 2011). Patches of coastal forest remain in localities all over Mafia Island, but the largest of these is the Chunguruma Forest, which is notable for its dense tree canopy of palms, lianas and epiphytes, with a dense underbrush of ferns (Clarke, 2000). Coastal forests are also important habitats for several faunal species. Closed canopy coastal forests retain numerous endemic plant and animal species (Luoga, 2000). These forests are already known to support 43 avifaunal species, three species of mammal, 29 herpetofaunal species (24 reptiles and five amphibians) and numerous invertebrates including 86 described species of molluscs and 75 described species of insects (Clarke, 2000).

3. Overall aim

We are interested in gaining more information about the biodiversity supported by two areas of forest: Mlola and Juani. The main justification for this project stems from the previously discussed issues of coastal forest management, where an uncontrolled level of deforestation, overexploitation and degradation is currently reported. These activities lead to topsoil erosion, habitat loss and ultimately a deteriorating ecosystem, increasing the vulnerability of extinction for threatened species. We also aim to address issues relating to communities living on Mafia Island, as according to Burgess and Hipkiss (2002) public inclusion and assessment of people's activities in these forests needs to be accounted for in order to better understand how the forest affects people's values, practices and management actions.

Given the lack of research carried out in the area, and the known importance of these forests as ecosystems for endemic organisms (Burgess et al., 2000), this study would contribute to a quantitative database on the status of species in this habitat. The research to be undertaken in this project would complement work carried out by Swai and his colleagues (2011), who undertook a similar study to identify flora and fauna in the coastal Forests of Mafia Island. It is expected that these results would allow Frontier to prepare an appropriate management plan in order to inform better conservation strategies and involvement of local communities in their management. We would like to conduct further research on birds and arthropods, chosen as useful indicators of ecosystem health, and establish an ongoing monitoring program to detect patterns and trends in these groups. We would also like to compare plant species found at disturbed and undisturbed sites, as well as soil health assessments.

Since there is currently little knowledge about the forests in this region, it is hard to develop management recommendations for mitigating human disturbance. The forest acts as a barrier against storms that would otherwise damage villages, and this is currently used as the main justification for preserving forests in the area. However, investigating disturbed forest sites and comparing them to healthier, undisturbed areas of forest would also help justify further conservation efforts.

Another way to help conserve the forest, as well as bring in money to fuel the local economy, is by re-establishing a hippo eco-tourism project that formerly existed on the island. We hope that by working with the District Council and local communities, we can get this project started again.

4. Objectives

1. To construct a database of bird, animal and plant species found in these forests, with the possible inclusion of arthropods.
2. Provide volunteers with field experience in a variety of ecological survey techniques, to include some or all of the following: bird surveys, reptile and amphibian surveys, mammal surveys, bird mist netting, vegetation census, soil sampling
3. Provide volunteers with experience in communicating with local communities as well as governmental organisations.
4. Re-establish a hippo eco-tourism project
5. Develop a mangrove seed-reseed project
6. Establish environmental awareness activities in the community with local school children

5. Methodology

5.1. Training Programme

This programme will help volunteers gain the knowledge required to conduct research on field through lectures and presentations as well as train them on different surveying, sampling, preserving and handling techniques. These will include: using pitfall traps to collect amphibians and invertebrates within the forest ground, Sherman traps for small mammals, making transects to count and observe birds and bats, mist netting and bird handling, swamp/pond netting for amphibians and aquatic invertebrates and setting up plots/quadrats for vegetation surveys. Samples collected will be identified in field, or photographs were taken for unknown species to be identified later in camp using a key or other identification reference.

Practice bird surveys have been continued through the beach/mangrove area near camp with new volunteers and science staff. These surveys allowed volunteers to practice bird species identification skills and data recording methods. Various lectures were also given to the volunteers by both Shawn and Nika. Shawn gave lectures on birds, mammals, reptiles, and amphibians of Mafia Island, and an overview of the TZF project. Nika gave a lecture on an introduction to biodiversity.

Example program of training activities:

Focus	Morning	Afternoon
Herpetofauna	Check traps, set up new drift fences. Look into possibility of new sites (visiting lagoon)	Check traps, identify site for one further drift fence
Mammals	Check traps, identify site for potential Sherman traps	Check traps, deploy further 20 (locked) Sherman traps.
Birds/Mammals	Check traps, identify sites for bird point counts. Recon Chole island for possible lagoon sites. Set up mist nets.	Check traps, review literature on bats and birds , identify species
Birds/ Herpetofauna	Point counts at 2 sites, check traps. Pond netting at Chole if possible.	Check traps, active search for herps, identify species
Mammals	Check traps, set up new drift fences	Check traps, unlock Sherman traps.
Community surveys	Conduct socio-economic surveys with the locals in the village and market	Conduct socio-economic surveys with the locals in the village and market
All	Check traps, close traps for weekend.	Possible excursion to hippo lagoon

Volunteer training in bird surveying methods as well as mangrove surveying continued throughout the phase. This was done with the intention of developing the project to begin an ongoing biodiversity study in Mlola and Juani forests and re-plant mangroves in areas where they have been completely cleared).

5.2. Mangrove project

TZF has been working in collaboration with the TZM team in developing a seed-reseed mangrove project involving children within the local area.

As the project is still under development, and the science team are conducting preliminary surveys in healthy mangrove sites near camp. These consist of general vegetation surveys, recording of species richness, abundance, high, canopy cover and diameter at breast high (DBH). In the future we hope to identify areas that have been completely cleared of mangroves and need to be re-seeded, and then have schoolchildren come out with us to plant mangroves. Provided we successfully identify these areas, have the funding to reach these sites, and acquire seedlings, we will carry through with this work.

5.3. Hippo ecotourism project

The island of Mafia has a small population of hippopotamus (*Hippopotamus amphibious*). Very few scientific studies have been conducted on them and the population size cannot therefore be accurately estimated, however it is currently believed to be somewhere between 20 and 40 individuals.

It is believed that these hippos came to the area after a flood in the Rufiji Delta approximately 100 years ago, but there is little local knowledge about this species, especially in those places far from the lagoons they inhabit. In some areas, local people are not even aware that they exist on the island.



Figure 2 - Meeting with the village committees for the Hippo ecotourism project

The hippos inhabit an area in the north-west part of the island where a group of lagoons provide shelter and food, these lagoons are spread into four communities: Baleni, Gonge, Chunguruma and Marimbani. The lagoons in Chunguruma and Marimbani are visited regularly by the hippos while moving from lagoon to lagoon and by females that are raising calves. Two lagoons (numbered 6 and 8) appear to support the largest number of hippos and are used permanently by them, especially in the dry season since they have water all year round.

So far, a few meetings have been conducted with Gange villagers (Figure 2) to further discuss the hippo ecotourism project. These meetings went very well, as the village is in support of getting the project started and were very open in discussing problems that occurred last year. In our second meeting we intend to consult with the elected tourism board. Currently their remit involves building a long drop and benches for tourists, and a few others from the board will become tour guides.

5.4. Arthropods

Through this project we aim to determine any regional differences in biodiversity, taxonomic composition, and species abundance of arthropods in both disturbed and non-disturbed forest sites.

Connections have been made with Dr. Mbije at University of Dar es Salaam to help us identify arthropods down to species level as well as to do soil testing. Further specific soil tests such as percentage of organic matter and bulk density will be considered once the permanent sites and locations are decided.

5.5. Birds

Mafia Island Marine Park and the District Council are both keen to have research conducted to assess biodiversity and any associated loss in both disturbed and undisturbed forest sites, so that any adverse effects of anthropogenic activity can be mitigated by working with the local community. We plan to use birds as an indicator group, as this is not only a reliable indicator of ecosystem health, but is also a popular and enjoyable activity for volunteers. Ongoing monitoring of this group has great potential to become a long-term project with strong conservation applications. Work on this project will start once funding has been secured to access the different survey sites.

5.6. Bats: socio economic survey

General observations at the local market by Frontier staff showed that many products made of or extracted from plant species found in the local forest and nearby area are available for sale. The Seychelles Flying Fox is present in high numbers on Mafia Island, and is a known

seed disperser, likely to play a role in the dispersal of economically important plant species in the forests of Mafia Island. It is therefore relevant for management of these forests to understand local attitudes towards fruit bats, in order to develop an understanding of how this may impact their population size. Seychelles Flying Foxes are not currently threatened, and assessing attitudes towards this species may be helpful to understanding why this is case, and identify potential future impacts on the population.

A short study was developed with the aim of investigating the link between attitudes towards specific fruit bat species and improving the livelihoods of local communities, through pollination or seed dispersal of economically important plant species. A questionnaire was developed that aimed to assess the perception of fruit bats by members of communities in the local area, and any social and cultural values associated with them.

Responses to this questionnaire showed that overall there is a positive opinion of bats on the island. Science staff also conducted some informal activities to inform people taking part in the survey about the ecological role of the bats. There was generally a positive consensus from local villagers, so it is not envisaged that further education activities on this subject would be particularly beneficial.

6. Overall expected results

Collation of species lists throughout this phase forms the start of the quantitative database that is eventually planned for the TZF project (Appendix 1).

Based on previous work on Mafia Island and on information about similar sites in other locations, we expect that our ongoing monitoring activities are likely to find a high biodiversity of birds, arthropods and plants within the forested areas of the island. In areas of high human disturbance, we expect to see statistically significant differences in soil health relative to undisturbed areas. These findings will hopefully provide strong incentives for conservation of old growth coastal forest on Mafia Island.

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8. Appendix 1

Species inventory lists:

Mammals

Common name	Scientific name	Place of sighting	IUCN status
Black and Rufous Elephant Shrew/Zanj Elephant Shrew	<i>Rhynchocyon petersi</i>	Nature Walk	Vulnerable
Blue Monkey/Samango Monkey	<i>Cercopithecus mitis</i>	Nature Walk	Least Concern
Red Bush Squirrel/Red-Bellied Coast Squirrel	<i>Paraxerus palliatus</i>	Nature Walk	Least Concern
Seychelles Flying Fox	<i>Pteropus seychellensis comorensis</i>	Marine Park	Least Concern
Zanj Sun Squirrel	<i>Heliosciurus undulatus</i>	Nature Walk	Data Deficient

Reptiles

Common name	Scientific name	Place of sighting
African Striped Skink	<i>Trachylepis striata</i>	Camp
Dull-Green Day Gecko/Comoros Day Gecko	<i>Phelsuma dubia</i>	Camp
Flap-Necked Chameleon	<i>Chamaeleo dilepis</i>	Camp
Green Sea Turtle	<i>Chelonia mydas</i>	Juani Hatching
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	Dive
Nile Monitor	<i>Varanus niloticus</i>	Nature Walk
Peter's Eyelid Skink	<i>Lygosoma afrom</i>	Pitfall trap
Tree Gecko	<i>Hemidactylus platycephalus</i>	Nature Walk
Tree Skink	<i>Mabuya planifrons</i>	Pitfall trap
Yellow-Headed Dwarf Gecko	<i>Lygodactylus luteopicturatus</i>	Camp

Birds

Common name	Scientific name	Place/Survey area of sighting
African Green-Pigeon	<i>Treron calvus</i>	Nature Walk
African Jacana	<i>Actophilornis africanus</i>	Gonge lagoon
African Palm-Swift	<i>Cypsiurus parvus</i>	Nature Walk
African Paradise-Flycatcher	<i>Terpsiphone viridis</i>	Mafia Lodge
Black Heron	<i>Egretta ardesiaca</i>	Nature Walk
Black Kite	<i>Milvus migrans</i>	Camp
Black-Backed Puffback	<i>Dryoscopus cubla</i>	Nature Walk
Black-Bellied Glossy Starling	<i>Lamprotornis corruscus</i>	Mafia Lodge
Broad-Billed Roller	<i>Eurystomus glaucurus</i>	Point count
Bronze Munia/Bronze Mannikin	<i>Lonchura cucullata</i>	Nature Walk
Collared Sunbird	<i>Anthreptes collaris</i>	Nature Walk
Common Bulbul	<i>Pycnonotus barbatus</i>	Camp
Common Greenshank	<i>Tringa nebularia</i>	Nature Walk
Common Sandpiper	<i>Actitis hypoleucos</i>	Nature Walk
Common Scimitarbill	<i>Rhinopomastus cyanomelas</i>	Nature Walk
Common Squacco Heron	<i>Ardeola ralloides</i>	Nature Walk
Emerald-Spotted Wood-Dove	<i>Turtur chalcospilos</i>	Point count
Glossy Ibis	<i>Plegadis falcinellus</i>	Nature Walk
Hadada Ibis	<i>Bostrychia hagedash</i>	Nature Walk
House Crow	<i>Corvus splendens</i>	Camp
Lesser Striped Swallow	<i>Hirundo abyssinica</i>	Point count
Lilac-Breasted Roller	<i>Coracias caudatus</i>	Mafia Lodge
Little Egret/Dimorphic Egret	<i>Egretta garzetta</i>	Nature Walk
Little Greenbul	<i>Andropadus virens</i>	Nature Walk
Mangrove Kingfisher	<i>Halcyon senegaloides</i>	Nature Walk
Olive Sunbird	<i>Cyanomitra olivacea</i>	Nature Walk
Palm-Nut Vulture	<i>Gypohierax angolensis</i>	Beach
Pied Crow	<i>Corvus albus</i>	Camp
Red-Eyed Dove	<i>Streptopelia semitorquata</i>	Camp
Ring-Necked Dove	<i>Streptopelia capicola</i>	Nature Walk
Square-Tailed Nightjar	<i>Caprimulgus fossii</i>	Nature Walk
Tambourine Dove	<i>Turtur tympanistria</i>	Nature Walk
Black-Faced Weaver	<i>Ploceus cucullatus</i>	Camp
Water Thick-Knee	<i>Burhinus vermiculatus</i>	Nature Walk
Whimbrel	<i>Numenius phaeopus</i>	Nature Walk
White-Browed Coucal	<i>Centropus superciliosus</i>	Nature Walk