







Status Report for the Eastern Arc Mountains and Coastal forests of Kenya and Tanzania Region, 2008.





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TABLE OF CONTENTS

ACKNOWLEDGEMENTS 2
EXECUTIVE SUMMARY 4
1.0 INTRODUCTION 8
Indicator 9
Level 9
Main tools/methods for obtaining information 9
1.1 The Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya region .. 11
1.2 Approach 11
2.0 RESULTS - STATUS AND TRENDS 12
2.1 State 12
2.1.1 Forest Quality and Health 12
2.1.2 Changes in Forest Cover area and degree of fragmentation 16
2.1.3 Presence of Globally Threatened Species 24
2.1.4 Change in species abundance for a few key species (e.g. endemics, threatened, migratory or other 'flagship' species 30
2.1.6 Environmental (ecological and economic) services from the site e.g. quality and quantity of water flowing from the site, soil erosion, non-timber forest products, pollination 34
2.2 Pressure 37
2.2.1 Change in extraction intensity of key species 37
2.2.2 Changes in human population density in wards/divisions containing Eastern Arc or Coastal Forests 39
2.2.3 Fire Frequency 40
2.3 Response 42
2.3.1 Change in protection status of Key Biodiversity Areas (KBAs) 42
2.3.2 Changes in forest management effectiveness 45
2.3.2 Actions and Research targeting key (threatened/endemic /migratory) species 48
2.3.3 Changes in national legislation/legal recognition 48
2.3.4 CEPF Investment in the EACF 48
2.3.6. Recent biodiversity conservation actions, strategies, plans, engagement of stakeholders and useful resources 50
3.0. CONCLUSIONS AND RECOMMENDATIONS 52
REFERENCES 52
APPENDICES 63
Appendix 1: Summary of status and trends information for various biodiversity indicators in the EACF 63
Appendix 2: Area of forest cover ~2000 in hectares, area deforested from ~1990 to ~2000 in hectare, and rates of forest change in units of percent forest loss per year for Kenya's Parks and Forest Reserves. 72
Appendix 3: Area of forest cover ~2000 in hectares, area deforested from ~1990 to ~2000 in hectare, and rates of forest change in units of percent forest loss per year for Tanzania's parks and forest reserves. 73

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EXECUTIVE SUMMARY

1. This report assesses the status of biodiversity in the Eastern Arc Mountains and Coastal Forests of Kenya and Tanzania (EACF) region against most of the 19 biodiversity monitoring indicators agreed upon by the stakeholders in the region. It uses information availed up to the end of 2008, and where possible comparisons made with past data to assess trends. This is done as part of an initiative geared towards instituting a standardised biodiversity monitoring system across the region.
2. Indicators are grouped in such a way that they assess STATE (changes in forest quality, cover, presence and abundance of threatened species, national legislation and ecosystem services), PRESSURE (changes in extraction intensity, human population and fire frequency) and RESPONSE (changes in forest management effectiveness, actions and research targeting key species and investment in the region) of the biodiversity in the EACF.
3. Forest disturbance data collected in 2005 and 2006 especially for Eastern Arc Mountain Forests is already showing clear differences in **forest quality** between differently-managed forest sites. It also provides useful baseline information for future monitoring of forest quality. For the few (6) sites where past comparative data exists, there is evidence of either stable (3 cases) or worsening (3 cases) forest quality in the past two to five years. Kaya Kinondo is probably one of the very few coastal forests where no disturbance was recorded over a long period - 13 years (1994-2007) of extensive field surveys. Further analysis shows that forest areas managed under joint and community-based forest management are recovering compared with forests managed by government alone, or under open access regimes. After 10 years of joint forest management implementation there is a dramatic decline in rates of cutting, indicating that participatory forest management is showing signs of delivering impact in terms of improved forest condition in Tanzanian forests at least. Forest health and condition measurements in parts of three areas of the Eastern Arc Mountains undertaken in 2000 and 2001 and re-measured in 2006 generally indicate that the measured trees were healthy. In one of the cases (Ngangao Forest in the Taita Hills) tree damages increased slightly over the survey period with stem decays constituting the most prominent symptom, but overall no significant change was found in this first re-measurement of forest conditions
4. An estimate of base-line **forest** and woodland **cover and change** for the 1990's and 2000's for the coastal forests of Tanzania and Kenya shows in 2000 there

were 2,267 km^2 of coastal forests in Kenya and 6,019 km^2 in Tanzania, of which 53 km^2 (5,300 ha or 2.6%) were deforested in Kenya and 388 km^2 (38,800 ha or 6.1%) were deforested in Tanzania between 1990 and 2000. Rates of forest loss were higher in non-protected areas than in protected areas, although forest was also being lost from protected sites. Between 1990 and 2000, the entire coastal forest region lost 5,100 km^2 (510,000 ha or 5.5%) of forest of which 11% is deforestation occurring inside protected areas. Deforestation rates are lowest within Key Biodiversity Areas (KBAs) and Alliance for Zero Extinction sites (AZEs) in the coastal forests. Other studies have shown evidence of forest cover declines in the Lower Tana River Forests (1994-2005, 37 % decline) and stable conditions for the indigenous forest cover in the Arabuko-Sokoke Forest between 1992 and 2004. Indeed recent visits to some sites coastal sites (e.g. Kisiju in Tanzania) show evidence of near-complete loss of forest cover, illustrating the urgent threats facing them, particularly when they lack some form of protection. In the context of the Eastern Arc Mountains, a baseline of forest cover and forest loss, has been established from the 1970s to 2000s for Tanzania (c. 6% loss) with the highest losses being observed in the East Usamabara and Uluguru Mountains (12% loss each). Broad-leaved forest cover losses of 3% (1987-2003) and increases in coniferous forest plantation cover of 32% (1987-2002) have been observed in the Taita Hills, Kenya.

5. Of the 333 **species listed as Globally Threatened** in the IUCN Red List in 2002 as known to occur in the EACF, 12 species had been down-listed (moved to lower risk categories) and eight up-listed (moved to higher risk categories) by the end of 2006. Most of the down-listing could be attributed to increased knowledge (and one case of change in taxonomy) while most of the up-listing could be attributed to genuine changes in status. Over 40 new species descriptions and splits have recently (after 2002) been made in the EACF, including plants (5), larger moths (11), amphibians (18), reptiles (3), birds (3) and mammals (3).
6. A substantial number of isolated field studies assessing **abundance changes for species** of interest in the EACF took place especially prior to 2005. A crude assessment of the few studies reviewed here show that 50%, 40% and 10% of the studies indicated declining, stable and increasing abundance respectively. The Pemba Flying Fox *Pteropus voeltzkowi* population continued to increase exponentially at 41% in 2005, 16% in 2006 and 11% in 2007. The abundance of following species could have declined: Spotted Ground-thrush *Zoothera guttata* (1990s to 2000s), three primates (Tana River Red Colobus *Procolobus rufomitratus*, Tana River Red Colobus *P. rufomitratus* and Tana River Mangabey *Cercocebus galeritus*) in the Lower Tana River forests (2005 cf. prior survey data), and the Kihansi Spray Toad *Nectophrynoides asperginis* in the southern Udzungwa Mountains (2003 cf. 2004/5 data). The abundance of following species could have remained stable: Sokoke Scops-owl *Otus ireneae* in Arabuko-Sokoke forest (1984-1998-2005), Uluguru Bush-shrike *Malaconotus alius* (1999/2000 cf. 2006/2007) and Udzungwa-endemic Red colobus *Procolobus gordonorum* and Sanje mangabey *Cercocebus (galeritus) sanjei*. (1998-2007).
7. Tracking of changes in **national legislation** affecting biodiversity in the EACF is not seen as a suitable biodiversity monitoring indicator since the legislation that

affects biodiversity in Kenya and Tanzania is quite broad and take a relatively long time to change.

8. In addition to a few other sources of baseline information on **ecosystem services**, 'Valuing the Arc' is an ongoing programme (2007-2011) focusing on the Eastern Arc Mountains in Tanzania that is developing a general procedure for analysing and synthesizing detailed information on ecosystem services. As regards trends, the few existing studies a possible deteriorating situation: (a) Assessments of water flow trends for seven rivers (1950-1975; 1975-1995; 1990s) showed that over the whole Eastern Arc Mountains in Tanzania there is negative trend in seasonal flows over time, (b) Analysis of mean monthly turbidity data collected at the Morogoro Road Bridge in the Ruvu River for the period 1992 – 2002 show that water turbidity in the Ruvu River increased at trends that could be associated with vegetation degradation which results into erosion and higher sediment delivery into the streams, (c) It was estimated that between 1995 and 2000 the CO_2 emissions associated with loss of vegetation in the Eastern Arc Mountains of Tanzania was approximately 10.6 million tonnes carbon (equivalent to 38.7 million tonnes CO_2), and (d) Assessments of Carbon Storage in Arabuko-Sokoke Forest (1992-2004) and Lower Tana River Forests (1992-2005) showed that the total estimated Carbon Stock could have declined. In Lower Tana River Forests, the Tana Delta Irrigation Project area (c. 5300 ha) and the Tana River National Primate Reserve (16800 ha) could have lost 29,000 Mg C and 52,400 Mg C respectively; and Madunguni Forest (c 860 ha forest at north end of Arabuko Sokoke) lost roughly 20,000 Mg C in1992 to 2004.
9. Separate studies on **extraction intensity** of different taxa prior to 2005 demonstrate that there had been many cases of increasing trends in extraction intensity within the case study sites, e.g. in 10 of 15 studies. Trees are apparently the taxa whose extraction has been most-studied in the region. One of the most extensive studies on timber extraction has been done in southern Tanzania, with recent a report expressing concerns that "at the harvest rates experienced during 2003 and 2004, and based on official forest inventories, it is apparent that all harvestable Class I and II trees in Rufiji and Kilwa Districts will have been felled within 20 years". A recently conducted study in the Udzungwa Mountains to assess the impact of hunting using number of traps per km^2 as an indicator of hunting intensity constitutes an important baseline for monitoring the effect of subsequent implementation of Joint Forest Management.
10. Generally **human population** (total and density) have been increasing over the census years at the regional/provincial, district and ward/divisional levels in the localities containing the EACF. However interesting trends have been observed for the two recent intercensal population growth rates in Kenya and Tanzania: all but one of the regions in Tanzania have shown declines in intercensal growth rates, whereas Morogoro region and Coast Province (Kenya) have had stable intercensal growth rates.
11. There is generally limited data on **fire frequency** in the EACF. Fire is a very serious threat to the forests and other vegetation cover in the Eastern Arc Mountains with and the most affected districts in Tanzania being Kilombero, Kilindi and Mpwapwa. An assessment of fire patterns in the Eastern Arc

Mountains of Tanzania from 2000-2007 showed that fire activity is found in approximately 40% of the mountains, and demonstrated peaks and troughs thought to reflect biomass fuel availability from the previous year's fire regime, with the years 2003 and 2005 having especially high fire frequencies. Mahenge Mountain had the greatest fire activity of any mountain block. On the other hand, the number of MODIS fire points within forest reserves, plantations and the remaining Eastern Arc portion of 14 Tanzanian Districts generally increased between 2001 and 2005.

12. An assessment of **forest management effectiveness** was carried out for 126 Eastern Arc forest sites in Tanzania (2005) and about 50 sites in Kenya (2006). Most of those sites had an 'average' management effectiveness score, with Tanzanian Private and Kenyan state-owned forest sites showing better management effectiveness than the other types of forest sites. Repeat data exists for some sites and trend data analysis is ongoing. In Tanzania the assessments will be repeated in 2009.
13. The current review of **actions and research targeting key species** in the EACF is incomplete. However, from the analysis of a few known actions, it is possible that such actions could have increased by about 250% between 2005 and 2006. This could be attributed to the increased investment in the region by the Critical Ecosystem Partnership Fund (CEPF).
14. Overall, in the recent years especially since 2004, there seems to be an increased knowledge of the state of biodiversity in the EACF as a result of increased research efforts and sharing of information among stakeholders. This has led to e.g. discovery of many new species and review of Red List categories for many species. In most cases however, biodiversity in the EACF has continued to face increased pressure, except in a few exceptional cases where stable conditions have been observed. Response towards biodiversity conservation in the EACF has however been on the rise as may be demonstrated by the increased number of research and conservation actions, stakeholder engagement and improved management effectiveness of sites. It remains to be demonstrated as to whether these responses will have direct positive effect on the actual state of biodiversity in the EACF.

1.0 INTRODUCTION

Many changes in the ecosystems are gradual and in principle detectable and predictable, yet the monitoring of biodiversity trends and outcomes has particularly been challenging to the global conservation fraternity (World Bank 2004).

Since February 2005, BirdLife International and its Partners in Kenya and Tanzania, (Nature Kenya and Wildlife Conservation Society of Tanzania respectively), have been coordinating a project that aims to institute a standardized sustainable biodiversity monitoring system in the Eastern Arc Mountains and Coastal forests of Kenya and Tanzania region (hereafter referred to as EACF). This initiative is funded by the Critical Ecosystems Partnership Fund (CEPF) a joint initiative of Conservation International, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank and is meant to steer a coordinated approach to biodiversity monitoring at species, sites and habitats/landscape levels within the region. It is also envisioned that the project will provide a mechanism to evaluate the impact of conservation activities arising from the five-year (2003-2008) CEPF investment within the region and how the conservation outcomes will have been achieved (i.e. avoiding extinction, protecting sites and creating corridors where necessary). Ultimately it is hoped that in the long-term actual biodiversity monitoring will be embedded into future core and routine conservation and research activities/programmes by governments, other conservation agencies and community based organizations operating across the region.

As a first step, through a stakeholder workshop held in Dar es Salaam in 2005, consensus was reached by stakeholders in the region: (1) to institute a collaborative and coordinated approach to biodiversity monitoring based on the pressure-state-response model (2) a list of indicators for monitoring at species, sites, habitat/landscape level and the appropriate monitoring tools/frameworks and (3) to network among all stakeholders in data gathering, management, sharing and dissemination. As a follow-up, BirdLife International through its Partners in Kenya and Tanzania is striving to enhance coordinated acquisition, storage, handling and sharing of biodiversity monitoring data across the EACF region.

It is imperative that standard and practical biodiversity monitoring indicators are implemented to measure conservation outcomes[1] in the EACF. Stakeholders agreed on a set of 19 indicators (Table 1a) as a first useful set for collating information at the local site or species level and giving the user flexibility in choosing from a variety of indicators and tools. To aggregate information at the regional level, a second set of fewer (nine) indicators (Table 1b) has been derived from the first set of indicators to help in reporting at the EACF regional scale. In this report, we provide information on what data is known to exist for both levels of the biodiversity indicators. Where possible, an attempt is made to present a synthesis of information or data with regard to the possible emerging trends.

[1] Conservation Outcomes are the full set of quantitative and justifiable conservation targets in a hot spot that need to be achieved to prevent biodiversity loss. Having these targets in place ensures that conservation action focuses on the species at greatest risk of extinction and the sites and landscapes that are most important for their protection. These targets are defined at three levels, which are species, sites, and landscapes, representing discrete units along an ecological continuum and using a data-driven process and standardized criteria.

Table 1a: List of monitoring indicators and tools agreed by stakeholders in the EACF

Indicator		Level	Main tools/methods for obtaining information
STATE INDICATORS	Forest quality and forest health	Site/habitat	- Disturbance Transects - IBA Monitoring Framework - Remote Sensing
	Area of different types of forest and degree of fragmentation	Site/habitat	- Remote Sensing
	Presence of endemic and globally threatened species	Site/habitat	- Methods will vary with the taxa selected
	Change in species IUCN Red List Category (Vulnerable, Endangered, Critically Endangered, etc.)	Species	- IUCN Red List Index
	Change in species abundance for a few key species (e.g. endemics, threatened, migratory, or other 'flagship' species)	Species	- Field Surveys - IBA Monitoring Framework
	Forest Cover Change	Landscape Site/habitat	- Remote Sensing - Forest Health Monitoring Framework
	Gaps in a) national legal recognition; b) international acceptance of nationally legislated reserves; c) making biodiversity conservation an official goal of key biodiversity areas.	Site/habitat	- Evaluating gazettement list - Questionnaire with site managers - IBA Monitoring Framework - Site Surveys
	Percentage area within Protected Areas	Landscape Site/habitat	- Maps - GIS - World Database on Protected Areas
	Environmental (ecological and economic) services from the site e.g. quality and quantity of water flowing from the site, soil erosion, non-timber forest products, pollination	Site/habitat	May include: - Hydrological surveys - Soil erosion measurements - Economic valuation and PRA
PRESSURE INDICATORS	Change in extraction intensity of key species	Species	- Market Survey (timber, bush meat etc) - Disturbance Transects/ surveys - CITES - Hunting levels/Cartridge frequency
	Changes in human population density in wards/divisions containing Eastern Arc or Coastal Forests	Landscape	- National Statistics
	Fire Frequency	Landscape Site/habitat	- Remote Sensing - Direct Observation - Disturbance Transects - IBA monitoring framework
RESPONSE INDICATORS	Changes in forest management effectiveness	Site Landscape (modified from site tool)	- METT (Management Effectiveness Tracking Tools) Indices
	Presence and use of management plan to protect threatened species	Site/habitat Species	- Management Plans - IBA Monitoring Framework
	Actions and research targeting key (threatened/ endemic/migratory) species	Species	- IBA Monitoring Framework - Survey of research initiatives

Indicator		Level	Main tools/methods for obtaining information
	Policy development (include site, species focused issues)	Landscape Site/habitat Species	- Legal Notices - Revised policies, laws, regulations
	Number of sites from which benefits accrue to local communities	Site/habitat Landscape	- Household Questionnaires - PRA - RRA
	Change in policies/rules to reduce tourist practices with negative impact on threatened/endemic species	Species Site/habitat	- Surveys/assessment of tourism related policy change - IBA Monitoring Framework
	Increase in ecotourism projects protecting species threatened by tourism	Species Site/habitat	- Survey/assess ecotourism projects in EACF

Table 1b: List of a collapsed set of monitoring indicators and tools for aggregating information at the regional level

	Indicator	Level	Tool/Method
STATE INDICATORS	Change in status of threatened species	Species	Assessment of the relative rate at which the number of species in each IUCN Red List category changes (Red List Index)
	Change in habitat extent in Key Biodiversity Areas (KBAs)	Landscape	Analysing satellite data to track habitat change in KBAs over years
	Change in fragmentation in biodiversity conservation corridors corridors	Landscape	Analysing satellite data to track changes in the proportion of habitat far (> I km) from non-habitat edge, and the proportion of habitat not in small (<100 km^2) isolated patches
PRESSURE INDICATORS	Change in extraction intensity of globally threatened species for commercial use	Species	Data derived from TRAFFIC database and Disturbance transects
	Change in human population density in administrative ditricts contained in the Eastern Arc Mountains and Coastal Forests of Kenya and Tanzania	Landscape	Review of National Bureaus of Statistics Reports in Kenya and Tanzania
RESPONSE INDICATORS	Change in protection status of Key Biodiversity Areas (KBAs)	Site/Landscape	Tracking the change in percentage of KBAs with official protection status using e.g. the World Database on Protected Areas (WDPA) database and requesting for information elsewhere.
	Change in Management Effectiveness of Protected Areas/KBAs.	Site/Landscape	The World Bank/WWF Management Effectiveness Tracking Tool (METT). METT will be used to assess the % of sites being managed effectively and the mean % change in scores across sites between assessments.
	Change in number of threatened species with research and monitoring in place	Species	Assessment of species-related data collected using a species data request form

	Indicator	Level	Tool/Method
	Change in number and percentage of globally threatened species that have national protection status	Species	Review of relevant acts, policies, legal notices in Kenya and Tanzania

This is a report on the biodiversity status and trends (State), threats (Pressure) and actions to address them (Response). It attempts to broadly analyse the data already obtained from contributors as well as giving the reader an idea of what is already available or lacking. It is one of the main ways of making information that has been shared and collated from various sources widely accessible to users.

1.1 The Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya region

The EACF runs 900 km along the Kenya-Tanzania coasts and includes Zanzibar, Pemba and Mafia Islands off the Tanzanian mainland. The region has two distinct habitats - the Coastal Forests and the Eastern Arc Mountains. Previously classified as a biodiversity hotspot itself, the region now lies within two hotspots—the Eastern Afromontane Hotspot and the Coastal Forests of Eastern Africa Hotspot—identified as part of a hotspots reappraisal released in 2005 (Conservation International 2007). The EACF had been identified by Myers *et al.* (2000) as one of the eight 'hottest hotspots' in terms of five factors: number of endemics and endemic species/area ratios for both plants and vertebrates, and habitat loss.

The region is characterised by a high level of species endemism, a severe degree of threat and exceptional diversity of its plant and animal communities (CEPF 2003). It is home to at least 1500 plant species, 16 endemic mammals, 22 endemic birds, 50 endemic reptiles and 33 endemic amphibians. Burgess et al. (1998) and the various chapters in Burgess and Clarke (2000) provided the overview of the biodiversity knowledge in the EACF at that time. An Ecosystem Profile for the region compiled in 2003 (CEPF 2003) showed that by the end of 2003, 333 species within the region were still considered globally threatened based on the 2002 IUCN Red List (CEPF 2003, IUCN 2002). The 333 species comprised of 29 mammals, 28 birds, 33 amphibians, 7 gastropods, and 236 plant species, which were either Critically Endangered, Endangered or Vulnerable (Table 3). A recent detailed analysis of biological importance of the Eastern Arc Mountains in particular is now available (Burgess *et al.* 2007). Arthropods, which as a taxonomic group also form the bulk of EACF species, did not feature during the compilation of Ecosystem Profile since it was least studied and described. Various efforts to describe this group are underway. However, Burgess *et al.* (2007) compiled and presented data on other less well known groups in the Eastern Arc Mountains to see whether they share similar patterns of importance as vertebrate fauna. This was done for trees and some invertebrates (butterflies, millipedes, spiders and dragonflies).

1.2 Approach

In this report, the status of biodiversity in the EACF is assessed against most of the 19 biodiversity monitoring indicators (Table 1a) agreed upon by the stakeholders in the region. For each of the indicators, an attempt is made to review what information has

been collected so far, and where possible broad conclusions on status or trend of biodiversity the arising from studies related to the respective indicators are summarized in Appendix 1. This review provides an indication of where baseline and trends information exists for the respective biodiversity indicators. A narrative providing a general analysis of the information available is provided against each of the indicators. In general the baseline condition is taken from the Ecosystem Profile described above (CEPF 2003).

2.0 RESULTS - STATUS AND TRENDS

2.1 State

2.1.1 Forest Quality and Health

Baseline

Substantial information on forest quality exists from a disturbance assessment of the Eastern Arc Mountains undertaken between January and April 2005 by a team from Sokoine University and Foresters from the Forestry and Beekeeping Division in Tanzania (Madoffe *et al.* 2005a&c, Madoffe and Munishi 2005). Forest disturbance was assessed in 26 forests and additional work was carried out by Tanzania Forest Conservation working Group (TFCG) in the Nguru South Forest Reserve (Appendix 1). According to CMEAMF (2006a), on average across a sample of 25 forests there are 44 cut trees and 52 cut poles per hectare of forest, where the density of uncut trees is 340 live trees and 418 live poles per hectare. Hence somewhere below 10% of trees and just over 10% of the poles are cut on average across all the forests (CMEAMF 2006a). CMEAMF (2005&2006a) present a summary of the baseline forest disturbance measurements in a sample of Eastern Arc Mountains forests. One problem is that it is not known how long cut trees and poles take to rot away, so it is not possible to estimate cutting per annum using these data.

On average all the forests were disturbed but to varying degrees. Although the sample sizes were not even in the four categories of forests i.e. Proposed Forests, Private Forests (PFs), Local Government Forest Reserves (LGFRs) and Central Government Forest Reserves (CGFRs), the differences in disturbance levels were striking (Figure 1).

Ten main threats were identified in all the forests. These threats occurred both at the forest edge and in the forest interior, except mining which occurred as an entirely forest interior threat in Ambangulu, Nilo, Mtai, Nguru North, Kilindi and Mselezi forest reserves and hunting which occurred in Mazumbai, Idewa, Ihang'ana, Nambinga, Ukwiva and North Mamiwa forest reserves. Fire and pole cutting appear to be the most dominant threat followed by grazing. Fire as a forest edge threat occurred in 25 out of the 26 study forests and in 14 forests as a forest interior threat. Pole cutting occurred in 18 forests as a forest edge threat and 17 forests as forest interior threat. Conversely collection of medicinal plants occurred only in one forest as a forest edge threat and in three forests as forest interior threat. Other threats, which were forest specific included

Bamboo and *Cussonia* extraction, honey collection, human trails, stone extraction and grass cutting.

In addition, forest disturbance monitoring is ongoing in Uluguru North FR, Rondo FR and Dakatcha Woodlands under this project. Baseline data for these sites was collected in 2006 and in some cases there exists past comparative data that is already indicating some trends (Appendix 1). There are other sites that have past disturbance and forest health data collected separately, e.g. Kaya Diani, Kaya Muhaka, Kaya Ukunda, Taita Hills (Appendix 1, Preston 2004, Madoffe and Munishi 2005). Also, based on sample plots of 400 m^2 each, Chege and Bytebier (2005) analysed the structure of four small forest fragments, Kichuchenyi, Macha, Ndiwenyi and Yale, all situated in the Dabida massif of the Taita Hills. All fragments were heavily disturbed, but Yale was the least disturbed of the four forests and had the highest number of species.

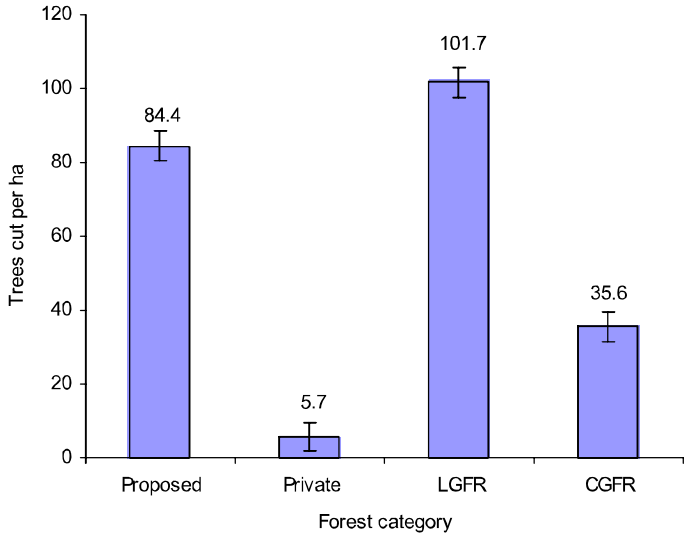


Figure 1. Mean number of cut trees per ha in Proposed forests (n=2), Private forests (n=2), Local Government Forest Reserves (n=3) and Central Government Forest Reserves (n=19) in the EAM forests of Tanzania (Source: Madoffe *et al.* 2005)

Monitoring and trends

Comparisons of forest quality assessment undertaken in April 2005 (above) with forests studied some years before indicated that there was not much change in levels of disturbance of forests, for example in Mtai and Nilo in the East Usambaras.

Madoffe et al. (2008) present the results of 43 permanent forest health study plots established in 2000 and 2001 and re-measured in 2006 in parts of three areas of the Eastern Arc Mountains – the Taita Hills in Kenya (Ngangao and Chawia), the East Usambara Mountains (Amani Nature Reserve) and the Uluguru Mountains (Morogoro Teachers College and Kimboza) in Tanzania. Three main indicators of forest health – mensuration, visual crown ratings, and tree damage – were collected. In general, the trees measured are considered healthy. Thirty five (35) globally-threatened tree species (1074 trees, saplings, and seedlings) were found on the initial plots. The 2001-2006 assessment, growth and diversity statistics are presented for 11 forest plots in Ngangao Forest in Taita Hills, Kenya (Rogers *et al.* 2008). Tree crowns appeared healthy overall, although one

species (*Albizia gummifera*) displayed increased dieback and foliage transparency and decreased crown density. Tree damages increased slightly over the survey period with stem decays constituting the most prominent symptom. Overall, Rogers *et al.* (2008) found no significant change in this first remeasurement of forest conditions at Ngangao Forest. The results reported, however, may require more intense inspection of conditions.

Comparison of past and recent data is already showing some interesting trends, e.g. (a) at the rates of disturbance occurring in 1998 and 2003 in Kaya Kinondo and Kaya Muhaka; interestingly, Kaya Kinondo is probably one of the very few coastal forests where no disturbance was recorded during the period 1994-2007. Neither collecting of dead wood, fire wood, pole cutting and cutting of trees was found over a period of 13 years of extensive field surveys and site surveys (Lehmann and Kioko, 2005; Lehmann and Kioko in prep.). In 2004, there were eight, five and four years remaining for Kaya Diani, Kaya Muhaka and Kaya Ukunda respectively, before poles are depleted (Preston 2004), although in Kaya Diani heavy pole cutting was found in 2007 resulting in complete clearance of undergrowth for poles on two localities of 700 m^2 each; a large area for such a small Kaya (Lehmann & Kioko in prep.) (b) While cutting of poles seemed to have remained the same, cutting of timber seemed to have declined between 2000 and 2005 in Uluguru North FR (Frontier-Tanzania 2005). However there were no apparent changes between 2005 and 2006 (Pius *et al.* 2007). Comparison of 2004 and 2005 basic Important Bird Area (IBA) Monitoring data for 14 Eastern Arc Mountain and Coastal Forests in Kenya shows that their state could have generally worsened (declined) between the two years (cf. Otieno *et al.* 2005; Musila *et al.* 2006).

Further work (Blomley *et al.* 2008, see case study below) suggests that forest condition in sites under Participatory Forest Management could have improved over time.

Case Study: **Improving Forest Condition as a result of PFM.** *Source*: Blomley *et al.* (2008)
Recently, Blomley *et al.* (2008) assessed the success of implementing participatory forest management in Tanzania over the past 15 years and in relation to improving forest condition. They measured success firstly in terms of the absolute area of forests now under such management arrangements and, secondly, in terms of the impact of such management on forest quality.

In one case Blomley *et al.* (2008) assessed temporal changes in forest condition under participatory and non-participatory forest management. Data were gathered from 13 forests over 1997–2007 in five regions across eastern, central and northern Tanzania (many of them falling within the EACF). In the 13 forests sampled there were increases in basal area and volume in sites managed under both joint and community-based forest management, and declines in both of these variables in forests under government or open access management (Fig. 2a,b). There were also declines in stems ha^{-1} in forests managed under community-based forest management, and increases in joint forest management areas and forests under exclusive state management (Fig. 2c). Although the data come from different areas of Tanzania and different ecological conditions, they tend to suggest that forest areas managed under joint and community-based forest management are recovering compared with forests managed by government alone, or under open access regimes.

In another case, a spatial comparison of forest condition in 49 forests under joint and non-joint forest management was done. Data on forest condition were compiled from a total of 477 km of transects in the Eastern Arc Mountain forests and lowland coastal forests that have been surveyed between 1997 and 2005 using Frontier-Tanzania transect methodology (Frontier Tanzania 2001a; Ahrends, 2005). Forest disturbance information was analysed for 24 Forest Reserves under joint forest management and 25 Forest Reserves under exclusive local or central government management. Across the broader sample of 49 Eastern Arc Mountain and lowland coastal forests there are also clear trends in forest condition. Comparing non-joint management sites with forests where joint management has been implemented for increasing numbers of years shows overall declines over time in rates of pole and timber harvesting

in the combined Eastern Arc and coastal forest sites (Fig. 3). After 10 years of joint forest management implementation there is a dramatic decline in rates of cutting, with regression analysis shows declining trends in cutting over time.

Overall, Blomley *et al*. (2008) concluded that participatory forest management is showing signs of delivering impact in terms of improved forest condition in Tanzanian forests but that further assessments need to be made to verify these initial findings.

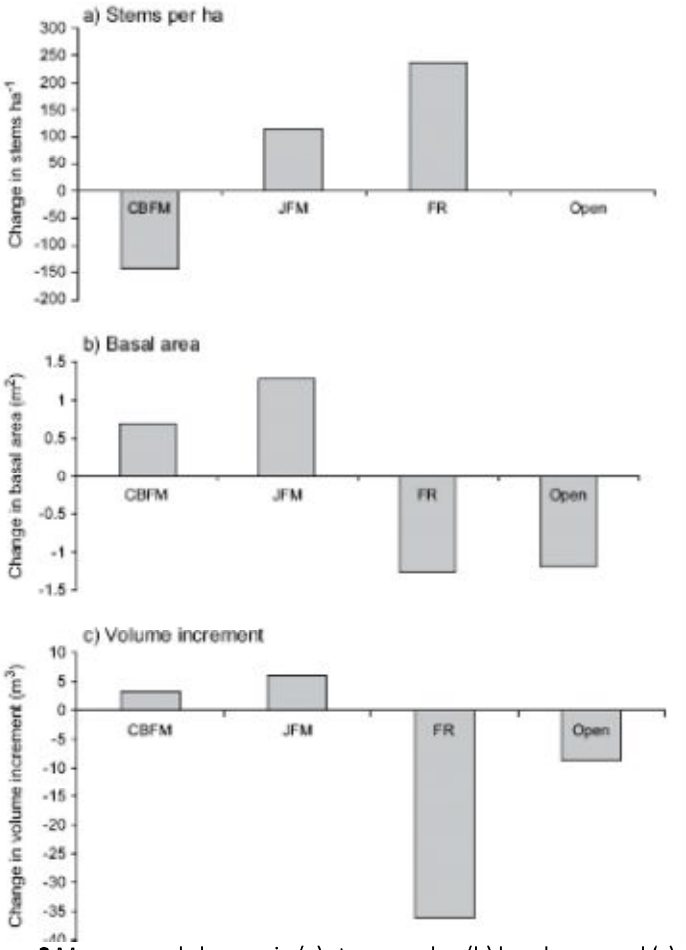


Figure. 2 Mean annual changes in (a) stems per ha, (b) basal area, and (c) volume increment in 13 forests under different management and ownership regimes: nine under community based forest management (CBFM), two under joint forest management (JFM), one under local government management as Forest Reserves (FR), and one an open access area (Open).

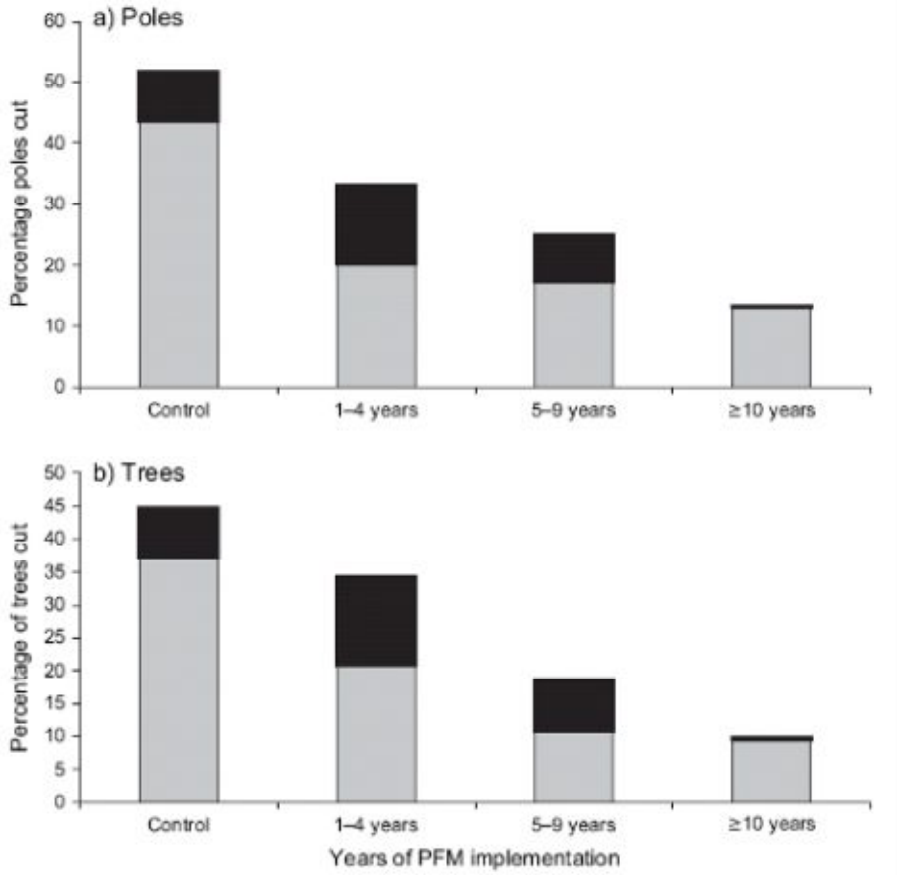


Figure. 3. Percentage cutting of (a) poles and (b) trees within seven coastal forests (grey portion of bars) and 42 Eastern Arc mountain forests (black portions) under non-joint forest management (control) and under increasing numbers of years of implementing participatory forest management (PFM). Control based on data from 23 Eastern Arc and two coastal forests managed by the State. Implementation of participatory forest management arrangements between the State and communities for 1–5 years duration based on data from eight Eastern Arc and one coastal forest; implementation for 6–9 years based on data from nine Eastern Arc and one coastal forest; implementation for ≥10 years based on data from one Eastern Arc and four coastal forests.

2.1.2 Changes in Forest Cover area and degree of fragmentation

Baseline

In the context of the Eastern Arc Mountains, a baseline of forest cover, and forest loss, has been established across the years 1975-2000 (CMEAMF 2006b). The results are summarised below (Table 2). There is also an ongoing TAITA project under the Department of Geography, University of Helsinki focusing on land use change studies in Taita Hills, South East Kenya. The data and results derived from it will form a useful geographic database for future research and governmental planning in the area and will be available through the map server at the project homepages (http://www.helsinki.fi/science/taita/) after the project has completed.

Studies focusing on processes associated with forest fragmentation have been undertaken: Using data from six bird capture–recapture sessions, Githiru and Lens (2006) estimated survival probabilities of the White-starred Robin in seven indigenous forest patches in the highly fragmented Taita Hills forests. That survival probability was similar among fragments (large 135 ha, medium 95 ha, and small 2–8 ha), but turnover rates differed denoted that different processes caused extirpation from the patches. Schöning *et. al*. (2006) examined the presence of the army ant *Dorylus* (*Anomma*) *molestus* in the highly fragmented and threatened forests of the Taita Hills and the Lower Tana River in relation to forest patch size and time since isolation. Their observations suggest that colonies can survive well outside forests, at least long enough to reach a neighbouring forest patch.

Table 2. Baseline of Forest Area in the Eastern Arc Mountains (from CMEAMF 2006b)

Mountain block	Forest area in 1970s (ha)	Forest area in late 1980s/early 1990s (ha)	Forest area in 2000s (ha)	Forest area change 1970s-1980/90s (ha)	Forest area change 1980/90s-2000s (ha)	Forest area change 1970s-2000s (ha)	Proportion of forest loss 1970s-2000s (%)
North Pare	2880	2720	2720	160	0	160	6
South Pare	15220	13860	13850	1360	10	1370	9
West Usambara	35440	32110	31890	3330	220	3550	10
East Usambara	29890	26540	26270	3350	270	3620	12
North Nguru	19730	18770	18760	960	10	970	5
South Nguru	30770	29790	29680	980	110	1090	4
Ukaguru	18070	17230	17200	840	30	870	5
Uluguru	31540	28680	27810	2860	870	3730	12
Rubeho	51770	46730	46450	5040	280	5320	10
Malundwe	1335	1330	1330	0	5	5	0
Udzungwa	138370	135390	135280	2980	110	3090	2
Mahenge	2050	1940	1940	110	0	110	5
Total	**377065**	**355090**	**353180**	**21975**	**1910**	**23885**	**6**

As regards all the coastal forests in Kenya and Tanzania, Tabor *et al.* (2008) provide detailed analysis (see below). Prins and Clarke (2007) provide a detailed analysis of the coastal forest cover in SE Tanzania. They conducted a detailed vegetation mapping based upon a combination of digital Landsat ETM satellite data and observations from fieldwork, thus identifying and classifying all patches of Coastal Forest in SE Tanzania. They discovered particularly large tracts of well-developed Coastal Forest at Namatimbili and on the Ruwawa plateau. This was significant, especially given the paucity of large patches of Coastal Forest elsewhere in eastern Africa. Prins and Clarke (2007) recommended that particular conservation attention should be given to the newly identified areas of forest that are currently without any form of formal protection, i.e. those at Namatimbili and on the Chitoa, Noto, Mbwalawala and Ruwawa plateaux, while efforts to safeguard the remaining forest in the Rondo, Litipo, Ndimba and Ruawa forest reserves should be stepped up.

Monitoring and trends

Conservation International (2008) mapped change in primary forest and woodland cover within KBAs between 1990 and 2000. Figure 4 shows change in the proportion of natural habitat cover for all Key Biodiversity Areas (KBAs) and Alliance for Zero Extinction (AZE) sites. An estimate of base-line forest and woodland cover and change for the 1990's and 2000's for the coastal forests of Tanzania and Kenya was produced by the Center for Biodiversity Science (CABS) and the Sokoine University of Agriculture (SUA) in Morogoro, Tanzania (Tabor *et al.* 2008). The data show in 2000 there were 2,267 km^2 of coastal forests in Kenya and 6,019 km^2 in Tanzania, of which 53 km^2 (5,300 ha or 2.6%) were deforested in Kenya and 388 km^2 (38,800 ha or 6.1%) were deforested in Tanzania between 1990 and 2000. Rates of forest loss are higher in non-protected areas than in protected areas, although forest is also being lost from protected sites. Between 1990 and 2000, the entire coastal forest region lost 5,100 km^2 (510,000 ha or 5.5%) of forest of which 11% is deforestation occurring inside protected areas. Deforestation rates are lowest within Key Biodiversity Areas (KBAs) and Alliance for Zero Extinction sites (AZEs) in the coastal forests. There was a reduction of 28.7 km (2870 ha or 1.2 %) of forested area inside KBA and AZE boundaries between 1990 and 2000. Appendix 2 and 3 show area of forest cover ~2000 in hectares, area deforested from ~1990 to ~2000 in hectare, and rates of forest change in units of percent forest loss per year for Kenya's and Tanzania's parks and forest reserves respectively.
Tabor *et al.* (2008) in the case study below presented the results for baseline forest cover and change in East Africa's coastal forest KBAs and AZEs.

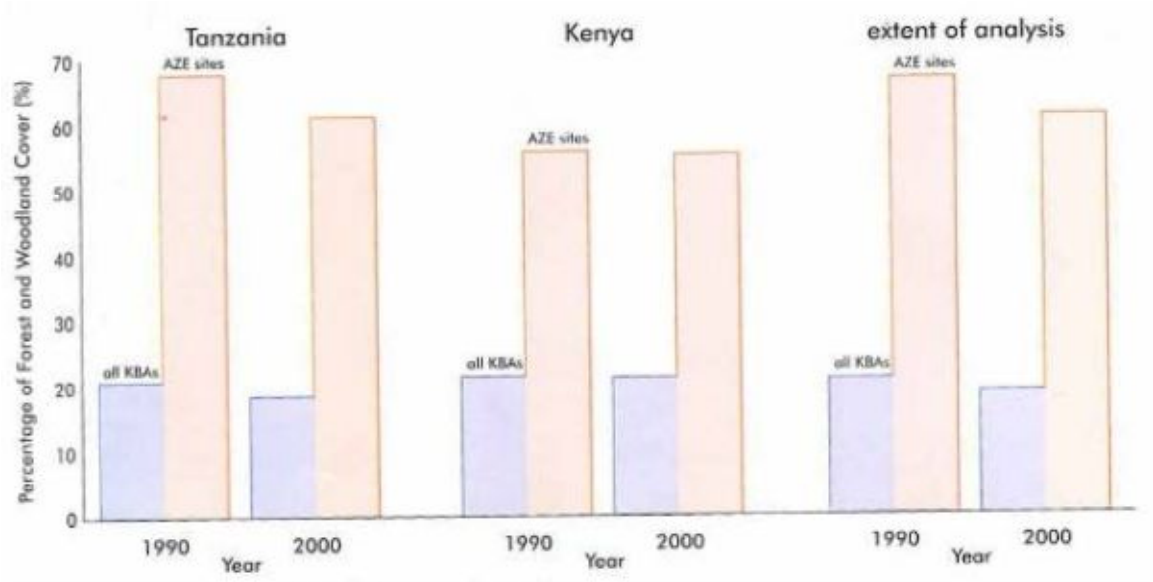


Figure 4: Change in primary forest and woodland cover within KBAs and AZE sites with greater than 1 km^2 forest and woodland cover in c.1990. Source: Conservation International (2008)

A summary of other known activities assessing forest cover changes in the EACF and apparent trends is provided in Appendix 1. Using remote sensing, analysis of forest area remaining in the Eastern-Arc Mountain Forests in Tanzania for the years between 1970s and 2000s evidence has been shown for declines in forest area cover (CMEAMF 2006b, Mbilinyi and Kashaigili 2005). Particular declines have been observed in forest cover areas in e.g. the following sites: North and South Pare, West and East Usambaras, Nguu, Nguru, Ukaguru, Uluguru, Rubeho, Udzungwa and Mahenge. Similarly forest cover declines of 3% (1987-2003) and 37% (1994-2005) have been observed for broad-leaved forest in the Taita Hills (Pellikka *et al.* 2004, Pellikka *et al.* 2005) and the Lower Tana River Forests (Luke *et al.* 2005) respectively. On the other hand, indigenous forest cover in the Arabuko-Sokoke Forest did not undergo significant change between 1992 and 2004 (Glenday 2005a), while in the Taita Hills coniferous forest plantation cover increased by 32% between 1987 and 2002 (Pellikka *et al.* 2004, Pellikka *et al.* 2005).

However, although Table 4 below lists 27 ha forest cover for Kisiju with an estimated forest loss of 4 ha between 1990 and 2000, the site was visited in 2004 (A. Ahrends and B. Mhoro, *pers com*), barely any remaining forest (c.1-2 ha) was found. Some parts of the area were characterised with secondary coastal forest regeneration under Cashew nut trees. The trees had been logged and burned to charcoal. The cuts were approximately 1-5 years old. This illustrates an example of the urgent threats facing the coastal forests, particularly when they have not been gazetted as protected areas.

Spatial data analyses carried out in 2007 for Dakatcha Woodlands and Marafa forests (Kenya) using LANDSAT images over the past 25 years showed that between 1975 and 2000 an extensive depletion of the dense forest cover resource from 82.2% to 34.2% occurred giving way to degraded woodland class and settlement mainly influenced by both human and climatic factors (Ojoyi 2008).

Analysis by Owino *et al.* (in press) showed that considerable changes in intact forest and other land covers occurred at the Tana River Primate National Reserve between 1994 and 2004. Overall, the forest patches still remained the second most dominant land cover after bushlands in the area over the period. However, the area under intact forest decreased by 223 ha representing mean annual rate of loss of 22.3ha per year. If the trend of mean annual rate of loss of pristine forest patches continues as noted between 1994 and 2004 then the forest patches would completely be diminished by the year 2088. Overall, the total forest patches' proportion decreased from 41% to 36% over the period.

A Multi-Date Baseline Forest Estimate for circa 1990 and 2000 for KBAs and AZEs of the Coastal Forests of Tanzania and Kenya . Source: Tabor *et al.* 2008.

An estimate of base-line forest and woodland cover and change for the 1990's and 2000's for the coastal forests of Tanzania and Kenya was produced by the Center for Biodiversity Science (CABS) and the Sokoine University of Agriculture (SUA) in Morogoro, Tanzania. The habitat cover and change map was derived using high spatial resolution satellite imagery from Landsat. The mapped forest class is defined as only primary, mature forest dominated by closed canopy trees over 5m in height. Statistics of forested area and rates of change for East Africa's coastal forests were generated from the map product. Data shows in 2000 there are 2,267 km^2 of coastal forests in

Kenya and 6,019 km^2 in Tanzania, of which 53 km^2 (5,300 ha or 2.6%) were deforested in Kenya and 388 km^2 (38,800 ha or 6.1%) were deforested in Tanzania between 1990 and 2000. Rates of forest loss are higher in non-protected areas than in protected areas, although forest is also being lost from protected sites. Between 1990 and 2000, the entire coastal forest region lost 5,100 km^2 (510,000 ha or 5.5%) of forest of which 11% is deforestation occurring inside protected areas. Deforestation rates are lowest within Key Biodiversity Areas (KBAs) and Alliance for Zero Extinction sites (AZEs) in the coastal forests. There was a reduction of 28.7 km (2870 ha or 1.2 %) of forested area inside KBA and AZE boundaries between 1990 and 2000. Presented here are the results for baseline forest cover and change in East Africa's coastal forest KBAs and AZEs.

Forest cover and change statistics for the coastal forest KBAs and AZEs are displayed in Table 3 for Kenya and Table 4 for Tanzania. The tables present forest cover ~2000 in hectares, deforested area between ~1990 and ~2000 in hectares and deforestation rates in percent forest loss per year. These statistics are based on observed forest only and do not include potential forest obscured by clouds in the ~2000 satellite imagery. Likewise, forest rate of change statistics reflect observed forest loss between ~1990 and ~2000. The tables include confidence values in percent which reveal the reliability of the forest cover and change estimates. The confidence values for habitat ~2000 indicate the possible underestimate of forest cover due to cloud cover. The percent confidence for forest change indicates the errors associated with cloud obscuring forest in both the ~1990 and ~2000 and deforestation in ~2000. Figures 5 and 6 graph forest cover for ~1990 and ~2000 and display the percent change in forested area within KBAs and AZEs for Kenya (figure 5) and Tanzania (figure 6). Only KBAs and AZEs with greater then 60% confidence in the forest change statistic are shown in these graphs, otherwise results with low confidence in observation can mislead by underestimating forest cover and exaggerating or underestimating percent forest loss.

Results show Kenya's KBAs contain a total of 806 km^2 (80596 ha) of forest with 82% confidence. The KBA with the most significant forest loss is the Dakatcha woodlands with an estimated 2% forest loss per year with only 66% of forest observation between the two dates. The Dakatcha woodlands KBA boundary does not include forested regions to the north were there is significant deforestation occurring just outside the KBA. Persistent cloud cover obscured results for many other of Kenya's coastal forest KBAs including Sabaki River Mouth, Diani Forest and Tana River. The Tana River forests are extremely fragmented with high rates of forest loss of more the 5% per year, however there is low confidence in these results because the region is too cloudy to get accurate estimates of forest cover and loss. The only Kenya AZE in this study area, the Shimba Hills forest reserve/nature reserve, shows virtually no forest loss from 1990 to 2000 with 85% confidence. Figure 5 shows generally low percent deforestation for KBAs in Kenya with relatively cloud free observations (with the exception of the Dakatcha Woodlands). In the figure there appears to be substantial forest loss from 1990 to 2000 in the Arabuko-Sokoke Forest, however this discrepancy is due to cloud cover between the image dates. In 1990, 93% of the potential forest was observed while only 86% of potential forest was observed in 2000. Our statistics only report observed deforestation between 1990 and 2000 therefore the figure for percent forest loss remains relatively low at only 0.1%.

The forest areas observed within Tanzania's KBAs cover more the double the area of observed forest within Kenya's KBAs. Tanzania's coastal forest KBAs contain 1,808 km^2 (180,841 ha) of forest with 93% confidence. The KBAs with large forested areas showing notable rates of forest decline between 1990 and 2000 are Lindi District Coastal Forests (0.75% per year), Rufiji Delta (0.21% per year), Kisarawe District Coastal Forests (0.17% per year) and AZE East Usambara Mountains (0.12% per year). The East Usambara KBA is a conglomeration of 25 forest reserves and one nature reserve. In total the forested area of the East Usambara KBA was reduced by 484 ha between 1990 and 2000 with 365 ha of deforestation occurring in the Bombo forest reserves. The Bombo West forest reserve lost 225 ha, 20% of its ~1990 forested area at a rate of 1.3% per year, while the smaller Bombo East forest reserves combined lost 140 ha, 22% of the ~1990 forested area at a rate of 1.2% per year (*see tables 3 and 4 in the appendix for statistics of forest cover and change for East Africa's coastal forest reserves*). The Pande Game reserve is another KBA in Tanzania with high deforestation rates losing 15% of it's forested area over a 5 year period from 1995-2000. Pande is located close to Dar es Salaam and surrounded by densely populated farming and is a target for exploitation because the forests inside the reserve have high value for commercial timber, fuelwood and charcoal. Another KBA surrounded by densely populated areas is the Mnazi Bay marine reserve which lost 266 ha of forest between 1990 and 2000 at a rate of 4.9% per year. There are a few KBAs such as Lindi Creek, Newala (Kitama) and Newala District Coastal Forests KBAs with extremely high percent forest loss. These KBAs have small forested areas in 1990 and produce high deforestation rates because any small amount of change will produce a large figure for percent of change (figure 6).

These statistics of forest cover and change were calculated based on the baseline forest cover and change map for the East Africa coastal forests. A map accuracy assessment of the baseline ~2000 forest cover produced an overall

map accuracy of 88%. However, the excessive cloudiness of this region complicates land cover classification by satellite data. Persistent cloud cover contributes to an underestimate of forest cover and deforestation which is most likely a problem in the cloudy coastal forests of Kenya. Our forest and deforestation estimates in Tanzania, however, are overestimated according to figures from previous regional studies. The overestimate of forest results from confusion in interpreting forest from dense woodland in satellite images of Tanzania's coastal forests. SUA and partners in the region are currently collecting further ground truth data for the coastal forest regions to produce a more accurate 2007 forest cover and change update to this 2000 analysis. Along with increased map accuracy, the 2007 update will provide forest cover statists with current forest extents and deforestation rates. Forest cover and change for two decades will be valuable for estimating carbon storage in the coastal forests and assessing the threat of habitat loss on species endemic to the coastal forests of Tanzania and Kenya.

Table 3: Area of forest cover ~2000 in hectares, area deforested from ~1990 to ~2000 in hectare, and rates of forest change in units of percent forest loss per year for Kenya's KBAs and AZE. Confidence values for forest cover and change are expressed in units of percent. Italicized values indicate low confidence is results due to cloud cover.

Kenya KBA	*forest cover ~2000 (ha)*	*Confidence in estimated forest cover ~2000 (%)*	*forest loss 1990-2000 (ha)*	*rate of forest loss (%y-1)*	*Confidence in estimated forest change (%)*
Arabuko-Sokoke Forest	24202	86	30	0.02	81
Boni Forest	22466	100	0	0.00	75
Buda Forest Reserve	396	100	0	0.01	93
Chuna Forest	32	97	*0*	*0.00*	*13*
Dakatcha Woodland	2593	77	450	1.91	66
Diani Forest	*3*	*18*	*1*	*1.11*	*3*
Dodori	2064	99	0	0.00	24
Dzombo Hill Forest	106	100	0	0.00	85
Gede Ruins National Monument	0	100	0	0.00	100
Gongoni Forest Reserve	409	100	0	0.00	80
Kayas	409	80	*0*	*0.00*	*31*
Kiunga Marine National Reserve	11	100	0	0.00	91
Lunghi	*10753*	65	*2*	*0.00*	*24*
Mangea Hill	417	54	207	4.21	55
Marafa	160	54	35	2.24	51
Marenji Forest	1225	99	0	0.00	96
Mrima Hill Forest	282	100	0	0.00	99
Mwache Forest Reserve	3	54	*0*	*0.00*	*6*
Sabaki River Mouth	*3*	*29*	*0*	*0.00*	*26*
Shimba Hills (AZE)	11397	100	6	0.00	85
Shimoni Forests	629	100	4	0.04	88
Tana River Delta	*820*	*43*	*1*	*0.02*	*38*
Tana River Forests	*163*	*3*	*252*	*5.21*	*4*
Witu Forest Reserve	2052	81	0	0.00	69

Table 4: Area of forest cover ~2000 in hectares, area deforested from ~1990 to ~2000 in hectare, and rates of forest change in units of percent forest loss per year for Tanzania's KBAs and AZE. Confidence values for forest cover and change are expressed in units of percent. Italicized values indicate low confidence is results due to cloud cover

Tanzania KBA	*forest cover ~2000 (ha)*	*Confidence in estimated forest cover ~2000 (%)*	*forest loss 1990-2000 (ha)*	*rate of forest loss (%y-1)*	*Confidence in estimated forest change (%)*
Bagamoyo (Kikoka Forest Reserve)	*8*	*12*	*0*	*0.00*	*6*
Bagamoyo District Coastal Forests	664	68	*0*	*0.00*	*6*
Dar es Salaam coast	*3*	*0*	*0*	*0.00*	*0*
East Usambara Mountains (AZE)	24815	100	484	0.12	98
Handeni District Coastal Forests	214	100	0	0.00	95
Kilwa District Coastal Forests	29487	100	146	0.05	100
Kisarawe District Coastal Forests	10545	84	90	0.17	79
Kisiju	*27*	86	*4*	*2.43*	*31*
Lindi (Nyangao River)	210	100	13	0.63	100
Lindi Creek	17	100	3	1.87	100
Lindi District Coastal Forests	6613	100	479	0.75	100
Mikindani	24	100	0	0.00	100
Mnazi Bay	343	100	266	4.85	100
Muheza District Coastal Forests	175	100	0	0.00	85
Newala (Kitama)	8	100	74	10.06	100
Newala District Coastal Forests	61	100	9	1.45	100
Pande Game Reserve and Dondwe Coastal Forests	666	97	148	3.64	95
Pangani District Coastal Forests	43	95	0	0.00	59
Rufiji Delta	6005	64	89	0.21	60
Rufiji District Coastal Forests	3409	99	17	0.05	97
Tanga North - Kibo saltpans	5	100	0	0.00	31
Tanga South	40	100	0	0.00	79

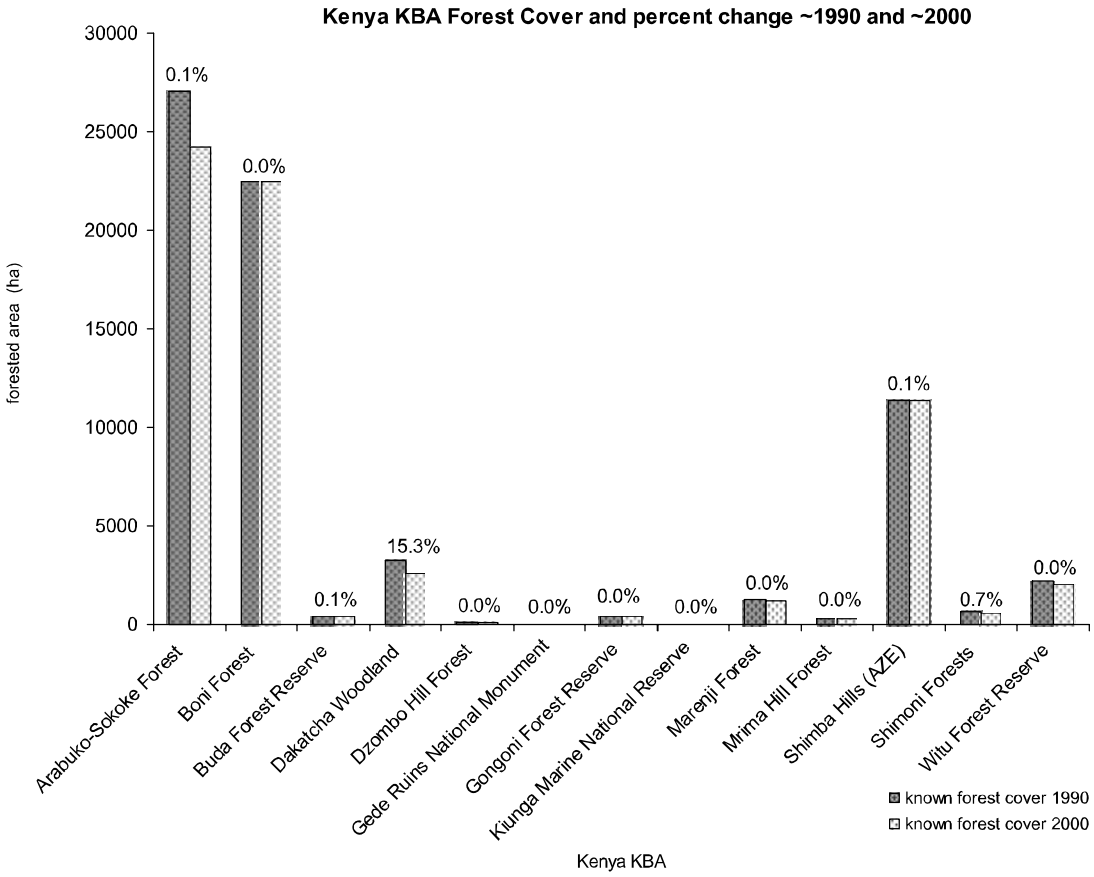


Figure 5. Known forest for ~1900 and ~2000 within Kenya's KBAs and AZE are graphed in units of hectare (ha). Above each pair of bars is the percent forest loss from 1990 to 2000 for each KBA. Only KBAs with confidence in the forest change statistic greater the 50% are plotted here.

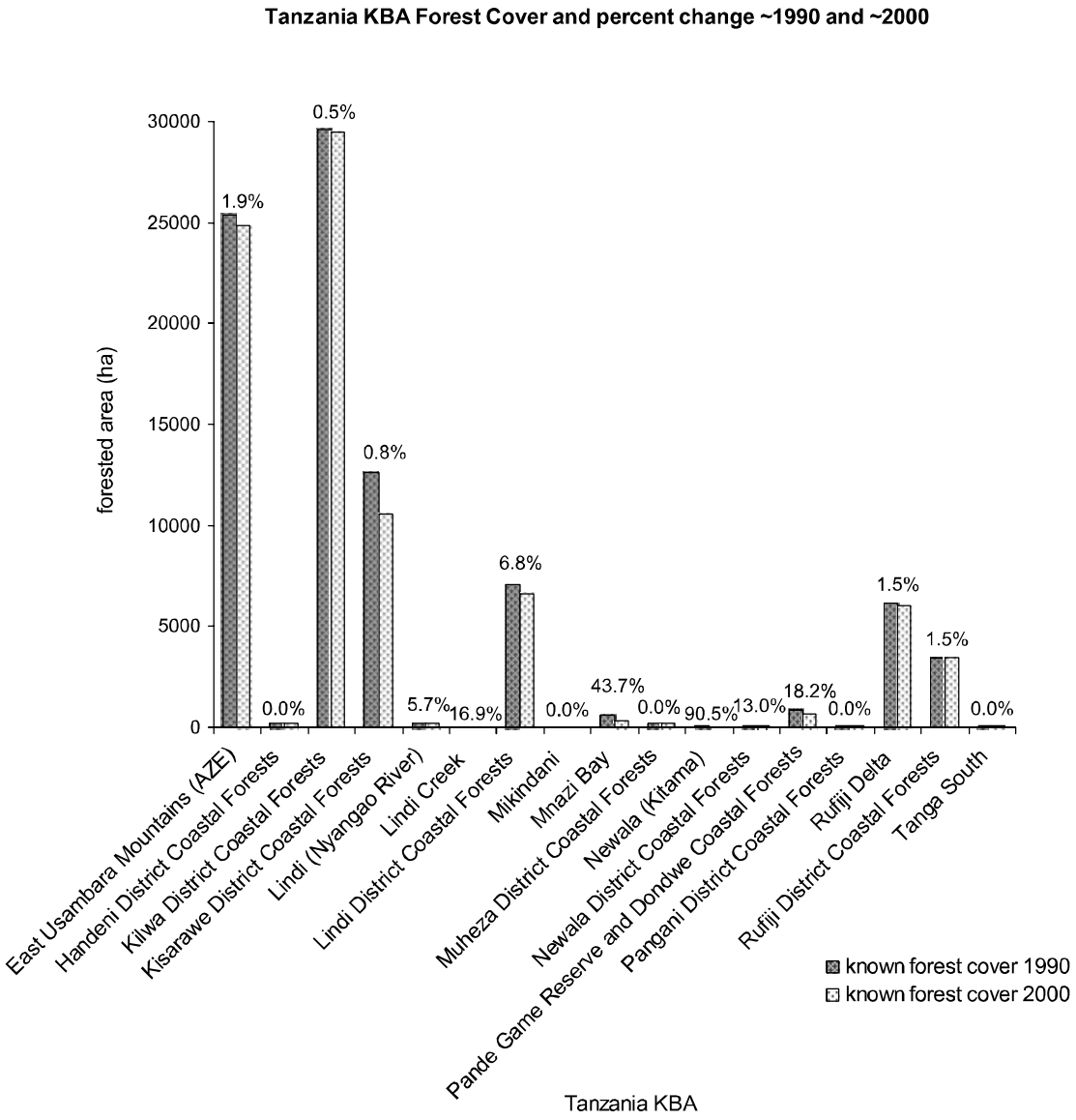


Figure 6. Known forest for ~1900 and ~2000 within Tanzania's KBAs and AZE are graphed in units of hectare (ha). Above each pair of bars is the percent forest loss from 1990 to 2000 for each KBA. Only KBAs with confidence in the forest change statistic greater the 50% are plotted here.

2.1.3 Presence of Globally Threatened Species

Baseline

In 2003 an ecosystem profile (CEPF 2003) produced to provide an overview of biodiversity values, conservation targets or "outcomes", the causes of biodiversity loss and conservation investments then in the EACF. Its purpose was to identify the niche

where CEPF investments would provide the greatest incremental value. This ecosystem profile is useful baseline since it provides information on species and site outcomes. Species outcomes in the profile included those species that were globally threatened (Vulnerable, Endangered and Critically Endangered) according to *The 2002 IUCN Red List of Threatened Species*. Recognising that most species are best conserved through protection of sites in which they occur, site outcomes were also defined for each target species. The results of the outcome definition indicated that 333 globally threatened species occurred in the EACF, with 105 being represented in Kenya and 307 in Tanzania (Table 5). On the other hand, the definition of site outcomes produced 160 Key Biodiversity Areas for the EACF (Table 5).

There are several initiatives in the EACF which contributed substantially towards knowledge about presence and status of species, e.g.

- The Conservation and Management of the Eastern Arc Mountains Forests (CMEAMF) and The Eastern Arc Mountains Conservation Endowment Fund (EAMCEF) in collaboration with the National Biodiversity Database at the University of Dar es Salaam have developed a simple set of Excel spreadsheets that cover the key (endemic, near-endemic and threatened) species of amphibians and birds found in each of the c.150 forest patches of the Eastern Arc Mountains in Tanzania (Howell *et al.* 2006). A total of fifty five (55) amphibian species were found to be endemic or near endemic to the Eastern Arc Mountains. Out of these amphibian species, 37 species are strictly endemic to the Eastern Arc Mountains and 18 species are near endemic. These species can be categorized as Critically Endangered (CR), 6 species; Endangered (EN), 14 species; Vulnerable, 17 species, Least Concern (LC), 12 species; Near Threatened (NT), one species and Data Deficient (DD), 5 species. Forty seven (47) bird species are strictly endemic or near endemic to the Eastern Arc Mountains. These include 21 species which are strictly endemic and 26 species which are near endemic to the mountains. These species can be categorized as Critically Endangered (CR), 3 species; Endangered (EN), 8 species; Vulnerable, 11 species, Least Concern (LC), 21 species and four species have given no status (Howell *et al.* 2006). Comparable tables are available in the taxons focused chapters of Burgess and Clarke (2000) and updated versions of these tables were made by Louis A Hansen for WWF Coastal Forest Ecoregion Programme. They were also used to make the paper by Aziera et al. (2007).
- Over the past 15 years Frontier-Tanzania, a collaborative project first formed in 1989 between the University of Dar es Salaam (UDSM) and the Society for Environmental Exploration (SEE) has conducted extensive baseline biological and resource use surveys in 44 Coastal Forests, 17 East Usambara Forest Reserves, in the Udzungwa Mountains and the Kilombero Valley, Mtwara and Pemba Island among others. Most of the data has been contributed to the National Biodiversity Database at UDSM.
- An inaugural Plant Red Listing Workshop for the EACF was held in March 2006, as a first step in the process of evaluating the conservation status of all the endemic and near endemic species in these areas (IUCN 2006a). An initial 176 taxa were evaluated including all target taxa in the families Amaranthaceae, Anacardiaceae, Ancistrocladaceae, Annonaceae, Apiaceae, Apocynaceae,

Araceae, Araliaceae, Arecaceae, Asteraceae, Canellaceae, Caricaceae, and Cucurbitaceae. 123 (71%) taxa were assessed as Threatened (30 CR, 53 EN, 40 VU), and an additional 12 as Near Threatened.

- Lehmann and Kioko (2005) presented the results of a long-term (1994-2007) and detailed field survey on plants, butterflies and larger moths as well as on the forest structure for Kaya Muhaka, Kaya Kinondo and Kaya Diani (Kenyan Coast), showing that Kaya Muhaka alone has 683 plant and Lepidoptera species on only 150 hectare forest of which 127 are butterfly species and 225 are larger moth species including two new species (Lehmann, 1997; Lehmann, 2008) and five species first recorded for Kenya. Interestingly, Kaya Muhaka has also 127 endemic plant and Lepidoptera species; a very high number for such a small forest while the other two forests have well below 70 endemics each. A further ten new species of Metarbelidae were added by Lehmann (2008) for the coastal forests and Eastern Arc Mountains of Kenya and Tanzania including the newly recorded genus *Paralebedella* for Kenya, Tanzania and Uganda.
- ABRI (2006) provided an overview of the butterfly faunas of the EACF. This includes a database of butterflies found in various localities and a general checklist of threatened butterflies with degrees of threat defined.
- Medley (2007) investigated indigenous knowledge of plant resources around Mt. Kasigau and listed 338 wild woody plants in 74 families and 208 genera identified during the ethnobotanical survey. The relative occurrences of woody plants among Medley's (2007) 55 ecological plots can be used to describe the ecological structure of plant resources at Mt. Kasigau and can act as a baseline.
- Lovett *et al* (??) developed a *Field Guide to the Moist Forest Trees of Tanzania.*
- Owino *et al*. 2008. We assessed the bird species composition and forest conditions of 14 forest patches within the Lower Tana River valley each February and October between 1999 and 2004.
- Herpetofaunal surveys of the Tana River Primate National Reserve were conducted between December 1998 and January 2002 to generate a species list (Malonza *et al* 2006).

As pointed out by Doggart *et al*. (2006), the documented biological importance of the EACF, especially the different Eastern Arc Mountain forest blocks, appears to be significantly affected by the amount of biological study that has been expended. In fact recent extensive surveys have brought in a lot of new records that continue to enrich the Outcomes Database (Doggart *et al*. 2006, Doggart and Loserian 2007, Frontier-Tanzania 2001b, 2005, 2007, Wegner *et al*. 2005). At the moment therefore, changes in numbers of threatened or endemic species within sites seems to be more related to increased knowledge, rather than an indication of changing threat level on the ground.

Monitoring and trends

Since the definition of species and sites outcomes (CEPF 2003), changes in the distribution of globally threatened species in the EACF has been continually tracked through populating an Outcomes Database that is fed with information provided by a network of volunteers and sourced from literature and other secondary sources. At the end of 2006 another assessment was done which took into consideration changes arising

from the release of the *2006 IUCN Red List of Threatened Species* (IUCN 2006b) and new information arising from contributors working in the region. As a result the number of globally threatened species hosted by the entire EACF by the end of 2006 had changed (Table 5). Of the 333 species listed as globally threatened species in the EACF in 2002, 12 species had been down-listed (moved to lower risk categories) and eight up-listed (moved to higher risk categories) by the end of 2006. Most of the down-listing could be attributed to increased knowledge (and one case of change in taxonomy) while most of the up-listing could be attributed to genuine changes in status. The next version of this report will provide an update that includes changes in the 2008 IUCN Red List.

The following species were up-listed from Least Concern (LC) IUCN Red List Category, thus being added to the list of globally threatened species of KBAs where they are found:

- A bird, Madagascar Pratincole *Glareola ocularis* (Vulnerable -VU) - found in Dar es Salaam coast and Sabaki River Mouth.
- A bird, Loveridge's Sunbird *Nectarinia loveridgei* (Endangered - EN) - found in Uluguru mountains.
- A bird, Pemba Scops-owl *Otus pembaensis* (VU) – found in Pemba Island.
- A bird, Basra Reed-warbler *Acrocephalus griseldis* (EN) found in Tana River Delta and Lower Tana River forests
- A bird, Pemba Green Pigeon *Treron pembaensis* (VU) found in Pemba Island
- A mammal, Kihaule's Mouse Shrew *Myosorex kihaulei* (EN) found in Udzungwa mountains.

The following were added to the list of globally threatened species found in the stated KBAs due to new information indicating that they are found in those sites

- A mammal, Lion *Panthera leo* (VU) to Newala District coastal forests and Mtwara District Coastal forests (Wegner *et al.* 2005).
- A plant (Voi Cycad) *Encephalartos kisambo* (EN) – to Mount Kasigau (Faden and Beentje 1989; Whitelock 2002)
- A plant (tree) *Vitex keniensis* (VU) to Kisarawe District coastal forests and Rufiji District coastal forests (Ahrends 2005)
- A newly described plant species *Cola lukei* (EN), - to East Usambara Mountains
- A plant, *Xylopia latipetala* (EN) - to Lindi Coastal Districts (Verdcourt *et al.* 1971, Beentje and Luke (*in prep*)
- An amphibian *Probreviceps macrodactylus* (VU) - to East Usambara Mountains, Mpanga village Forest Reserve, Nguru mountains, South Pare mountains, Udzungwa mountains, Udzungwa National Park, Uluguru mountains and West Usambara mountains (Howell *et al.* 2006)
- An amphibian *Probreviceps rungwensis* (VU) - to Udzungwa mountains (Howell *et al.* 2006)
- An amphibian *Afrixalus morerei* (VU) - to Udzungwa mountains (Howell *et al.* 2006)
- An amphibian *Arthroleptis nikeae* (EN), a newly described species - to Rubeho Mountains (Howell *et al.* 2006).
- An amphibian *Callulina kisiwamsitu* (EN) - to West Usambara mountains.

- The amphibians, *Nectophrynoides viviparus* (VU) and *N. poyntoni* (Critically Endangered - CR*)* - to Rubeho, Udzungwa and Uluguru mountains (Howell *et al*. 2006).
- The insects (dragonflies) *Micromacromia miraculosa* (CR), *Oreocnemis phoenix* (CR) and *Amanipodagrion gilliesi* (CR) - to East Usambara Mountains (Darwall *et al*. 2005)

In fact in the recent past there have been several new (and potentially new) descriptions and splits of species in the EACF (Table 6) in additional to reviews of nomenclature (e.g. Butynski *et al*. 2006).

Table 5: Numbers of Globally Threatened species in major taxonomic groups as assessed in 2003 and 2007 in the EACF

	2002							2006					
	Degree of Threat				Country			Degree of Threat				Country	
Taxonomic Group	**CR**	**EN**	**VU**	**Total**	**Tanzania**	**Kenya**		**CR**	**EN**	**VU**	**Total**	**Tanzania**	**Kenya**
Mammals	5	8	16	29	27	9		5	8	16	29	27	10
Birds	3	10	15	28	24	10		3	10	15	28	24	10
Amphibians	4	11	18	33	31	3		5	11	22	38	37	4
Gastropods*	3	3	1	7	4	3		3	3	1	7	4	3
Plants	9	36	191	236	221	80		9	38	192	239	222	81
Insects*								2			2	2	
Total	**24**	**68**	**241**	**333**	**307**	**105**		**27**	**70**	**246**	**343**	**316**	**108**

*Data on the invertebrate biodiversity in the EACF is meager. Reptiles, freshwater fish and nearly all invertebrates were absent from the species outcomes as a result of either (i) lack of information on these species or (ii) lack of required "assessment" for possible inclusion in the Red List. Among invertebrates, information was only available for threatened Gastropods. Two dragonfly species have now been added to the list following an assessment in 2005 by Viola Clausnitzer.

Table 6: Some examples of recent new (and potentially new) descriptions and splits of species in the EACF

Group	Genus/Species	References or source	Location	Comment
Amphibians (Anura, Arthroleptidae)	*Arthroleptis* sp. *Leptopelis* sp.	Menegon *et al*. 2008.	Nguru Mountains, Eastern Arc, Tanzania	2 new species in Nguru
Amphibians (Anura, Bufonidae)	*Nectophrynoides*	Menegon *et al*. 2004, 2008.	Eastern Arc Mountains, Tanzania	5 new species
Amphibians (Anura, Brevicipitidae)	*Callulina*	Menegon *et al*. 2008, Rafael *et al*. 2004.	Eastern Arc Mountains, Tanzania	5 new species: 1 in West Usambara, 4 in Nguru

Amphibian (Anura, Microhylidae)	*Hoplophryne* sp.	Menegon *et al.* 2008	Eastern Arc Mountains, Tanzania	1 new species in Nguru
Amphibian (Anura, Petropedetidae)	*Petropedetes* sp.	Menegon *et al.* 2008	Nguru Mountains, Eastern Arc, Tanzania	1 new species
Amphibian (Gymnophiona, Caeciliidae)	*Boulengerula* sp. *Boulengerula* sp. *Scolecomorphus* sp.	Müller *et al.* 2005 Menegon *et al.* 2008 Menegon *et al.* 2008	Taita Hills Nguru Mountains Nguru Mountains	3 new species
Dwarf Chameleon (Squamata)	*Rhampholeon* sp. *Rhampholeon* sp.	Menegon *et al.* 2002 Menegon *et al.* 2008	Udzungwa Mountains Nguru Mountains	2 new species
Frog	*Arthroleptis nikeae*	Doggart 2006, Doggart 2003, Poynton 2003	Rubeho	new species, Now EN (IUCN 2008)
Reptile (Gerrhosauridae)	*Tetradactylus*	Salvidio *et al.* 2004	Udzungwa Grasslands	new species
Elephant Shrew	*Rhynchocyon udzungwensis*	Rovero & Rathbun 2006; Rovero et al. (2008)	Udzungwa Mountains	new species
Shrew	*Congosorex phillipsorum*	Stanley *et al.* 2005	Udzungwa Mountains	new species, Now CR (IUCN 2008)
Bird (Akalat)	*Sheppardia aurantiithorax*	Beresford *et al.* 2004; Doggart *et al* 2006	Rubeho; Ukagurus; Ulugurus	newly described
Bird (Batis)	*Batis crypta*	Fjeldsa° *et al* 2006	Eastern Arc Mountains, Tanzania	new species
Bird (Partridge)	*Xenoperdix obscurata*	Doggart *et al.* 2006; Bowie & Fjeldsa° 2005; Fjeldsa° & Kiure 2003	Rubeho	newly split
Mangabey (Kipunji)	*Rungwecebus kipunji*	Davenport *et al.* 2006, Jones *et al.* 2005, Olson *et al.* 2008	Udzungwa Mountains and Southern highland forests	new species, Now CR (IUCN 2008)
Plant (Annonaceae)	*Toussaintia*	Deroin and Luke 2005	Udzungwa Mountains	new species
Plant (Coffee)	*Coffea*	Davis and Mvungi 2004	Eastern Arc Mountains, Tanzania	2 new species
Plant (Fabaceae, Faboideae)	*Crotalaria mwangulangoi*	Gereau and Bodine 2005	Udzungwa Mountains	new species
Plant (Rubiaceae, Faboideae)	*Rytigynia*	Lantz and Gereau 2005	Northern Tanzania	new species

Larger moths (Lepidoptera, Metarbelidae)	*Metarbela, Lebedodes, Ortharbela, Paralebedella, Salagena*	Lehmann, 1997; Lehmann, 2008	Coastal forests and Eastern Arc Mountains of Kenya and Tanzania	11 new species
Butterfly (Kihansi Charaxes)	*Charaxes*	Mtui, D.	Proposed Kihansi Conservation Area in Tanzania	New species

2.1.4 Change in species abundance for a few key species (e.g. endemics, threatened, migratory or other 'flagship' species

Baseline

A number of isolated field studies assessing abundance changes for particular species of interest in the EACF have been taking place, most of them prior to 2005. A summary of such known activities and apparent trends is provided in Appendix 1.

Other single field surveys of species that have already been carried out will form useful baselines for future monitoring of those species, e.g. (1) an assessment of the distribution and population size of the land snail *Gulella taitensis* (Gastropoda: Streptaxidae) endemic to the Taita Hills, Kenya (July-December 2000, Lange 2006) (2) research carried out in the Arabuko-Sokoke forest (2005-2006) that is hoped to provide data on the abundance of the Ader's Duiker *Cephalopus aders* (3) a 2006 survey of population densities of the Critically Endangered Taita Thrush *Turdus helleri* in the Taita Hills. (N. Otieno *in litt*), (4) ongoing studies on at least four species endemic to the Pemba Island (J. Juma, *pers comm.*), (5) Schöning *et. al*. (2006) examined the presence of the army ant *Dorylus* (*Anomma*) *molestus* in the highly fragmented and threatened forests of the Taita Hills and the Lower Tana River forests. This study has also helped significantly to extend the knowledge on the distribution and the habitat requirements of *D.* (*Anomma*) *molestus*.

Monitoring and trends

Examples of studies that offer comparative data that could give trends can be found in Appendix 1 and some are highlighted below, including two case studies:

- The Pemba Flying Fox *Pteropus voeltzkowi* population continued to increase exponentially at 41% in 2005, 16% in 2006 and 11% in 2007 (Juma 2007).
- Comparison of data arising from monitoring activities and separate species field surveys indicate that prior to 2005 there was evidence of possible declines in abundance of Spotted Ground-thrush *Zoothera guttata* in its Kenyan non-breeding grounds (Britton *et al.*1980, Bennun 1987, Waiyaki 1995, Ndang'ang'a *et al.* 2004) and in Litipo Forest, Tanzania (Bagger *et al.* 1990, Jensen *et al.* 2005). Few records and the numbers recorded in Rondo Forest (Tanzania) suggest a very small population in this site where the species is known to be breeding (Holsten *et al.* 1991, Bagger *et al.* 1990, Eriksen *et al.* 1994, N. Baker *in litt*, J. Jasson *pers. comm*). Focused monitoring of the species has been initiated for the species in a few selected sites.

- Counts of primate groups in (Red colobus *Procolobus gordonorum*, Angolan black and white colobus *Colobus angolensis palliatus*, Sykes monkey *Cercopithecus mitis* and Yellow baboon *Papio cynocephalus* prior to and in 2001) and assessments of vegetation in1 ha permanent sample plots and 10m x 4 km transects in March 2007 show that primate and vegetation composition have been seriously affected by logging in the Udzungwa Mountains and Magombera Forest, Tanzania (A. Marshall *pers comm.*, Marshall *et al.* 2005, Rovero *et al.* 2006).
- Although a little inconsistent, monitoring of six threatened bird species in Arabuko-Sokoke Forest (Kenya) prior to and in 2005 showed apparently stable abundance and composition (C. Jackson, *unpublished data*, Thompson *et al.* 2007).
- The Sokoke Scops-owl *Otus ireneae* population in Arabuko-Sokoke forest was stable between 1984 and 1998 (Virani 1994, 2000), but transect surveys conducted in 2005 revealed that the owl densities had not changed much although the overall area under good forest may have reduced (Munir Virani, pers. Comm.).
- Initial crude analysis comparing 1999/2000 with recent 2006/2007 census data for the Critically Endangered Uluguru Bush-shrike *Malaconotus alius* indicates that its population in the Uluguru North is probably stable (J. John *pers. comm*).
- A 16-year (1989-2004) study (Newmark 2006) of forest disturbance effects on understory bird community structure and composition in East Usambara Mountains, Tanzania found out that forest disturbance resulted in: increased temporal variability in species richness; more that one-half of all guilds were affected by forest disturbance; and recovery time for many understory species adversely affected by forest disturbance was at best very long.
- Based on the outcomes of separate surveys comparing records collected within and prior to 2003 and recent (2004 and 2005) surveys there is an apparent steep decline of the Kihansi Spray Toad *Nectophrynoides asperginis* in the southern Udzungwa Mountains (Weldon and du Preez 2004, IUCN *et al.* 2007). In fact according to most experts, it is now extinct.
- Comparisons between prior and 2005 survey data for three primates (Tana River Red Colobus *Procolobus rufomitratus*, Tana River Red Colobus *P. rufomitratus* and Tana River Mangabey *Cercocebus galeritus*) in the Lower Tana River forests show possible declines in total numbers of these species, despite having apparently stable number of groups for one of the species - the Tana River Mangabey (Luke *et al.* 2005).
- African elephant *Loxodonta africana* data in Arabuko-Sokoke Forest are anecdotal, but there have been suggestions that the elephant population has increased from 120 to 150 in 10 years (Marten 2005).
- Two nine-month periods of butterfly monitoring in Arabuko-Sokoke – one in 1993 before butterfly harvesting started and one in 1997 after four years of operations suggest that butterfly harvesting seems not to have had any impact in wild populations (Gordon and Ayiemba 2003). More recent butterfly monitoring data largely support this earlier conclusion, but are yet to be published (Ian Gordon *pers. comm.*)

- The coastal forests which are located a few kilometers further inland from the shoreline of the Indian Ocean in south-east coastal Kenya have particularly more rare and endemic Lepidoptera, more species which also occur in West and Central Africa as well as much more ancient (at least Tertiary) Metarbelidae (Lehmann, 2008).
- Permanent Sampling Sites surveyed once per year from 1994-2007 in Kaya Kinondo (Kenyan Coast) indicated that this Kaya is completely undisturbed at least since 1994 and that it is largely covered by a rare forest type in Kenya, namely the "Groundwater forest on coral rag" (Lehmann and Kioko, 2005).
- Permanent Sampling Plots (PSPs) surveyed thrice (1990, 1998; 2004) in Arabuko-Sokoke forest show that the forest has maintained its regenerative capacity; abundance of seedlings and saplings has remained fairly steady (Simon Wairungu *pers. comm.*).
- Whereas all the other districts in the Kenya coast witnessed declines in their total wildlife populations between 1977/8 and 1994/6, Kwale district witnessed a 47% increase (World Resources Institute *et al.* 2007).
- Two primates found in the EACF are among the world's 25 most endangered primates in the 2004-2006 (Mittermier *et al.* 2006): Tana River Red Colobus *Procolobus ruformitratus* and Sanje River Mangabey *Cercocebus sanjei*.
- Based on the focus of a project that is decreasing illegal activities and improving management in both Jozani-Chwaka Bay National Park (Zanzibar) and in the community forests, all indications are that CARE and Zanzibar Department of Commercial Crops, Fruits and Forestry (2008) are on track to ensure that Aders' Duiker and Zanzibar Red Colobus populations are stable or increasing within 2 years.
- Borghesio et al. (2008) report the preliminary observations and results of a survey that collected information on the distribution, habitat selection and relative abundance of those species of greatest conservation concern. Amongst the 124 species recorded during the survey, six are listed in the global Red Data book and nine are considered to be restricted-range.Whilst ground-foragers (Usambara Thrush *Turdus* (*olivaceus*) *roehli*, *Modulatrix* spp.) were observed to be clearly dependent on intact forest, Banded Sunbird *Anthreptes rubritorques*, Amani Sunbird *Hedydipna pallidigastra*, Fischer's Turaco *Tauraco fischeri*, Kenrick's Starling *Poeoptera kenricki* and Long-billed Tailorbird *Artisornis moreaui* are also frequent in successional habitats created by disturbance, at forest edges or even in relatively open, agricultural landscapes. This suggests that some threatened species might benefit from conservation initiatives (e.g., planting of useful indigenous trees) specifically targeted to counter the degradation of such 'fringe' habitats.

Eradication of invasive species

- Between 2005 and 2007 the total area covered by the invasive *Maesopsis eminii* in the Ngezi-Vumawimbi Nature Forest Reserve (Pemba) has been reduced by 75 ha (15%) from the original 500 ha through eradication by ring barking and uprooting seedlings (Juma 2007).

Monitoring of primates in the Udzungwa Mountains National Park

By Francesco Rovero

Monitoring of diurnal primates in Mwanihana forest, Udzungwa Mountains National Park (UMNP), was being established in 1998 by individual researches and conducted discontinuously until 2004. The programme was resumed and expanded in 2007 by the Udzungwa Ecological Monitoring Centre, which is a facility of UMNP established and administered by Italy's Museo Tridentino di Scienze Naturali (see www.udzungwacentre.org for information). Primate group counts are conducted by a field biologist and assistant on monthly basis, using 4 km line-transects. The same protocol is conducted in the southern and less protected Uzungwa Scarp Forest Reserve.

Figure 7 summarizes the results obtained so far in terms of mean primate groups' encounter rates (groups per km walked). For all diurnal monkey species, no apparent trend with time has emerged, indicating possible stability of these populations. The species censused include the two Udzungwa-endemic monkeys: the IUCN Vulnerable red colobus *Procolobus gordonorum* and the IUCN Endangered Sanje mangabey *Cercocebus (galeritus) sanjei*. Variations in the encounter rates were attributed to inter-observer inconsistencies in primate detection, with possible exception of the yellow baboon that might show evidence of decrease, yet to be confirmed and interpreted with certainty.

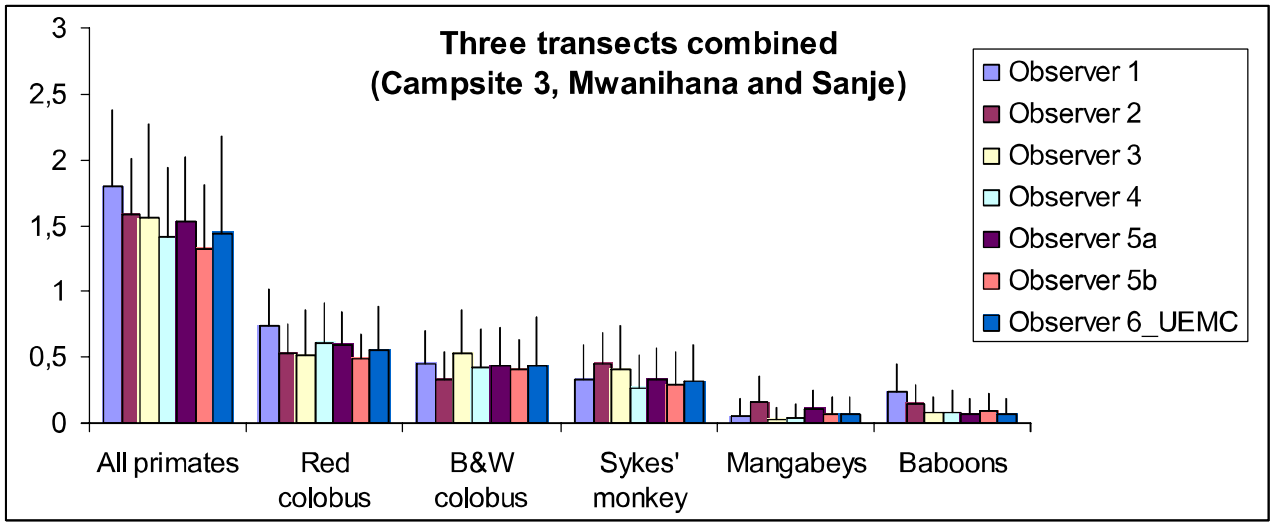


Figure 7: Results (mean number of primate groups seen per km and standard deviation) of primate counts pooled for 3 transects censused in Mwanihana forest during 1998 -2007 (the last set of data being collected by UEMC). Data are from Rovero et al. (2006), Rovero and Mtui (2006), Udzungwa Ecological Monitoring Centre (2008).

Sources:

Rovero F., Struhsaker T.T., Marshall A.R., Rynne T.A., Pedersen U.B., Ehardt C.L., Butynski T.M. and Mtui A.S. 2006. Abundance of Diurnal Primates in Mwanihana Forest, Udzungwa Mountains, Tanzania. International Journal of Primatology, 27: 675-697.

Rovero F. and A. Mtui 2006. Comparing multi-observer, line transect data for primate monitoring: a case from the Udzungwa Mountains of Tanzania. Proceedings of the 21st Congress of the International Primatological Society. International Journal of Primatology, 27 (Special Issue): abstract #350.

Udzungwa Ecological Monitoring Centre 2008. Annual Technical Report - Year 1 (December 2006-December 2007). Unpublished report to Tanzania National Parks and Museo Tridentino di Scienze Naturali.

Population Status of the Critically Endangered Uluguru Bush-shrike *Malaconotus alius*
By Jasson John

Uluguru Bush-shrike is among the highly globally threatened bird species in the world. Its limited population size, vulnerability of its preferred habitats and its extremely restricted distribution led to the species being listed as a critically endangered by IUCN in 2006. It endemic to the Uluguru Mountains in Tanzania, and its habitats are highly fragile and threatened by human activities. Since its discovery in 1927, the species has been known to be confined in one of the main forest block of the Ulugurus, the Uluguru North Forest Reserve within an area of 84 sq. km. The Uluguru North and South Forest Reserves are separated by the Bunduki Gap (1.5km), thought by many to be a potential obstacle to movements of Uluguru Bush-shrike, a canopy-reliant bird. Surveys in 1999-2000 supported by the Wildlife Conservation Society of Tanzania (WCST) estimated about 1200 breeding pairs only found in the Uluguru North. Data gathered between 2006 and 2008 supported by WCST and CEPF have established that its estimated population has not changed significantly although more numbers were estimated (John in litt) cf to the previous estimation of 1200 breeding pairs. The record of 2 pairs in the Uluguru South was a significant milestone during the recent survey and gives hope to its continued survival. The record of the Uluguru Bush-shrike in the Uluguru South in 2006/2007 survey highlighted the importance of reconnecting these two forests to allow for the exchange of genetic diversity. A monitoring programme supported by Birdlife partners including RSPB and a support through Species Guardian/Champion Programme under BirdLife International is underway to collect long term data and address habitat destruction of its habitats. This is in line with the Tanzanian Government Forest Policy and Eastern Arc Mountains Conservation strategy and the Tanzania Government is working on a proposal to reconnect the two forests to a single Nature Reserve.

Key references

Baker. N.E., Baker, E.M. (2002). Important Bird Areas in Tanzania: a first inventory. Wildlife Conservation Society of Tanzania, Dar es Salaam, Tanzania.
BirdLife International (2008) Species factsheet: *Malaconotus alius*. Downloaded from http://www.birdlife.org on 25/10/2008
John, J.R.M. (2005). Globally threatened bird species: A priority for conservation for the Eastern Arc Mountains and coastal forests in Tanzania, *Proceedings of the 5th Scientific Conference*, Tanzania Wildlife Research Institute, Impala-Arusha, Tanzania.
URT (2002). Tanzania Forestry Act. Forestry and Beekeeping Division, Dar es Salaam Tanzania.
URT (1998). Tanzania Forestry Policy, Forestry and Beekeeping Division, Dar es Salaam.
URT (2006). Protected area strategy for the Eastern Arc Mountains. Ministry of Natural Resources.

2.1.6 Environmental (ecological and economic) services from the site e.g. quality and quantity of water flowing from the site, soil erosion, non-timber forest products, pollination

Baseline

Baseline estimates done in 2001 exist for the following economic values derived from the Eastern Arc Mountain forests of Tanzania: Total annual economic value of (a) water, hydropower and non-timber products (b) water to town people (c) electricity to domestic users, and (d) biodiversity and non-timber forest products (Pfliegner and Burgess 2005).

In addition, the York Institute for Tropical Ecosystem Dynamics (KITE) is combining new environmental datasets with modelling initiatives to explore past, present and future ecosystem dynamics at a number of sites along the Eastern Arc Mountains of Kenya and Tanzania. This involves linking palaeoecological data sets with a bioclimatic model to constrain past, present and future reconstructions to inform future management.

Some fieldwork focused on raising sedimentary cores from numerous locations in the Eastern Arc Mountains has already been done and more work is in progress. More details on this initiative can be obtained from http://www.york.ac.uk/res/kite.

The Valuing the Arc (VTA) programme (2007-2011) is focusing on the Eastern Arc Mountains in Tanzania (http://valuingthearc.org/). The aim of the programme is to develop a general procedure for analysing and synthesizing detailed information on ecosystem services, and for identifying institutions capable of capturing ecosystem values in decision-making. The VTA programme is implemented by WWF Tanzania Programme Office in collaboration with other partners working on modules based on biodiversity, water, carbon, timber products, non timber products, ecotourism, pollination/agriculture and valuation of ecosystem services. So far VTA has made several achievements:

- Biodiversity data sets for the Eastern Arc study area, which cover about 25% of the land area of Tanzania, have been synthesized.
- Eight 1 ha plots have been established in the Udzungwa Mountains and three in the West Usambara Mountains for undertaking detailed estimates of carbon storage and uptake.
- Existing timber inventory data have been collated for 14 Districts.
- Inventory of the available data on non-timber forest product for the Eastern Arc have been compiled.
- Data from 55 rainfall stations and 20 river gauging stations have been assembled, together with land cover data and a detailed Digital Elevation Model (DEM) for the area to run the Soil and Water Assessment Tool (SWAT) hydrological model in the Eastern Arc Mountains.
- A survey of ecotourism numbers and their values to within the Eastern Arc Region have been designed.
- A map of governance regimes has been compiled for the study area.
- A report on crops and their pollinators has been produced and indicative values of the pollination service have been calculated.
- A modelling tool for biodiversity, pollination, carbon storage & sequestration, timber & non-timber production, water quality, water quantity & timing has been built.
- Scoping study on PES and carbon trade issues has been conducted.

Monitoring and trends

A summary of known studies assessing environmental services and apparent trends is provided in Appendix 1.

In addition, Carbon Stock storage for Lower Tana River Forests (1992-2005) and Arabuko-Sokoke Forest (1992-2004) have been assessed and found to be declining (Glenday 2005a,b).

An assessment of water flow trends from 19 Gauging stations for Rivers Pangani, Sigi, Ruvu, Wami, Kilombero, Kihansi and Great Ruaha shows that the flow rates have been declining in the previous years (1950-1975; 1975-1995; 1990s, BICO 2005, Mtalo *et al.* 2005).

In an effort to assess the potential for mobilizing carbon finance towards conservation and restoration of forests in the Eastern Arc Mountains of Tanzania, the

Edinburgh Centre for Carbon Management estimated changes in carbon storage of various blocks between from 1995 to ~2000 (ECCM 2007). ECCM conluded that there is considerable potential for using carbon finance to reduce deforestation pressures and restore areas of degraded forests. In particular, the ECCM assessment of deforestation found that there was a loss or severe degradation of approximately 35,000 ha of natural forest; almost 10% of natural montane and sub-montane forests between 1995 and ~2000. It is estimated that the CO_2 emissions associated with this loss of vegetation to be approximately 10.6 million tonnes carbon (equivalent to 38.7 million tonnes CO_2). ECCM found large differences in loss of forest and associated carbon stocks between different areas with the Eastern Arc Mountains: from 0 – 21% between 1995 and ~2000 (Appendix 1). South Nguru and East Usambara had the highest losses over the period – around 20%, but other areas – West Usambara, Rubeho, North Nguru and Ukaguru appear to have suffered much lower levels of loss (0 to 5%). Overall there is a clear trend that shows that rates of deforestation are significantly higher in close proximity to roads and existing settlements.

Yanda and Munishi (2007) undertook detailed hydrological analysis of the Ruvu (Uluguru) and Sigi (Usambara) River basins in relation to land use/cover change. This included among others, collection of time series data of runoff records on the Ruvu and Sigi Rivers, and the corresponding changes in land cover over a long span of time. Although there were no continuous monitoring programmes for water quality in the two basins, longer time turbidity data series could be obtained for the Ruvu River. Analysis of thee data set for mean monthly turbidity measured at the Morogoro Road Bridge in the Ruvu River for a period of 11 years (January 1992 – November 2002) show that water turbidity in the Ruvu River increased from 130 Nephelometric Turbidity Units (NTU) in 1992 to 185 NTU in 2002. This is an increase in turbidity in the river of 5 NTU per year reflecting increases in sediment loading into the river over the same time. Such trends of increasing water turbidity are associated with vegetation degradation which results into erosion and higher sediment delivery into the streams.

For the shorter time periods of available water quality data, the trends of average daily sediment load showed an increase in sediment loading in the Ruvu River up to early 1970s after which there was a decrease in sediment loading. The Sigi River shows the same trend in turbidity which is an indication of increase in sediment loading into the river up to the early 1970s. The increase in sediment loading during this period may be attributed to higher rates of reduction in vegetation cover. Yanda and Munishi argued that the upper catchments of the Ruvu river basin contributes more to the observed turbidity trends (approximately by more than 70%) due to various reasons contained in the report. Analysis of river flows in the two basins show that annual flow (discharge (m^3s-1) and volumes (m^3) are predominated by decreasing trends over a period of more than 30 years. Of significance is the declining trend in dry season flows which are associated with degradation of natural forests/woodlands (higher forms of cover) to cultivated/bare lands (lower forms of cover). Decreasing trends in the dry season and increasing trends in the rain seasons is seen as an indication of low water storage capacity in the catchments.

2.2 Pressure

2.2.1 Change in extraction intensity of key species

Baselines and trends

Most studies on extraction intensities of different taxa were carried out prior to 2005 and the majority (10 out of 15) demonstrated increasing trends in extraction intensity within the case study sites. A few species extraction studies are known for the period 2005 and 2006, the majority of which still show increasing trends of extraction. A summary of such known studies and apparent trends is provided in Table 7 and Appendix 1. Trees are apparently the taxa whose extraction has been most-studied in the region. One of the most extensive studies on timber extraction has been done in southern Tanzania, with recent report (Milledge *et al.* 2007) expressing concerns that "at the harvest rates experienced during 2003 and 2004, and based on official forest inventories, it is apparent that all harvestable Class I and II trees in Rufiji and Kilwa Districts will have been felled within 20 years".

Elsewhere, Permanent Sampling Plots (PSP's) were used as a representative of the whole newly gazetted Ngezi-Vumawimbi Nature Forest Reserve(Pemba) and within these plots there was an approximate reduction in illegal logging and harvesting of 100% (Juma 2007). Similarly, preliminary indications from the data collected between January 2006 and December 2008 in Jozani-Chwaka Bay National Park (Zanzibar) are that the project executants are on track to accomplish their set target of reducing Illegal activities (poaching, fuelwood and building pole extraction) by 50% (CARE and Zanzibar Department of Commercial Crops, Fruits and Forestry, 2008).

In June / July 2006 the Wakuluzu -Friends of the Colobus Trust (2008) conducted a resurvey of retail outlets (that had originally been baseline surveyed in August 2005) to determine which ones had achieved a 75% plus Good Woods stock level, the aim being that these outlets would then get a poster promoting them as a Good Wood outlet. The survey revealed that only one out of the 37 outlets has achieved a 75% or greater Good Wood stock level by number of carvings, although 13 of them have achieved a 50% or greater level. The average level of Good Wood carvings in stock by cubic metre has gone from 46% to 62%. There has been a move in the right direction, however not as great as hoped for.

Topp-Jørgensen *et al* (in review) assess the impact of hunting by comparing relative densities of species between the little-hunted West Kilombero Scarp Forest Reserve (WKSFR), the medium-hunted Udzungwa Scarp Forest Reserve (USFR) (traps/km^2) and the heavily-hunted New Dabaga Ulangambi Forest Reserve (NDUFR) using number of traps per km^2 as an indicator of hunting intensity. This study constitutes an important baseline for monitoring the effect of subsequent implementation of Joint Forest Management in the Udzungwa Mts. Further, Nielsen (2006) evaluates the importance, cause and effect of bushmeat hunting and the implications for the feasibility of Community Based Wildlife Management (CBWM) in the Udzungwa Mts. Nielsen concludes that CBWM only has limited capacity to reduce these causes of hunting, maintain the communities' interest and offset the opportunity costs of conservation.

Ndangalasi *et al.* (2007)assessed the extraction of plant products from Uzungwa Scarp Forest Reserve (USFR). The densities of eight commonly harvested tree species, most of which were used as building poles, were approximately 2.4–4.5 times lower in

disturbed versus undisturbed habitats across all four sites in USFR. Interviews with 91 women and 54 men suggested that most species were harvested for medicinal uses (57 species) and building purposes (50 species). The study revealed that harvesting of NTFPs occurs even in the protected forest area, and that over-exploitation not only threatens species of high-demand, but could also alter forest structure and composition.

Table 7: Examples of trends in extraction intensity

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Frequency of traps	Investigation of the status of bushmeat trapping	Mammals	Arabuko-Sokoke Forest	2006 cf 2003	Increase	According to ages of the traps found, the frequency of traps seems to have increased in the Nature Reserve since the year 2003 from 50 to about 400 new traps set per year	Lutz and Newiadomsky (2007)
Resource timber stock (cubic metres)	Inventory of resource stock	*Brachylaena huillensis*	Arabuko-Sokoke Forest	??	Decline	The entire resource could be depleted in less than 2-3 decades	CIFOR (2002)
Proportions of lower value tree species in trade	Monitoring of timber trade and associated socio-economic factors: Impact of Mkapa Bridge	Trees	Rufiji District	2001 cf. past	Increase	Over-harvesting of higher value hardwood specieshas pushed traders to exploit a larger number of alternative species, mostly Class V (e.g. Hymenaea verrucosa, Trichilia emetica)	Milledge and Kaale (2005); Milledge (2004)
Harvest areas	as above	Trees	Rufiji District	2001 cf. past; 2001-2003	Increase	Harvest areas have moved southwards as areas become over-exploited; most pronounced for *Pterocarpus angolensis* and *Dalbergia melanoxylon*	Milledge and Kaale (2005); Milledge (2004)
Harvest levels of under-size trees	as above	Trees	Rufiji District	2001 cf. past	Increase	Fewer large trees remain in wild stands	Milledge and Kaale (2005); Milledge (2004)
Trade volumes	as above	Trees	Rufiji District	2003 (bridge opened) cf. past	Increase	Observations and discussions with stakeholders indicate rapid increase in trade volumes since opening of bridge.	Milledge (2004)
Extraction intensity	Comparison of past extraction values with recent	Trees	Vikindu FR, Pande GR, Pugu FR	2005 cf. past 10 years	changes in harvested and remaining tree species	Harvesting pressures subsequently targetting less profitable species and further moved to charcoal burning	Ahrends (2005)
Extraction intensity	Comparison of past extraction values with recent	Trees	Ruvu South FR, Namakutwa FR, Kiwengoma FR	2005 cf. past 10 years	changes in harvested and remaining tree species	All valuable timber species logged out	Ahrends (2005)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Extraction intensity	Comparison of past extraction values with recent	Trees	Mchungu FR	2005 cf. past 10 years	Stable	no substantial discrepancy between previous and current timber values	Ahrends (2005)
Trade volumes	An assessment of wildlife trade	Animals	East Usambara Mountains	1998-2001	Decline	Overall greatly reduced trade since 1998 although increase in trade recorded from areas further from Amani NR	Roe *et al.* (2002)
Number of traded classes and species	An assessment of wildlife trade	Animals	East Usambara Mountains	1990-2001	Increase		Roe *et al.* (2002)
Trade volumes	An assessment of wildlife trade	Birds	East Usambara Mountains	1995-2001	Decline	Bird sales almost completely ceased after 1995	Roe *et al.* (2002)
Local prices in US Dollars	An assessment of wildlife trade	Animals	East Usambara Mountains	1990-2001	Decline	Local prices have continually declined	Roe *et al.* (2002)
Trade volumes	An assessment of wildlife trade	Reptiles and invertebrates	East Usambara Mountains	1990-1995	Increase	Trade dominated by reptiles and invertebrates	Roe *et al.* (2002)
Trade volumes	An assessment of wildlife trade	Reptiles	East Usambara Mountains	1995-1998	Decline	Decline but involving a wider diversity of species	Roe *et al.* (2002)

2.2.2 Changes in human population density in wards/divisions containing Eastern Arc or Coastal Forests

Detailed national human population census data exist for 1969; 1979; 1989 and 1999 in Kenya (Kenya National Bureau of Statistics 2006) and for 1967; 1978; 1988 and 2002 in Tanzania (Tanzania National Website 2003). Generally human population (total and density) have been increasing over the census years at the regional/provincial, district and ward/divisional levels in the localities containing the Eastern Arc or Coastal Forests.

Interesting trends have however been observed for the two recent intercensal population growth rates in Kenya (1979- 1989; 1989-1999) and Tanzania (1978-1988; 1988-2002, Figure 8a&b): most of the regions in Tanzania (Kilimanjaro, Tanga, Lindi, Iringa, South Unguja, North Pemba, South Pemba, Dar es Salaam) have shown declines in intercensal growth rates; Morogoro region and Coast Province (Kenya) have had stable intercensal growth rates; whereas Pwani, Mtwara and North Unguja have shown declines in growth rates.

At the district level, in Tanzania 9.7 million people (27% of national population) from 42 districts depend on forest products in one way or the other, yet some districts have relatively fewer forests than others (e.g. Muheza District has nine KBAs compared to Iringa Rural's which has one, John and Pius 2007) . This would in turn translate to intense pressure to some of the KBAs compared to others based on the human population depending on them for forest products.

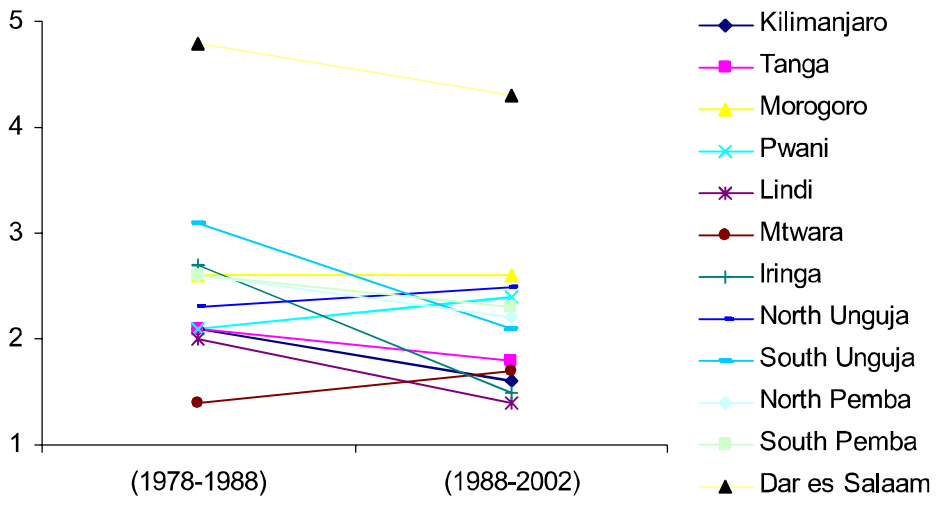


Figure 8a: Intercensal human population growth rates for Tanzanian Regions in the EACF

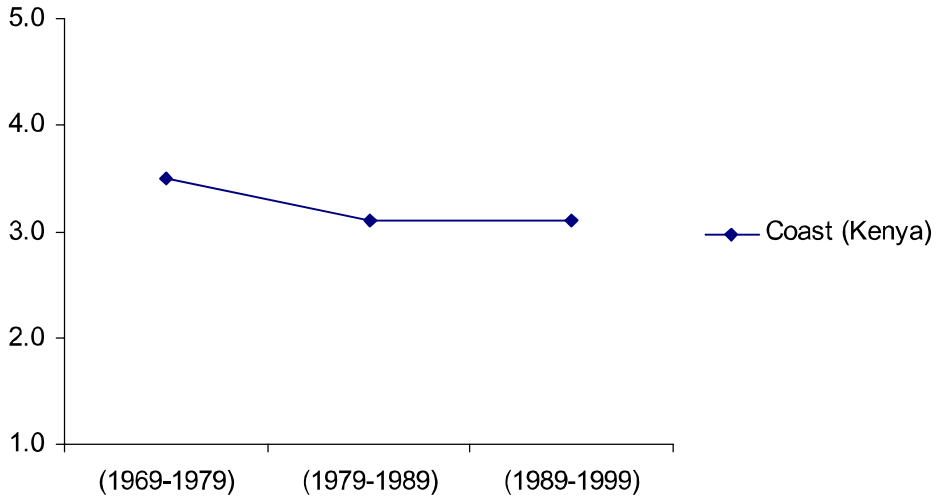


Figure 8b: Intercensal human population growth rates for Kenyan Coastal Province

2.2.3 Fire Frequency

Baseline

Forest disturbance assessments done at various sites have produced information on fire occurrence within those sites (Appendix 1). Forconsult (2005) showed that fire occurred in 23 forests out of 25 Eastern Arc Mountains (EAMs) forests studied in the 14 districts of the EAMs in Tanzania. FORCONSULT-SUA and TAFORI (2006) showed that fire is a very serious threat to the forests and other vegetation cover in the Eastern Arc Mountains with and the most affected districts in Tanzania being Kilombero, Kilindiand Mpwapwa. In comparison, Korogwe and Mvomero are mildly affected whereas Mwanga,

and Mufundi Districts have very few incidences of fire. The main causes of forest fires were: preparation of agricultural fields, hunting, pastoralism, charcoal burning and timber harvesting. Other minor causes include honey collection, culture and arsonists. In most of the areas, fire is persistent due to a lack of funds to facilitate patrols, lack of village by-laws and awareness amongst the local communities.

Monitoring and trends

Moderate Resolution Imaging Spectroradiometer (MODIS) satellite showed that the number of fire points within forest reserves, plantations and the remaining Eastern Arc portion of 14 Districts have generally increased over the past five years (Wurster and Burgess 2005; Table 8).

Table 8: Fire incidences in selected Districts in the Eastern Arc Mountain Forests of Tanzania

District	Period	No. of fires	Remarks
Kilindi	1988 - 2000	28	Year incidences unavailable
Kilombero	1997 - 2006	34,40,22,19,15,150,6, 6,7,3*	
Korogwe	2000 - 2006	7,6,11,10,6,4,3*	* Chrological order
Mufindi	1997 - 2006	36,24,28,32,19,23,15,17,14,12*	
Mwanga	1998-2006	35,10,20,15,50,10,101,12,25,None*	
Lushoto	1997 - 2006	4,1,2	Respectively 1997, 2001, 2002 & 2005

Bracebridge (2007) used MODIS satellite fire data from 2000-2007 to assess inter- and intra-annual fire activity in the Eastern Arc Mountains of Tanzania. Inter-annual fire patterns demonstrated peaks and troughs thought to reflect biomass fuel availability from the previous year's fire regime (Figure 9). The years 2003 and 2005 had especially high fire frequencies and approximately 60% of all fires recorded in the EAM comprise these two years. Fire frequencies were approximately 10% in 2004 and 7% in 2006. Overall, noon fires were higher in frequencythan those recorded during the early morning and late at night, corresponding with maximum daily temperatures (Figure 9). Fire peaks during October and November representing approximately 55% of total fires. In 2003, there was a small peak of fire in August before the decrease in September and the characteristic increase in fires in October/November. Fire activity is found in approximately 40% of the EAM. Mahenge Mountain has the greatest fire activity of any mountain block (64%), whilst four mountain blocks have over 40% of the area with fire activity (Nguu 48%, Udzungwas 45%, Malundwe 44% and Rubeho 42%). However, the Udzungwas account for 75% of the total fires across the EAM, which is unsurprising given its relatively huge area.

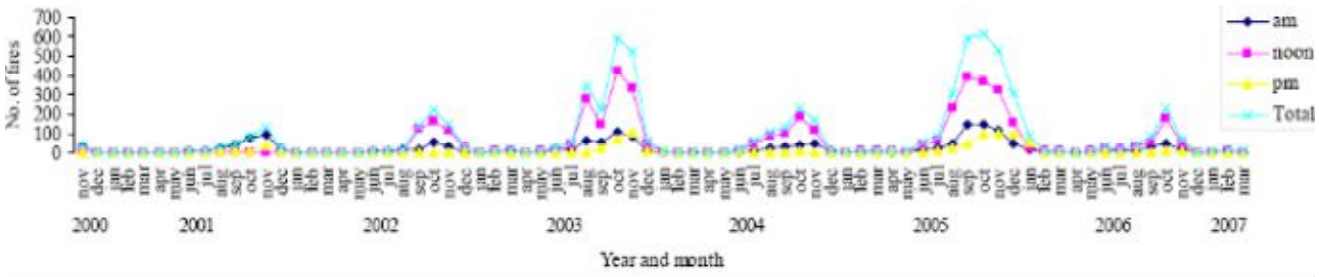


Figure 9: Summary of intra- and inter-annual fire trends in Eastern Arc Mountains, Tanzania. Noon fire data is missing from November 2000 - August 2002 and pm fire data is missing from January, March, May - December 2002 and January - May, August 2003. Noon data recording starts from September 2002. Number of fires represents a presence or absence of fire per 0.01 pixel cell. *Source: Bracebridge (2007)*

The number of fires in the coastal districts of Tanzania appears to be increasing yearly (Figure 10, Burgess and Clarke 2008). This is linked to human population increase and the number of fires being used to clear fields, as well as the incidence of dry years (e.g. 2003).

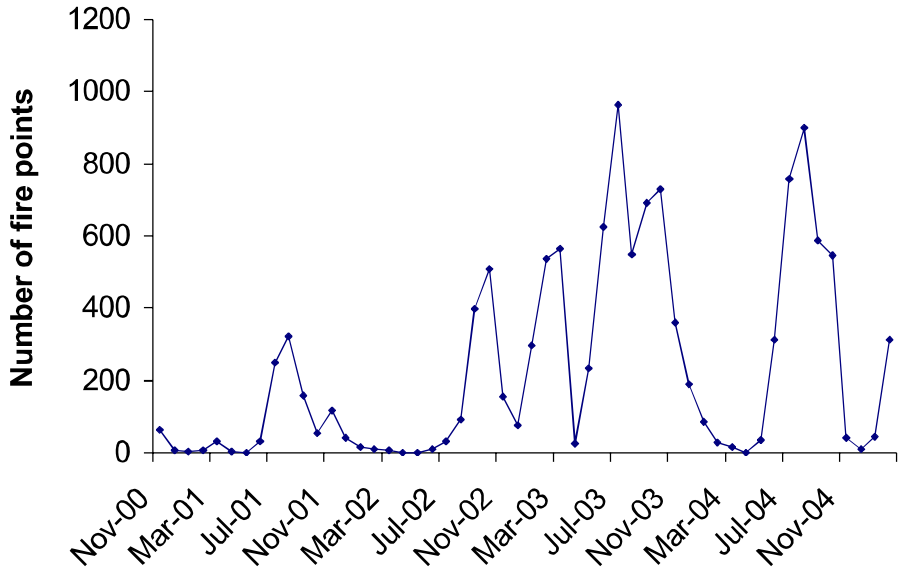


Figure 10. Number of fire points per month in the coastal districts of Tanzania from 2000-2004. Data derived from MODIS fire points database, University of Maryland (Burgess and Clarke 2008)

2.3 Response

2.3.1 Change in protection status of Key Biodiversity Areas (KBAs)

Baseline

The status of the network of reserves in the Eastern Arc Mountains of Tanzania as of 2005 is summarised in Table 9. Burgess and Kilahama (2005) further provide a summary of the reserve network and area coverage in the Eastern Arc Mountains of Tanzania as of June 2005 (Figure 11). Some changes have occurred since then and various Forest Reserves and Nature Reserves are now coded as IUCN protected areas and included in the WDPA. Some of the Forest Reserves and village FRs that had been proposed by 2005 have recently been legally gazetted. As regards Private and Village forests, Tea estates in Mufindi (Udzungwa), East Usambara and West Usambara and the Magrotto oil palm estate in the East Usambara mountains all contain significant areas of natural forest. In some mountains the local inhabitants also protect small patches of forest for rituals and

as burial groves. This practice is particularly well developed among the c.300 clan forests of the North Pare Mountains, but it is also strong in South Pare and West Usambara.

As regards Eastern Arc Mountains on the Kenyan side (Taita Hills Forests), an estimated are of 1310 ha is contained in 25 government gazette forests and another 7592 ha is contained in 27 County Council Forests (East African Wildlife Society 2005).

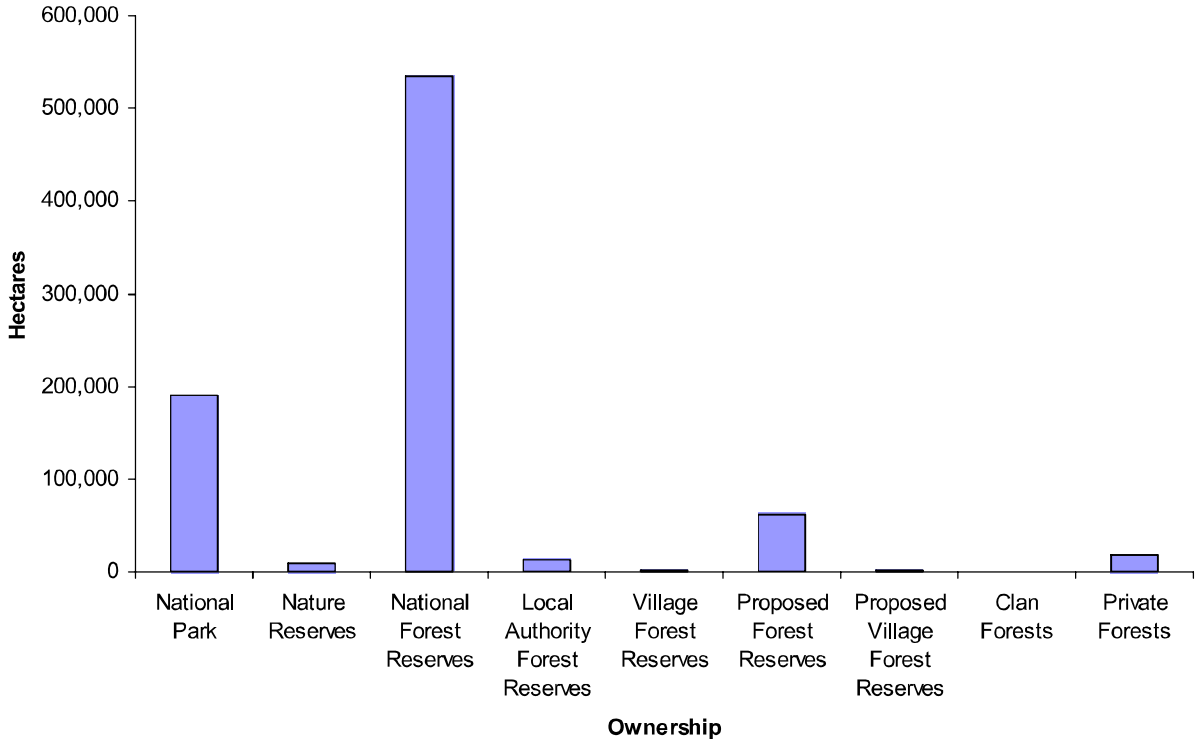


Figure 11: Area of land under different categories of reserve or forest ownership within the Eastern Arc Mountains (June 2005). Lowland forests transitional between Eastern Arc and coastal forest types have been excluded. Source: Burgess and Kilahama (2005)

Table 9: Reserve network across the Eastern Arc Mountains (Forestry and Beekeeping Division 2005).

District	National Parks (name)	Nature Reserve (ha)	National FR area (ha)	Local Authority FR (ha)	Village Forest Reserve (ha)	Private Forests (ha)
Mpwapwa			15,465	0	0	0
Kilolo	Part Udzungwa		80,554	0	0	0
Mufindi			21,812	1,547	282	13,450
Same			19,748	7,420		0
Mwanga			7,407	0	0	0
Kilindi			30,337	0	0	0

Lushoto			34,015	1,360	2,211	500
Korogwe			11,047	0	0	3,521
Muheza		8,300	31,599	0	988	215
Kilombero	Part Udzungwa		67,337	3,467	0	0
Kilosa	Part Mikumi		80,151	0	0	0
Morogoro	Part Mikumi		35,628	20	0	0
Mvomero			31,792	0	0	0
Ulanga			4,956	0	0	0
TOTAL	**190,100**	**8,300**	**471,848**	**13,814**	**3,481**	**17,686**

Burgess and Clarke (2008) provide the current analysis of the protected area coverage of network for the coastal forests in Tanzania: Coastal habitat (forest and thicket) can be found in seven internationally recognised Protected Areas: two National Parks (Saadani and Jozani), one Game Reserve (Selous), three Marine Parks (Mafia Island, Dar es Salaam Marine Park and Mnazi Bay, Marine Conservation Areas (Menai Bay and Pemba Channel) and one Private Reserve (Chumbe Island Marine Park). The coastal habitat can also be found in other reserves that are not internationally recognized as protected areas: one Forest Nature Reserve (Ngezi-Vumawimbi in Pemba Island) and at least 166 Forest Reserves in lowland areas, which cover 1,191,000 ha of land (around 231,000 ha of which are coded as protection forest, primarily for water catchment and habitat conservation purposes). In recent years further areas of forested land have been protected as Village Forest Reserves under the authority of the village government (Table 10). Despite the low levels of management input into most Forest Reserves in Tanzania, their boundaries are usually respected and encroachment into the reserves is rare. Illegal logging is however widespread. In addition to the formally gazetted network of national and Local Authority Forest Reserves in the coastal region of Tanzania, other forest areas are found within proposed Forest Reserves, where the gazettment process has never been completed. Most such reserves are found in Mtwara District.

Table 10. National, Local Authority and Village Forest Reserves within the Coastal Regions of mainland Tanzania (Burgess and Clarke 2008)

Regions	National FR	Local Authority FR	Village FR	Proposed FR	Productive (ha)	Protective (ha)
Pwani (Coast)	46	4	6	2	302,841.7	64,324.7
Dar es Salaam	13	0	0	0	0.0	4,503.9
Lindi	27	3	0	5	542,042.6	82,455.5
Mtwara	5	8	0	6	56,356.6	17,812.2
Tanga	55	5	1	1	58,654.8	62,488.7
Totals	**146**	**20**	**7**	**14**	**959,895.7**	**231,585.0**

As regards Kenya, a review undertaken by Matiku (2004) showed that Kenya has a total of 107 coastal forests. The priority ones are listed below (Table 11). Most coastal forests (80.3%) in Kenya have been awarded some form of protection: 1 National Park (6 km^2); 2 national Reserves (74 km^2); 21 national Monuments (6 km^2); 14 Forest Reserves (469

km^2); 23 sacred sites (13 km^2). 35 forests (95 km^2) have no legal protection and fall within private land. National Parks (Shimba Hills) and a small part of Arabuko-Sokoke forest and National Reserves (including Tana River Forests) are officially managed by the Kenya Wildlife Service.

Table 1: Priority Kenyan Coastal Forests, their area and legal status Forest Area (Source: Matiku 2004)

	Area (km^2)	**Status**	**Vegetation type**
Arabuko Sokoke	370	FR	Forest
Madunguni	53	FR (2003)	Forest
Shimba Hills	214	NR	Forest/Grassland
Kaya - 47 Sites	28.4	NMK/FR	Forest/Woodland
Medium Kwale	51	FR	Forest
Marafa Brachystegia	30	TL	Forest/Woodland
Tana River Delta	10	TR	Forest/Woodland
Witu Lamu	15	FR	Forest
Boni/Lungi	95	FR	Woodland
Tana Gallery Forest	11	TL	Forest/Woodland
Dodori/Boni	220	FR/NR	Woodland
Ras Tenawi	20	TL	Thicket/Forest/Woodland
Kilibasi	2	CC	Forest
Mwangea	15	TL	Forest
Mwangea Hill	5	TL/Private	Forest

Monitoring and trends

This report has not yet attempted to assess the growth of protected area network in the EACF of time, but efforts are ongoing to compile data on protected area and forest reserve network trends using the WDPA. However, it is worth noting that various protected areas in EACF have been gazetted in the recent years, e.g. Saadani National Park with 30 km^2 of coastal forest (gazetted in 2005), Jozani National Park with 10 km^2 of coastal forest (gazetted in 2004) and Ngezi-Vumawimbi Nature Reserve, covering around 2,000 ha of lowland forest habitat (gazetted in 2007).

2.3.2 Changes in forest management effectiveness

Baseline

The World Bank/WWF management effectiveness tracking tool was used to capture data on the effectiveness of management across > 100 forest sites in the Eastern Arc mountain forests in Tanzania in 2005 (Madoffe *et al*. 2005b) and >49 sites in Kenya in 2006 (Ngari 2007). This tool was designed as a simple way to capture management data that can be tracked across time and rolled up globally to show the state of management of the worlds protected areas.

In Tanzania (2005), the management effectiveness of 126 Eastern Arc forest sites (84 Central Government forest reserves (CGFR), 18 Local Government forest reserves (LGFR) and proposed forest reserves, four private forests and two village forests) was

scored in 2005 (Figure 12). Most forests (81 forests, 64.4%) in this study had 'average' management-effectiveness score of 31% to 45%. Conversely, four Local Government Forest Reserves and 13 proposed forest reserves had 'poor' management. From these data private forests had better management effectiveness than government forest reserves and village forests, and the proposed forests were the least effectively managed.

In Kenya (2006) 29 out of 49 forest sites were considered for calculation of the Management Effectiveness Score (Figure 13). State owned forests had higher Management effectiveness scores (48%) than the rest. Arabuko-Sokoke Forest had the highest score (68%), and had shown improvement from 2005 scores. Gongoni forest reserve (34%) had the lowest score among the government-owned forests. Although only two forests were considered under the community/local government ownership, this category had the least average score (27%).

From the analysis it was clear that most of the Kenyan coastal forests are gazetted and their boundaries are well known, suggesting that tenure disputes around such forests are minimal or absent. However, most of them seem to lack sustainable budget which adversely affects implementation of management plans. This is despite most of them having reasonable staffing to handle management issues. Of all the Kenyan forests evaluated, only Arabuko-Sokoke has a research, monitoring and valuation program that is being implemented.

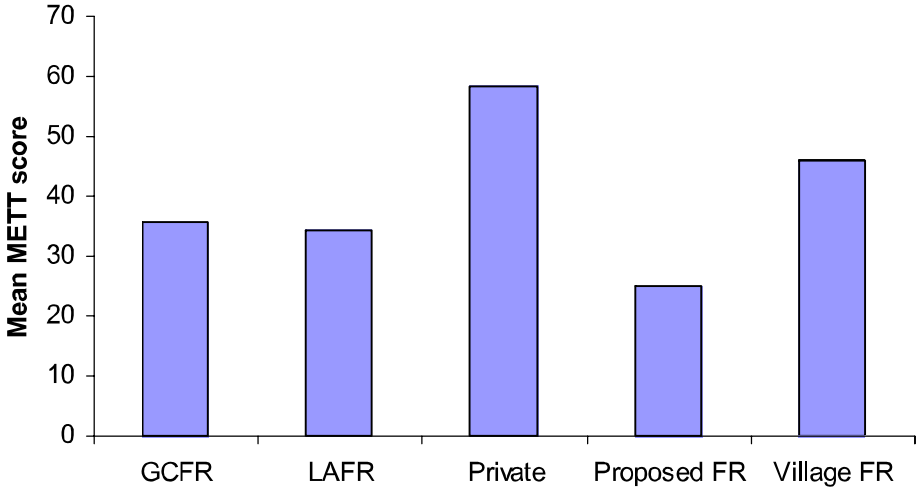


Figure 12. Mean management effectiveness tracking tool (METT) scores across the various categories of forest in the Eastern Arc mountain forests in Tanzania in 2005. GCFF=Central Government Forest Reserve (n=85), LGFR= Local Government Forest Reserve (n = 18), Private = Private forest (n=2), Proposed FR=Proposed Forest Reserve (n=18), Village FR = Village Forest Reserve (n=2). Source: Madoffe *et al.* (2005b).

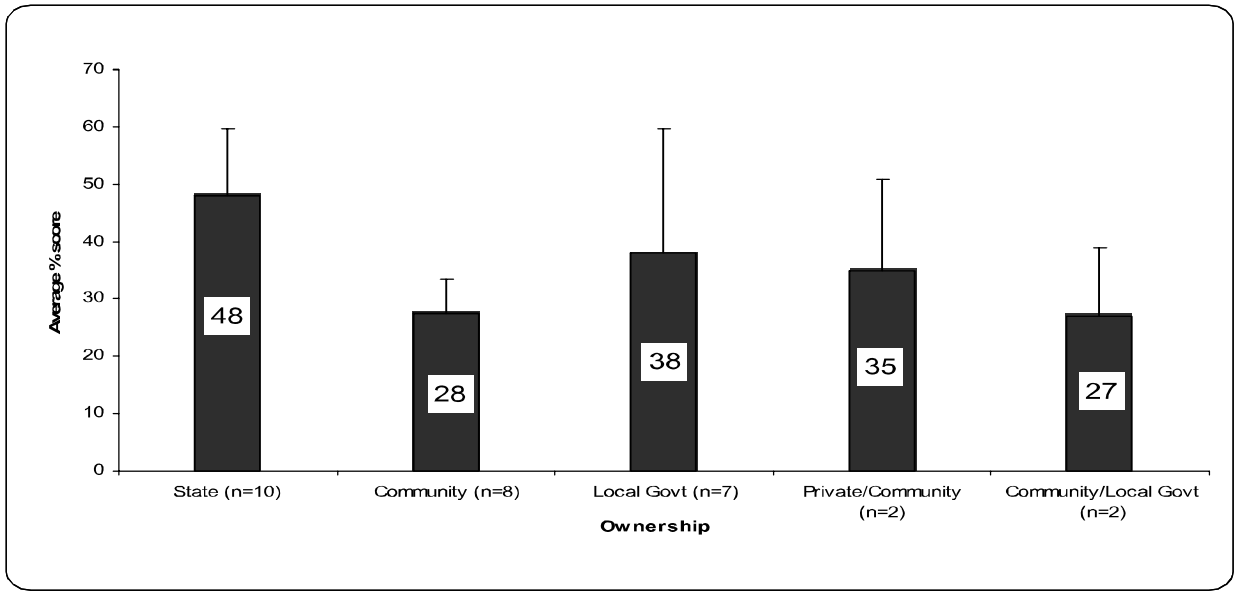


Figure 13: Baseline Management Effectiveness scores by ownership for some Kenyan Coastal forest sites in 2006. Source: Ngari (2007).

Monitoring and trends

Repeat of METT data in some of the sites mentioned in the baseline now exists but has not been analysed for trends, or is in the process of being collated (e.g. in Kenyan

sites).Trends have therefore not been analysed in this version of the report, but should be availed in the next version.

2.3.2 Actions and Research targeting key (threatened/endemic /migratory) species

The current review of actions and research targeting key species in the EACF is far from complete and information is still being gathered. It is therefore difficult to assess this indicator confidently in this report. However, a crude analysis on the inventory of the few listed research activities that have in the past contributed to knowledge on abundance of key species (list in Appendix 1) shows that such actions could have increased by about 250% (from 5 to 13 actions) between 2005 and 2006. If this is a true picture, this could be attributed to the increased investment in the region by the CEPF (see below).

2.3.3 Changes in national legislation/legal recognition

In Kenya forest biodiversity protection is mainly covered by two acts of parliament namely: the Wildlife (Conservation and Management) Act of 1985 and Forests Act of 2005. The protected wildlife in Kenya is listed in the 1st, 2nd and 3rd Schedules of Wildlife Act. The act provides for regulation of game hunting by providing procedures on which animals and how this activity has to be carried out. *Loxodonta africana* and *Lycaon pictus* which both occur in the EACF are listed as game animals in the Schedule 1 of this act.

On the other hand *the Kenya Forests Act* pays particular attention to the occurrence of rare and threatened species. Whereas the Act is very emphatic on managing sites hosting the rare and threatened species it does not list any of these nor does it spell out any express process that would lead to identification of such species.

The Tanzanian wildlife Act of 1974 protects all wildlife species from utilization (live animal trade, trophy etc). However there are some wild game that are completely not subjected to any kind of utilization apart from photographic safari and game viewing. These are referred to as National game, e.g. giraffe. Moreover some of the wildlife listed in the IUCN red list are protected from hunting, e.g. Rhinoceros (CR). Recent changes in the law, with the introduction of the Tanzania Forest Act 2002, place biodiversity high on the land use agenda. Although red-lists have yet to be drawn up, under the new Forest Act red-listed species will be protected by law, environmental impact assessments will need to be carried out for proposed developments and biodiversity conservation included as a land management objective.

Generally law making processes, for Kenya and Tanzania, are usually slow and it may take several years for a bill to be passed into law. This, therefore, makes periodic assessment of the laws as a tool to monitor protected of wildlife, unsuitable for individual countries but can be important if looked at from a global perspective.

2.3.4 CEPF Investment in the EACF

Baseline

The Critical Ecosystem Partnership Fund (CEPF)–funded comprehensive conservation programme in the Eastern Arc Mountains and Coastal Forests of Kenya and Tanzania region (EACF) now ends in 2008. This USD 7 million investment started in 2004. By

March 2007 more than 338 project proposals had been submitted in application for those funds, 85 of which had already been funded at USD 6,383,783 or 91% of the entire investment. More details on how these funds have been allocated are provided by BirdLife International (2007). Other investments are yet to be fully investigated and analysed. However, through a Sustainable Financing Consultancy for the EACF, desktop research of past and current funding in region and likely opportunities for long-term funding was undertaken (Love and Morrison 2007). The consultancy also assessed funding needs and gaps for the region.

Love and Morrison (2007) estimate that the annual square kilometer cost of conserving Arabuko Sokoke is approximately **US$1,500-US$1,750/km²/year**. Using this range, they estimate that the total annual funding needed for effective conservation of the EACF's remaining habitats is between **US$10 million – US$11.7 million**. Given that they estimate that only around one-half of the Hotspot's protected area needs are currently being met, the annual *minimum* range of funding (or the estimated funding gap) that the fundraising strategy should seek to raise is approximately half of the optimal level, or **US$5 million - $5.85 million.** With the current and anticipated funding environment in the Hotspot, it is unlikely that one or two funding sources will either fully fill the estimated funding gap or provide full funding for all priority areas in the near future, necessitating development of *several potential funding sources* over the next 10+ years.

Monitoring and Trends

Love and Morrison (2007) assessed current funding levels for all conservation activities in the Hotspot to determine to what degree they had changed from the levels determined in the Funding Synopsis included in the CEPF (2003) Ecosystem Profile. They found current funding levels (for 2007) to have apparently slightly increased since 2003. However, as in 2003, it is not equitably spread over the region, with some areas, such Arabuko Sokoke in Kenya and the Udzungwa Mountains in Tanzania, receiving more assistance than others. This increase is, in part, attributable to the increase in CEPF funding in the region, which will total over US$7 million by 2009. There may be an overall funding *decrease* after 2008/09 with end of CEPF funding in both countries and World Bank/GEF Forest Sector program in Tanzania, but that may be offset in part by new funding, such as the US$3 million GEF grant for Tanzania's Coastal Forests that was anticipated to start soon, and WWF elevating the Coastal Forests as a high institutional priority.

In Tanzania and Kenya, major bi-lateral donors, notably Scandinavian Embassies, are redirecting support to Government budgets, and Kenya is re-organizing its Forest Service, so this may lead to slight increases in Government contributions to conservation-related efforts. Conversely, the re-direction of funding may actually result in *decreased* funding provided to conservation NGOs working in the EACF; however, no confirmation of this was possible from stakeholder consultations done by Love and Morrison (2007). Though overall estimates of future funding from Government and traditional bi- and multi-lateral donors varied, most stakeholders interviewed felt that they will continue to constitute a critical source (40- 50%) of total conservation funding for the EACF for the foreseeable future. It is worth noting that while most stakeholders felt the current contributions were important for conservation efforts, no stakeholder consulted felt the

traditional donor community would be able to provide the total conservation funding needed to protect the EACF's most critical habitats over the next five to ten years.

2.3.6. Recent biodiversity conservation actions, strategies, plans, engagement of stakeholders and useful resources

A number of broad conservation initiatives are now in place in the EACF to counter threats facing biodiversity, e.g.

- Conservation and Management of the Eastern Arc Mountain Forests (CMEAMF) is a five year (2004-2008) project of the Ministry of Natural Resources and Tourism, Forestry and Beekeeping Division. One of its outputs is the development of a holistic conservation strategy – to be produced, agreed and be under implementation within three years. The project has an output that relates to the development of thematic strategies to enhance conservation within the Eastern Arc Mountains region: *A set of thematic strategies for biodiversity conservation are developed and implemented – through both macro frameworks and individual management plan processes.* These thematic strategies are being developed to focus on a number of themes; biodiversity conservation, fire management, sustainable forest use, sustainable financing (water and carbon service payments), protected areas, mining, participatory forest management, management planning. These cover the most important issues facing the sustainable conservation of the Eastern Arc Mountain forests, as defined by stakeholders from 14 separate District meetings and 4 meetings bringing groups of stakeholders together. For more information on this initiative, visit www.easternarc.or.tz to download all the strategy documents among others.
- The East African Coastal Forest Ecoregion (EACFE) Programme managed by WWF Eastern Africa Regional Programme Office (EARPO) aims to develop and implement a strategy for conservation and sustainable management of the regional forests. The programme will build on existing site level projects by bringing together several components to engage policy at local, national and regional levels and increase the participation of local communities in natural resource management and livelihood activities. The **o**bjective is to conserve the biodiversity of the East African Coastal Forests while ensuring sustainable use of the forest resources in harmony with the needs and aspirations of Eastern Africa people. A 20-year (2005-2025) Strategic Framework for Conservation document (Mugo 2006, http://assets.panda.org/downloads/eacfe_strategic_framework.pdf) has already been finalized and disseminated, and gives a long-term vision of the EACFE programme. It is endorsed by the 4 government representatives of Kenya, Mozambique, Tanzania and Zanzibar Island. The strategy will provide an overarching framework on how to achieve a biodiversity vision through short, medium and long term goals. It also brings together stakeholders to develop strategies and potential activities aimed at long term collaboration and effective participation of individuals and organizations. Several other achievements have already been made.
- Unilever Tea Tanzania (UTT) has developed a biodiversity action plan to help preserve ecosystems in the country's Eastern Arc region (Unilever 2007). UTT's biodiversity action plan, set out in November 2003, is designed to ensure that expansion of agriculture into high biodiversity value forest areas is avoided within the

land area managed by the company. The natural vegetation on the Mufindi Tea Estate at the southern end of the Udzungwa mountains will benefit from this action plan and much its implementation will be in partnership with local and international GOs, NGOs, academics and key local stakeholders.

- Githiru and Lens (2007) highlight and review key scientific results from an ongoing long-term ornithological research project in the highly fragmented and threatened forests of the Taita Hills. They integrated their findings and their implications for conservation in a recent stakeholders' workshop bringing together scientists, government officials and members of the local community in the Taita Hills. During this workshop the local community and the government voiced their priorities concerning these forest resources, by identifying the pressing problems and suggesting best avenues of mitigating them. Githiru and Lens (2007) discuss how the scientific results and recommendations from a biodiversity standpoint are being translated into actual conservation, taking into account the views and priorities of other key stakeholders. This exemplifies one of the few unique situations in eastern Africa where enormous effort is being made towards bridging the chronic gap between scientists, government and local communities concerning the conservation of natural resources.
- In an effort to bridge the gap between the community and the tourism industry, and ultimately encourage conservation, Nature Kenya has introduced the Arabuko-Sokoke Eco-Tourism Circuit including Arabuko-Sokoke Forest, Mida Creek, and Gede Ruins with Kipepeo. It is hoped that the circuit will help promote eco-tourism and generate an income for local people while also highlighting this important biodiversity area.
- WWF-TPO (2005) brought together all key stakeholders and there was a general consensus on the declining resources of the Udzungwa Mountains and the need for concerted management efforts. The workshop jointly agreed on development of project interventions along the following major areas: (1) improving the management of Magombera area, (2) corridors to connect Udzungwa to other protected areas, and (3) improving management of Ndundulu and Nyumbanitu Forests.

The engagement of stakeholders in the EACF in conservation activities has been growing quite fast. As an example, the list of contacts with whom information is being shared within this BirdLife-led monitoring project has grown from 70 in 2005 to 350 at the end of 2006.

Additionally, a number of resources are now available especially for reference on issued regarding the EACF, e.g.

- Publications about the Coastal Forests organised by State; Response; Response and by region are available at http://coastalforests.tfcg.org/publications.html.
- The Eastern Arc Mountains Conservation Endowment Fund has launched a new website with detailed information about each mountain block and many Technical Reports not previously available on the internet (http://www.easternarc.or.tz).
- The website **http://www.easternarc.org** provides information and coordination for institutions and organizations working in the forested systems of the Eastern Arc Mountains.

- Various articles and papers about the Uluguru Mountains can be found at http://www.africanconservation.com/uluguru/downloads.html

3.0. CONCLUSIONS AND RECOMMENDATIONS

Overall, although this report serves mostly as a baseline, there are a few apparent trends. In the recent years especially since 2004, there seems to be an increased knowledge of the state of biodiversity in the EACF as a result of increased research efforts and sharing of information among stakeholders. This has led to e.g. discovery of many new species and review of Red List categories for many species. In most cases however, biodiversity in the EACF has continued to face increased pressure, except in a few exceptional cases where stable conditions have been observed. Response towards biodiversity conservation in the EACF has however been on the rise as may be demonstrated by the increased number of research and conservation actions, stakeholder engagement and improved management effectiveness of sites. It remains to be demonstrated as to whether these responses will have direct positive effect on the actual state of biodiversity in the EACF.

We recommend that stakeholders working in the EACF region adopt standard biodiversity monitoring indicators, tools and frameworks (e.g. forest disturbance transects, Management Effectiveness Tracking Tools, IBA monitoring frameworks) and share information as much as possible. The wide range of researchers in the EACF should also strive to communicate back their results and recommendations to site management authorities and decision makers so that actions taken to manage sites in the region are guided by sound information. It is also important that conservation actions by the wide range of stakeholders are well coordinated. This will only be achieved by sharing information as widely as possible.

We appreciate that this report is not exhaustive and we could have missed a lot of information. It is hoped that the report will trigger inputs that lead to an improved future status report. Readers are challenged to identify gaps and communicate them for inclusion in the next version.

REFERENCES

ABRI. 2006. An overview of the butterfly faunas of the Eastern Arc Mountains and Coastal Forests: biodiversity, endemism, conservation. Unpublished Report to CEPF.

Ahrends, A. 2005. *Patterns of degradation in lowland coastal forests in Coast Region, Tanzania.* Unpublished MSc Thesis, University of Greifsward.

Bagger, J., Halberg, K. and Nnyiti, P.Y. 1990. *Observations of birds in Rondo and Litipo Forests, South East Tanzania*. Danish-Tanzanian ICBP Expedition Report. Zoological Museum, University of Copenhagen.

Beentje, H. and Luke, Q. (in prep) *Atlas of the Rare Trees of Tanzania*.

Bennun, L. 1987. Ringing and recapture of Spotted Ground Thrushes at Gede, Kenya in coast: indications of site fidelity and population size stability. *Scopus* 11: 1-5.

Beresford, P., Fjeldså, J. and Kiure, J. 2004. A new species of akalat (*Sheppardia*) narrowly endemic in the Eastern Arc of Tanzania. *Auk* 121, 23–34.

BICO. 2005. Hydrology of the Eastern Arc Mountains. CMEAMF Morogoro, Tanzania.

BirdLife International. 2007. Co-ordination of Critical Ecosystem Partnership Fund Investment in the Eastern Arc Mountains and Coastal Forests Region of Kenya and Tanzania: Annual Analysis of the Project Portfolio - 31st March 2007. *Unpublished Report*.

Blomley, T., Pfliegner. K., Isango, J, Zahabu, E., Ahrends, A. and Burgess, B. 2008. Seeing the wood for the trees: an assessment of the impact of participatory forest management on forest condition in Tanzania. *Oryx* 42(3): 380-391.

Bowie, R.C.K. and Fjeldså, J. 2005. Genetic and morphological evidence for two species in the Udzungwa forest partridge *Xenoperdix udzungwensis*. *J. East Afr. Nat Hist.* 94, 191–201.

Borghesio, L., John, J.R., Mulungu, E., Mkongewa, V., Joho, M. and Cordeiro, N. J. 2008. Observations of threatened birds in the East Usambara Mountains, Tanzania. *Bull ABC* 15(1): 59-70.

Bracebridge, C. 2007. Spatio-temporal patterns of fire activity in Tanzania at national, regional and local scales. Unpublished Masters Thesis, Department of Biology, University of York.

Britton, P. L., Britton, H. A. and Coverdale, M. A. C. (1980) The avifauna of Mrima Hill, South Kenya coast. *Scopus* 4: 73 – 78.

Burgess N.D., Butynski, T.M., Cordeiro, N.J., Doggart, N.H., Fjeldså, J., Howell, K.M., Kilahama, F.B., Loader, S.P., Lovett, J.C., Mbilinyi, B., Menegon, M., Moyer, D.C., Nashanda, E., Perkin, A., Rovero, F., Stanley, W.T. and Stuart, S.N. 2007. The biological importance of the Eastern Arc Mountains of Tanzania and Kenya. *Biological Conservation* 134: 209-231.

Burgess, N.D. and Clarke, G.P. (Eds.) 2000. *Coastal Forests of Eastern Africa. IUCN Forest Conservation Series*. Cambridge & Gland: IUCN.

Burgess, N. and Clarke, G. P. 2008. Towards a Protected Area network in the Coastal Forests ecoregion of Tanzania: analysis and recommendations. *Discussion document prepared as an input to the GEF PPG process to develop a full sized proposal for the Tanzanian Coastal Forests*.

Burgess, N.D., Clarke, G.P. and Rodgers, W.A. 1998. Coastal forests of eastern Africa: Status, species endemism and its possible causes. *Biological Journal of the Linnean Society* 64: 337–367.

Butynski, T.M., de Jong, Y.A., Perkin, A.W., Bearder, S.K. and Honess, P.E. 2006. Taxonomy, Distribution, and Conservation Status of Three Species of Dwarf Galagos (Galagoides) in Eastern Africa. *Primate Conservation* 2006: 63–79.

CARE and Zanzibar Department of Commercial Crops, Fruits and Forestry. 2008. Conservation of Zanzibar's Unique Flora and Fauna via Community Based Forest Management and Socioeconomic Development Around Jozani-Chwaka Bay National Park. *Unpublished progress report to CEPF*.

CEPF. 2003. Ecosystem Profile: Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya. Critical Ecosystem Partnership Fund. Washington DC. http//www.cepf.net/xp/cepf/where_we_work/easern_arc_mountains/full_strategy.xml.

Chege, J. and Bytebier, B. 2005. Vegetation structure of four small forest fragments in Taita hills, Kenya. *Journal of East African Natural History* 94(1): 231–234.
CIFOR. 2002. Planning for woodcarving in the 21st Century. *CIFOR Infobrief*. April 2002 Number 1.
CMEAMF. 2006a. Thematic Strategy: Monitoring Natural Resources in The Eastern Arc Mountains. Ministry of Natural Resources and Tourism.
CMEAMF. 2006b. A forest area baseline for the Eastern Arc Mountains. Forestry and Beekeeping Division/Sokoine University of Agriculture, Morogoro, Tanzania.
Conservation International. 2007. Eastern Arc Mountains and Coastal Forests. Downloaded from http://www.cepf.net on 14/5/2007.
Conservation International. 2008. *1990-2000 Forest Cover and Change in Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya, 1/1,000,000*. Arlington: Conservation International.
Darwall, W., Smith, K., Lowe, T. and Vié, J.-C. 2005. *The Status and Distribution of Freshwater Biodiversity in Eastern Africa*. IUCN SSC Freshwater Biodiversity Assessment Programme. IUCN, Gland, Switzerland and Cambridge, UK.
Davenport, T.R.B., Stanley, W.T., Sargis, E.J., De Luca, D.W., Mpunga, N.E., Machaga, S.J. and Olson, L.E. 2006. A New Genus of African Monkey, *Rungwecebus*: Morphology, Ecology, and Molecular Phylogenetics. Science 312: 1378-1381.
Davis, A.P. and. Mvungi, E.F. (2004). Two new and endangered species of *Coffea* (Rubiaceae) from the Eastern Arc Mountains (Tanzania) and notes on associated conservation issues. *Botanical Journal of the Linnean Society* **146,** 237.
de Sá, R.O., Loader, S.P., and Channing, A. 2004. A New Species of Callulina (Anura: Microhylidae) from the West Usambara Mountains, Tanzania. *Journal of Herpetology*, Vol. 38 (2), 219–224.
Deroin, T. and Luke Q. 2005. A New *Toussaintia* (Annonaceae) from Tanzania. *Journal of East African Natural History* **94**(1): 165–174.
Doggart, N. (Ed.).2003. Results of Biodiversity Surveys in Three Forest Reserves of the Rubeho Mountains. Technical Report 4, Tanzania Forest Conservation Group, Dar es Salaam.
Doggart, N. and Loserian, D. 2007. *South Nguru Mountains: A description of biophysical landscape*. TFCG Technical Paper No.11.
Doggart, N., Perkin, A., Kiure, J., Fjeldså, J., Poynton, J. and Burgess, N. 2006. Changing places: how the results of new field work in the Rubeho Mountains influence conservation priorities in the Eastern Arc Mountains of Tanzania. *Afr. J. Ecol*. 44:134–14.
East Africa Wild Life Society. 2005. Stakeholders' workshop on the Conservation and Management of the Taita Hills Forests. Unpublished Workshop Report.
ECCM. 2007. Establishing mechanisms for payments for carbon environmental services in the Eastern Arc Mountains, Tanzania. *Unpublished report.*
Eriksen, T., Halberg, K., Lemberg, T. and Petersen, F.S. 1994. *A survey of bird life in five Coastal Forests of southern-Tanzania 1993*. Copenhagen: BirdLife-Denmark Zoological Institute, University of Copenhagen.
Faden, R. B. and H. J. Beentje. 1989. *Encephalartos kisambo*, a new cycad from Kenya, with a note on *E. tegulaneus*. *Utafiti* 2(1): 7-10.

Finnie, D. 2004. *Cephalophus adersi*. In: IUCN Red List of Threatened Species. www.iucnredlist.org. Downloaded on 29 March 2007.

Fjeldså, J and Kiurie, J. 2003. A new population of the Udzungwa forest partridge. *Bull. B.O.C.* 123, 52–57.

Fjeldså, J., Bowie, R.C.K. and Kiure, J. 2006. The forest batis, *Batis mixta*, is two species: description of a new, narrowly distributed *Batis* species in the Eastern Arc biodiversity hotspot. *J Ornithol* 147:578–590.

FORCONSULT-SUA and TAFORI. 2006. Fire Reduction Strategies in the Eastern Arc Mountains of Tanzania. Unpublished report for Ministry of Natural Resources and Tourism, Forest and Beekeeping Division and Conservation and Management of the Eastern Arc Mountain.

Frontier-Tanzania. 2001. West Kilombero Scarp Forest Reserve – Zoological Report. Doody, K.Z., Howell, K.M. and Fanning, E. (Eds.). Report for the Udzungwa Mountains Forest Management Biodiversity Conservation Project, MEMA, Iringa, Tanzania.

Frontier–Tanzania. 2001b. Udzungwa Mountains Biodiversity Surveys – Methods Manual (eds K.Z. Doody, K.M. Howell & E. Fanning). Unpublished Report for the Udzungwa Mountains Forest Management and Biodiversity Conservation Project, Iringa, Tanzania.

Frontier-Tanzania. 2005. Uluguru Component Biodiversity Survey 2005 (Volume III): Uluguru North Forest Reserve. Bracebridge, Fanning, Howell, Rubio, St. John (eds). Society for Environmental Exploration and University of Dar es Salaam; CARE-Tanzania, Conservation and Management of Eastern Arc Mountains Forests (CMEAMF): Uluguru Component, Forestry and Beekeeping Division for the Ministry of Natural Resources and Tourism, GEF/UNDP:URT/01/G32.

Frontier-Tanzania. 2007. Owen N., Wilkins V., Fanning E., & Howell K. M. (eds.) *Biodiversity Research and Awareness in the lesser-known Eastern Arc Mountains (BREAM) Volume I: Mahenge Mountains Report, Ulanga District.* Society for Environmental Exploration and the University of Dar es Salaam; Critical Ecosystems Partnership Fund.

Gereau, R.E. and Bodine, S. 2005. *Crotalaria mwangulangoi* (Fabaceae, Faboideae), a New Species from the Udzungwa Mountains, Tanzania. NOVON **15**: 286–289.

Githiru, M. and Lens, L. 2006. Annual survival and turnover rates of an Afrotropical robin in a fragmented forest. *Biodiversity and Conservation* 15:3315–3327.

Githiru, M. and Lens, L. 2007. Application of fragmentation research to conservation planning for multiple stakeholders: An example from the Taita Hills, southeast Kenya. *Biological Conservation* 134: 271–278..

Glenday, J. 2005a. Preliminary Assessment of Carbon Storage and Potential Forestry Based Carbon Offset Projects in Arabuko-Sokoke Forest. Unpublished Report to Critical Ecosystem Partnership Fund.

Glenday, J. 2005b. Preliminary Assessment of Carbon Storage and Potential Forestry Based Carbon Offset Projects in Lower Tana River Forests: The Tana Delta Irrigation Project and Tana River National Primate Reserve. Unpublished Report to Critical Ecosystem Partnership Fund.

Gordon, I. and Ayiemba, W. 2003. Harnessing butterfly biodiversity for improving livelihoods and forest conservation: the Kipepeo Project. *Journal of Environment and Development* 12: 82-98.

Holsten, B., Bräunlich, A. and Huxham, M. 1991. Rondo Forest Reserve, Tanzania: an ornithological note including new records of the East Coast Akalat *Sheppardia gunningi*, the Spotted Ground Thrush *Turdus fischeri*, and the Rondo Green Barbet *Stactolaema olivacea woodwardi*. *Scopus* 14: 125-128.

Howell, K.M., Ngalason, W. and Werema, C. 2006. Eastern Arc Mountains: Assessment of Forest Reserve values for endemic and Near Endemic vertebrate species: Amphibians and Birds. Unpublished Consultancy Report of the Department of Zoology & Wildlife Conservation, University of Dar es Salaam to EAMCEF via CMEAMF.

IUCN 2006b. *2006 IUCN Red List of Threatened Species.* <www.iucnredlist.org>. Downloaded on **15 May 2007**.

IUCN, Conservation International, and NatureServe. 2007. Global Amphibian Assessment. <www.globalamphibians.org>. Accessed on 26 March 2007.

IUCN. 2002. *The 2002 IUCN Red List of the Threatened Spoecies.* IUCN, Cambridge and Gland.

IUCN. 2006a. News -9 March 2006. First Plant Red Listing Workshop lists 123 taxa of East Africa as threatened. Downloaded from http://www.iucn.org.

Jackson, C. 2000. Reconnaissance of Dakatcha Woodland, Malindi-District, 11th-13th August 2000. Unpublished Report, A Rocha Kenya.

Jackson, R. and Jackson, J. 2006. Draft Technical report for 2006 Surveys Cut Stems Analysis. Unpublished Report, A Rocha Kenya

Jensen, F.P., Tøttrup, A.P. and Christensen, K.M. 2005. The avifauna of coastal forests in southeast Tanzania. *Scopus* 25: 1-22.

John, J. and Pius, E. 2007. Annual National Sites and Species Status and Trends Report – Tanzania: Eastern Arc Mountains and Coastal Forests. Unpublished Draft Report.

Jones, T., Ehardt, C.L., Butynski, T.M., Davenport, T.R.B., Mpunga, N.E., Machaga, S.J., and De Luca, D.W. 2006. The Highland Mangabey *Lophocebus kipunji*: A New Species of African Monkey. *Science* 308: 1161-1164.

Jordan, G., Buru, A., Gabow, A., Massiwe, K., Murithi, A. and Rumbold, T. 2004. Participatory Livelihoods Analysis of Forest Dependent Communities in Lamu District, Coast Province. Unpublished Report, Farm Africa.

Juma, J. 2007. Conservation of Indigenous Forest and Endemic Species on Pemba Island. *Unpublished progress report to CEPF from FFI.*

Kanga, E.M. 2002a. *Some ecological aspects and conservation of duikers in Arabuko-Sokoke Forest, Kenya*. Unpublished MSc. Thesis, University of Nairobi

Kanga, E.M. 2002b. *A conservation and recovery plan for Aders' duiker in Arabuko-Sokoke Forest, Kenya*. Unpublished report to Paignton Zoo Environmental Park

Kenya National Bureau of Statistics. 2006. Population Distribution by Province/District and Sex: 1979 - 1999 Censuses.http://www.cbs.go.ke. Accessed on 29 March 2007.

Kolehmainen, J. 2004. Urgent need for restoration of the African Violet habitat in the Amboni Caves, Tanga, Tanzania. *The Arc Journal* 16: 11-12.

Lange, C. N. 2006. The endemic land snail *Gulella taitensis* of the Taita Hills forests, Kenya: on the brink of extinction. *Oryx* 40:3.

Lantz, H. and Gereau R.E. 2005. A New Species of *Rytigynia* (Rubiaceae, Vanguerieae) from Northeastern Tanzania, with Notes on the Circumscription of the Genus. NOVON **15**: 315–318.

Lehmann, I. 1997. Metarbela haberlandorum spec. nov., a new moth from Kenya (Lepidoptera: Metarbelidae). *Nachrichten entomologischer Verein Apollo* **18**(1):45-53.

Lehmann, I. and Kioko, E. (2005). Lepidoptera diversity, floristic composition and structure of three Kaya forests on the south coast of Kenya. *Journal of East African Natural History* **94**(1): 121-163.

Lehmann, I. 2008. Ten new species of Metarbelidae (Lepidoptera:Cossoidea) from the coastal forests and the Eastern Arc Mountains of Kenya and Tanzania, including one species from two upland forests. *Journal of East African Natural History* **97**(1): 43-82.Love, G. and Morrison, K. 2007. Sustainable Funding Strategy for the Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya. *Consultancy report to CEPF.*

Lovett, J.C., Ruffo, C.K. and Gereau, R.E. ?? Field Guide to the Moist Forest Trees of Tanzania

Luke, Q., Hatfield, R. and Cunneyworth, P. 2005. Rehabilitation of the Tana Delta Irrigation Project Kenya. An Environmental Assessment. Unpublished Report to Critical Ecosystem Partnership Fund.

Lutz, B. and Newiadomsky, M. 2007. *Fauna threatened by bushmeat hunting? Investigation of the status of bushmeat trapping in Arabuko-Sokoke Forest, Kenya.* Unpublished Bachelor-Thesis Animal Management, Van Hall Larenstein.

Madoffe S.S. and Munishi P.K.T. 2005. Forest condition assessment in the Eastern Arc Mountain Forests of Tanzania. Unpublished Report, Ministry of Natural Resources and Tourism Forest and Beekeeping Division: Conservation and Management of the Eastern Arc Mountain Forests Project.

Madoffe, S. S., Munishi, P.T.K. and Burgess, N. 2005a. How disturbed by human activities are the Eastern Arc Mountain Forests? *The Arc Journal* 19: 13-15.

Madoffe, S. S., Munishi, P.T.K. and Burgess, N. 2005b. How well managed are the Eastern Arc Mountain Forests? *The Arc Journal* 19: 22-23.

Madoffe, S., Mwang'ombe, J., O'Connell, B. Rogers, P., Hertel, G. and Mwangi, J. 2005c. Forest Health Monitoring in the Eastern Arc Mountains of Kenya and Tanzania: a baseline report on selected forest reserves. Unpublished Report.

Madoffe, S., Mwang'ombe, J., O'Connell, B., Rogers, P., Tillman, T. M. and Hertel, G. 2008. Forest Health Monitoring in the Eastern Arc Mountains of Kenya and Tanzania: a baseline report on selected forest reserves. *Unpublished Final Report to CEPF.*

Malonza, P.K., Wasonga, V.D., Muchai, V., Rotich, D., Bwong, B.A., Bauer, A.M. 2006. Diversity and biogeography of herpetofauna of the Tana River Primate National Reserve, Kenya. *Journal of East African Natural History* 95(2): 95–109 (2006)

Marshall, A., Topp-Jørgensen, J., Brink, H. and Fanning, E. 2005. Monkey Abundance and Social Structure in Two High-Elevation Forest Reserves in the Udzungwa Mountains of Tanzania. *International Journal of Primatology* 26: 127-145.

Marten, D. 2005. Electric fence, a benefit or a menace? *Mbambakofi* (ASF News Bulletin) 1(1): 3. Mbilinyi, B. and Kashaigili, J. 2005. How much forest is there in the Eastern Arc Mountains? *The Arc Journal* 19: 4-5.

Matiku, P. (2004). *The Coastal Forests of Kenya, Forests data, threats, socio-economic issues, values, stakeholders, challenges, strategies, investment and enabling*

environment. Nature Kenya. Prepared for WWF Eastern Africa Coastal Forests Ecoregion Programme, Nairobi, Kenya.

Medley, K. 2007. Ethnobotanical Knowledge for Adaptive Collaborative Management at Mt. Kasigau, Kenya. *Unpublished report to CEPF.*

Menegon, M., Doggart, N. and Owen, N. 2008. The Nguru mountains of Tanzania, an outstanding hotspot of herpetofaunal diversity. *Acta Herpetologica* 3(2): 107-127.Menegon, M., Salvidio, S. and S.P. Loader. 2004. Five new species of *Nectophrynoides* Noble 1926, (Amphibia Anura Bufonidae) from the Eastern Arc Mountains, Tanzania, *Tropical Zoology* **17**: 97-121

Menegon, M., Salvidio, S. and Tilbury, C. 2002. A New Dwarf Forest Chameleon from the Udzungwa Mountains of Tanzania, East Africa, (Squamata: *Rhampholeon* Gunther, 1874). *Journal of Herpetology,* **36**(1), 51–57.

Milledge, S. 2004. Forests and timber trade in southeast Tanzania: What will be the legacy of Mkapa Bridge? *The Arc Journal* 16: 1; 4-5.

Milledge, S.A.H. and Kaale, B.K. 2005. Bridging the Gap – Linking timber trade with infrastructure development in southern Tanzania: Baseline data before completion of the Mkapa Bridge. TRAFFIC East/Southern Africa, Dar es Salaam, Tanzania.

Milledge, S.A.H., Gelvas, I.K. and Ahrends, A. 2007. *Forestry, Governance and National Development: Lessons Learned from a Logging Boom in Southern Tanzania.* TRAFFIC East/Southern Africa/Tanzania Development Partners Group/ Ministry of Natural Resources and Tourism, Dar es Salaam, Tanzania.

Mittermeier, R.A., Valladares-Pádua, C., Rylands, A.B., Eudey, A.A., Butynski, T.M., Ganzhorn, J.U., Kormos, R., Aguiar, J.M. and Walker, S. 2006. Primates in peril: the world's 25 most endangered primates, 2004–2006. *Primate Conservation* (20): 1–28.

Mtalo, F., Mkhadi, S., Mwanuzi, F. and Mulungu, D. 2005. Water: Is the amount of water flowing from the Eastern Arc Mountains decreasing or increasing? *The Arc Journal* 19: 6-7.

Mugo, K. (ed.) 2006. *The Eastern Africa Coastal Forests. Ecoregion: Strategic Framework for Conservation. 2005-2025.* WWF-EARPO, Nairobi, Kenya.

Musila, S.N., Ng'weno, F., Matiku, P., Mwema, M., Kanyanya, E., Mulwa, R., Musina, J., Buckley, P. and Njehia, S. 2006. *Kenya's Important Bird Areas, Status and Trends 2005*. Nairobi: Nature Kenya.

Musila, S.N., Ngari, A., Jackson, C., Jackson, R. and Ngala, D. 2006. Dakatcha Important Bird Area Monitoring Survey Report. Unpublished Report, Nature Kenya.

Mwanyoka, I.R. 2005. Payment for water services as a mechanism for watershed management: the case of the Sigi River Catchment, Tanga, Tanzania. Unpublished Report to WWF-TPO.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.

Müller, H.G., Measey, J., Loader, S.P., and Malonza, P.K. 2005. A new species of *Boulengerula* Tornier (Amphibia: Gymnophiona: Caeciliidae) from an isolated mountain block of the Taita Hills, Kenya. *Zootaxa* **1004**: 37–50.

Ndangalasi, H.J., Bitariho, R. and Dovie, D.B.K. 2007. Harvesting of non-timber forest products and implications for conservation in two montane forests of East Africa. *Biological Conservation* 134(2): 242-250.

Ndang'ang'a, K., Mulwa, R. and Jackson, C. (2004). Status of the endangered Spotted Ground Thrush *Zoothera guttata fischeri* in Kenya. *Research Reports of the Centre for Biodiversity, National Museums of Kenya: Ornithology*, 53.

Newmark, W.D. 2006. A 16-year study of forest disturbance and understory bird community structure and composition in Tanzania. *Conservation Biology* 20: 122-134.

Ngari, A. 2007. Biodiversity Status and Trends Report for the Eastern Arc Mountains and Coastal Forests of Kenya. Unpublished Report. Nature Kenya.Olson, L.E., Sargis, E.J, Stanley, W.T., Hildebrandt, K.B.P. and Davenport,T.R.B. 2008. Additional molecular evidence strongly supports the distinction between the recently described African primate *Rungwecebus kipunji* (Cercopithecidae, Papionini) and *Lophocebus*. *Molecular Phylogenetics and Evolution* 48:789–794.

Ojoyi, M. M. 2008. Land use dynamics and impacts on conservation of *Warburgia stuhlmannii* in Dakatcha and Marafa forests in Malindi district. Unpublished Msc Thesis. Moi University

Otieno, N., Mwangi, S., Bennun, L., Musila, S., Mulwa, R. and Kiragu, A. 2005. *Kenya's Important Bird Areas, Status and Trends 2004*. Nairobi: Nature Kenya.

Owino, A.O., Amutete, G., Mulwa, R.K. and Oyugi, J.O. 2008. Forest patch structures and bird species composition of a lowland riverine coastal forest in Kenya. Tropical *Conservation Science* 1 (3) : 242-264.

Owino, A. and Oyugi, J. In press. Assessment of forest patches' extents and land cover changes in the Tana River Primate National Reserve, 1994-2004. *Africa Journal of Ecology.*

Pellikka, P., B. Clark, P. Hurskainen, A. Keskinen, M. Lanne, K. Masalin, P. Nyman-Ghezelbash and T. Sirviő. 2004. Land use change monitoring applying geographic information systems in the Taita Hills, SE-Kenya. In: *The Proceedings of the 5th African Association of Remote Sensing of Environment Conference, 17-22 Oct, 2004, Nairobi, Kenya.*

Pellikka, P.K.E, B.J.F. Clark, T. Sirviő and K. Masalin. 2005. Environmental change monitoring applying satellite and airborne remote sensing data in the Taita Hills, Kenya. In: *Remote sensing and geoinformation processing in the assessment and monitoring of land degradation and desertification, Trier, Germany*.

Pfliengner, K. and Burgess, N. 2005. What are the Eastern Arc Mountain forets worth to Tanzania? *The Arc Journal* 19: 11-12.

Pius, E., Mungaya, E., Mbwana, S.B. and John, J. 2007. Field Report on Biodiversity Monitoring in the Uluguru North and Rondo Forest Reserves. Unpublished Draft Report.

Poynton, J.C. 2003. A new giant species of *Arthroleptis* (Amphibia: Anura) from the Rubeho Mountains, Tanzania. *Afr. J. Herpetol.* 52: 107–112.

Preston, O. 2004. Report on the Kaya Forests Survey: Monitoring resource extraction in Kaya Diani, Muhaka and Ukunda. Unpublished Report, Wakuluzu; Friends of the Colobus Trust.

Prins, E. and Clarke, G.P. 2007. Discovery and enumeration of Swahilian Coastal Forests in Lindi region, Tanzania, using Landsat TM data analysis. *Biodiversity and Conservation* 16(5): 1551-1565.

Republic of Kenya. 1985. Wildlife (conservation and Management) Act Chapter 376, Laws of Kenya. Nairobi: Government Printer.

Republic of Kenya. 2005. *Kenya Gazette Supplement Acts 2005 .Special Issue. Kenya Gazette Supplement No. 88 (Act No. 7)*. Nairobi: Government Printer.

Robson, M. (2006). Woodmark SLIMF Forest Certification Report. Unpublished Report for Coast Farm Forestry Association.

Roe, D., Mulliken, T., Milledge, S., Mremi, J., Mosha, S. and Grieg-Gran, M. 2002. Making a killing or a living? Wildlife trade, trade controls and rural livelihoods. *Biodiversity and Livelihoods Issues No. 6.* IIED and TRAFFIC.

Rogers, P.C., O'Connell, B., Mwang'ombe, J., Madoffe, S. and Hertel, G. 2008. Forest Health Monitoring in the Ngangao Forest, Taita Hills, Kenya: A Five Year Assessment of Change. *Journal of East African Natural History* 97(1):3-17.

Rovero, F and Marshall, A.R. 2005. Diversity and Abundance of Diurnal Primates and Forest Antelopes in Relation to Habitat Quality: A Case Study from the Udzungwa Mountains of Tanzania. In: B.A. Huber, B.J. Sinclair and K.Lampe. *African Biodiversity*. Springer US, Pp 297-304.

Rovero, F. and Doggart, N., Bowkett, A. and Burgess, N. 2005. New records for Lowe's servaline genet from the Eastern Arc Mountains of Tanzania. *Oryx (Conservation News)* **40** (2) pg 139.

Rovero, R. and Rathbun, G.B. 2006. A potentially new giant Sengi (Elephant-Shrew) from the Udzungwa Mountains, Tanzania. *Journal of East Africa Natural History Society* 95: 111-115.

Rovero, F., Rathbun, G.B., Perkin, A., Jones, T., Ribble, D.O. Leonard, C., Mwakisoma, R.R. and Doggart, N. 2008. A new species of giant sengi or elephant-shrew (genus Rhynchocyon) highlights the exceptional biodiversity of the Udzungwa Mountains of Tanzania. *Journal of Zoology* 274 (2): 126 – 133.

Rovero, F., Struhsaker, T.T., Marshall, A.R., Rinne, T.A., Pedersen, U.B., Butynski, T.M., Ehardt,C.L and Mtni, A.S. 2006. Abundance of diurnal primates in mwanihana forest, Udzungwa Mountains, Tanzania : A multi-observer comparison of line-transect data. *International Journal of Primatology* 27: 675-697.

Salvidio, S., Menegon, M., Sindaco, R., and Moyer, D. 2004. A new species of elongate seps from Udzungwa grasslands, southern Tanzania (Reptilia, Gerrhosauridae, *Tetradactylus* Merrem, 1820). *Amphibia-Reptilia* **25**: 19-27.Schöning, C., Kinuthia, W. and Boomsma, J.J. 2006. Does the afrotropical army ant *Dorylus* (*anomma*) *molestus* go extinct in fragmented forests? *Journal of East African Natural History* 95(2)**:** 163–179.

Stanley, W.T., Rogers, M.A. and Hutterer, R. 2005. A new species of *Congosorex* from the Eastern Arc Mountains, Tanzania, with significant biogeographical implications. *J. Zool., Lond.* 265: 269–280.

Tabor, K., Mbilinyi, B., Kashaigili, J., Steininger, M. K., Burgess, N. 2008. A Multi-Date Baseline Forest Estimate for circa 1990 and 2000 and Habitat Assessment within Protected Areas and administrative boundaries for the Coastal Forests of Tanzania and Kenya. (*In prep*).

Tanzania National Website. 2003. *2002 Population and Housing Census*. <http://www.tanzania.go.tz/census>. Accessed 29 March 2007.

Thompson, H.S., Eshiamwata, G., Githiru, M., Matiku, P. and Ayiemba, W. 2007. *Enhanced sustainability at Arabuko-Sokoke Forest: Conservation Successes, Challenges and Lessons Learnt*. Nairobi: Nature Kenya.

Topp-Jørgensen, J.M., Nielsen, M.R., Marshall, A. and Pedersen, U. In review. Mammalian density in response to different levels of bushmeat hunting in the Udzungwa Mountains, Tanzania.

Unilever. 2007. Tanzania: Biodiversity action plan. Downloaded from http://www.unilever.com on 24/07/2007.

Waiyaki, E. M. 1995. *Effects of forest fragmentation, isolation and structure on the richness and abundance of bird communities in major coastal forests of south coast, Kenya.* Unpublished MSc Thesis, University of Kent, UK.Wegner, G., Howell, K.M., Gereau, R., Davenport , T., and Burgess, N. (submitted). The forgotten Coastal Forests of Mtwara , Tanzania – A biologically impoverished and yet important ecosystem. *Journal of Eastern Africa Natural History*.

Weldon, C. and du Preez, L.H. 2004. Decline of the Kihansi Spray Toad *Nectophrynoides asperginis* from the Udzungwa Mountains, Tanzania. *FrogLog* 62: 2-3.

Verdcourt, B., Milne-Redhead, E. and Polhill, R.M. (Eds). 1971. *FTEA (Annonaceae III)*. London: Crown Agents for Overseas Governments.

Virani, M. 1994. Ecology of the endangered Sokoke Scops Owl (*Otus ireneae*). Unpublished MSc. Thesis, Leicester University, UK

Virani, M. 2000. Distribution and population size of the Sokoke Scops Owl *Otus ireneae* in the Arabuko-Sokoke Forest, Kenya. Pp. 795–801 in R.D. Chancellor and B.-U. Myberg, eds. *Raptors at risk. Proceedings of the fifth world conference on birds of prey and owls*. (Midrand, South Africa, 4–11 August 1998). Surrey Canada: Hancock House.

Wakuluzu - Friends of the Colobus Trust (2008) Conserving Coastal and Eastern Arc Forests through Community Access to Retail Markets for Good Wood Carvings on the South Coast of Kenya. *Unpublished final report to CEPF*.

Whitelock, L. 2002. *The Cycad*. Timber Pr.

World Bank. 2004. *Ensuring the Future*. The World Bank and Biodiversity. World Bank, Washington, D.C.

World Resources Institute; Department of Resource Surveys and Remote Sensing, Ministry of Environment and Natural Resources, Kenya; Central Bureau of Statistics, Ministry of Planning and National Development, Kenya; and International Livestock Research Institute. 2007. *Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-Being*. Washington, DC and Nairobi: World Resources Institute.

Wulster, K. and Burgess, N. 2005. Fire: Is the fire problem getting better or worse in the Eastern Arc Mountains? *The Arc Journal* 19: 18-19

WWF-TPO. 2005. Facilitating the Process of Designing CEPF/GCF Connectivity Interventions in the Udzungwa Mountains Area. *Unpublished report to CEPF*.

Yanda, P.Z. and Munishi, P.K.T. 2007. Hydrologic and Land Use/Cover Change Analysis for the Ruvu River (Uluguru) and Sigi River (East Usambara) Watersheds. Unpublished Report for WWF/CARE Dar es Salaam, Tanzania

APPENDICES

Appendix 1: Summary of status and trends information for various biodiversity indicators in the EACF

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Forest quality and forest health							
Forest Health - mensuration, visual crown ratings, damage	Baseline survey	Trees	Taita Hills - Ngangao	2000	55% of trees had no damage while 34% and 11% had one and two damage types respectively	Advanced decay and vines in crowns were the most common damage types.	Madoffe *et al.* (2005b)
Forest Health - mensuration, visual crown ratings, damage	Baseline survey	Trees	Taita Hills - Chawia	2000	60% of trees had no damage while 33% and 7% had one and two damage types respectively	Advanced decay and vines in crowns were the most common damage types.	Madoffe *et al.* (2005b)
Mean percentage of cut poles and trees	Disturbance transects	Trees	Kaya Diani	2004	28%; 11%	At current rate, 8 yrs remaining before poles are depleted	Preston (2004)
Mean percentage of cut poles and trees	Disturbance transects	Trees	Kaya Muhaka	2004	41%; 5%	At current rate, 5 yrs remaining before poles are depleted	Preston (2004)
Mean percentage of cut poles and trees	Disturbance transects	Trees	Kaya Ukunda	2004	44%; 10%	At current rate, 4 yrs remaining before poles are depleted	Preston (2004)
Relative Level of Disturbance (%RLD)	Disturbance transects	Trees	Arabuko-Sokoke	2006	Forest Edge 49%; Interior 44% and Nature Reserve 38%	0.1% of the forest was covered by study, extrapolated to translate to 124,000 trees cut from the whole forest in the previous year.	Jackson and Jackson (2006)
Density of cut trees	Disturbance transects	Trees	Dakatcha Woodlands	2006	36.6 poles/ha	Cutting of trees for timber seems to have occurred intensively about 2 years ago and loggers probably shifted after almost depleting timber trees	Musila *et al.* (2006); Ngari (2007)
Density of cut trees - poles	Disturbance transects	Trees	Uluguru North FR	2005 cf 2000	Stable		Frontier-Tanzania (2005)
Density of cut trees - timber	Disturbance transects	Trees	Uluguru North FR	2005 cf 2000	Decrease	Averages of dead timber (at 30.4 per ha) higher than cut timber	Frontier-Tanzania (2005)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Density of cut trees	Disturbance transects	Trees	Uluguru North FR	2006 cf. 2005	Stable	Low human disturbance; apparently not much change between 2005 and 2006; 5% (56 per ha) and 5% (23 per ha) cut poles and timber	Pius *et al.* (2007)
Density of cut trees - poles	Disturbance transects	Trees	Rondo FR	2006	0.3% (1 per ha) cut poles		Pius *et al.* (2007)
Density of cut trees - timber	Disturbance transects	Trees	Rondo FR	2006	2% (6 per ha) cut timber		Pius *et al.* (2007)
Litter depth	Quadrats		Taita Hills	2006		litter was deepest in Kasigau then Ngangao, Mbololo and Chawia; Floor litter invertebrate density was in the order Ngangao; Kasigau; Chawia; Mbololo	N. Otieno (2007)
Frequency of cutting, firewood collection, footpaths, cattle grazing	Disturbance transects	Trees	Taita Hills	2006		Vegetation cutting and human disturbance was most intense in Chawia	N. Otieno (2007)
botantical, disturbance, timber, information	> 2500 vegetation plots from various sources,	Trees	Eastern Arc wide	1976-2007	Numeruous	Additional data on tree character, height, dbh, etc available	http://www.york.ac.uk/res/kite/rm524@york.ac.uk
Change in species abundance for a few key species							
Abundance	Continued monitoring	Birds	Arabuko-Sokoke Forest	2000-2005	stable	monitoring has however been inconsistent	C. Jackson (pers. comm.)
Abundance	Continued monitoring	Sokoke Scops Owl	Arabuko-Sokoke Forest	1984-1998	stable	overall area under good forest may have reduced, thus owl population may have declined	Virani (1994; 2000); Munir Virani (pers. comm.)
Abundance	Two periods of monitoring – before and after harvesting operations	Butterflies	Arabuko-Sokoke Forest	1993;1997	stable	recent butterfly monitoring data largely support this earlier conclusion	Gordon and Ayiemba (2003); Ian Gordon (pers.comm)
Abundance	Separate surveys	Ader's Duiker	Arabuko-Sokoke Forest	1999; 2006	?	No consistent monitoring, but detailed work in 2006 (report not yet produced)	Kanga (2000a,b); Finnie (2004); C.Jackson (pers.comm.)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Abundance	Estimation	Elephants	Arabuko-Sokoke Forest	?	Increase	Population suggested to have increased from 120-150 in 10 years	Marten (2005)
Regenerative capacity	Permanent Sample Plots	Plants	Arabuko-Sokoke Forest	1990; 1998; 2004	stable		S. Wairungu (pers. comm.)
Abundance	Disturbance transects	*Lantana Camara*	Uluguru North	2006	Increase?	Is being widely planted as hedge and is slowly invading margins of natural forest	Pius *et al.* (2007)
Abundance	Separate surveys	Spotted Ground-thrush	Coastal Forests of Kenya	1980; 1983; 1986; 1994; 2003	Decline	Based on ratios of individuals caught in comparison with two other ground-dwelling thrushes at Gede in 1983 and 1986, South Coast (Mrima Hill, Marenje, Kaya Gandini, Kaya Waa, Diani) in 1994), two of the south coast forests (Mrima Hill and Diani) in 1980 and at both places in 2003	Britton *et al.* (1980); Bennun (1987); Waiyaki (1995); Ndang'an g'a *et al.* (2004)
Abundance	Separate surveys	Spotted Ground-thrush	Rondo Forest Reserve	1988; 1989; 1993; 1996; 2006; 2007	?	Few records and the numbers recorded suggest a very small population.	Holsten *et al.* (1991); Bagger *et al.* (1990); Eriksen *et al.* 1994; N. Baker (in litt); John and Pius (2007); Pius *et al.* (2007)
Abundance	Separate surveys	Spotted Ground-thrush	Litipo Forest	1989; 1993	Decline		Bagger et al. (1990); Jensen *et al.* 2005
Abundance and composition of bird communities	Assesment of impact of forest disturbance on bird communities	Birds	East Usambara Mountains	1989-2004	N/A	Forest disturbance resulted in: increased temporal variability in species richness; more that one-half of all guilds were affected by forest disturbance; recovery time for many understory species adversely affected by forest disturbance was at best very long	Newmark (2006)
Abundance	Separate surveys	Uluguru Bush-shrike	Uluguru Mountains	1999/2000; 2006/2007	stable?		John and Pius (2007)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Abundance (frequency of capture)	Bird monitoring - baseline survey by WCST	East Coast Akalat	Rondo Forest Reserve	2006	N/A	Quite abundant	Pius *et al.* (2007)
Abundance (number of territories)	Surveys of threatened species	Long-billed Apalis	East Usambara Mountains	2006	N/A	over 36 territories recorded, but work ongoing	John and Pius (2007)
Abundance	Single survey	Land snail *Gulella taitensis*	Taita Hills	2000	N/A	Single assessment in 2000 which could form baseline.	Lange (2006)
Abundance (number of groups)	Separate surveys	Tana River Red Colobus	Lower Tana River Forests	2001; 2005	Decline	Group numbers declined and changes in distribution occurred	Luke *et al.* (2005)
Abundance (number of groups)	Separate surveys	Tana River Mangabey	Lower Tana River Forests	2001; 2005	Decline	Group numbers declined and changes in distribution occurred	Luke *et al.* (2005)
Abundance (total number)	Separate surveys	Tana River Red Colobus	Lower Tana River Forests	1994; 2005	Decline	Decreased from 260 to 127	Luke *et al.* (2005)
Abundance (total number)	Separate surveys	Tana River Mangabey	Lower Tana River Forests	1994; 2005	stable	Stayed stable (144 in 1994, >149 in 2005)	Luke *et al.* (2005)
Abundance	Single survey	African Violets	Amboni Caves and Mkulumuzi River (Tanga)	2003	N/A	402 adult plants recorded in the vicinity of the caves	Kolehmainen (2004)
Abundance	Separate surveys	Kihansi Spray Toad	Kihansi and Mhalala waterfalls (Udzungwa Mountains)	2003; 2004	Decline		Weldon and du Preez (2004); IUCN *et al.* (2007)
Abundance	Quadrats	Invertebrate (litter)	Taita Hills	2006		Floor Litter invertebrate density was in the order Ngangao; Kaigau; Chawia; Mbololo	N. Otieno (2007)
Abundance (density)	Point counts along line transects	Taita Thrush	Taita Hills	2006		Densities per ha: Ngangao (64); Mbololo (40); Chawia (1); Kasigau (0)	N. Otieno (2007)
Abundance (groups/km walked)	Transects walked	Udzungwa Red Colobus	Udzungwa Mountains National Park (UMNP)	1998-2003	0.49-0.74 (Mean=0.59)		Rovero *et al.* (2006)
Abundance (groups/km walked)	Transects walked	Udzungwa Red Colobus	Udzungwa Mountains - West Kilombero Scarp Reserve	2000	0.45		Marshall *et al.* (2005)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Abundance (groups/km walked)	Transects walked	Udzungwa Red Colobus	Udzungwa Mountains - New Dabaga-Ulangambi FR	2000	0.24	abundance in the Udzungwa Mountains is lowest at high elevations; Low group sizes appear to be related to human activity rather than elevation	Marshall *et al.* (2005)
Abundance (groups/km walked)	Transects walked	Angolan Black and white colobus	UMNP	1998-2003	0.33-0.54 Groups/km		Rovero *et al.* (2006)
Abundance (groups/km walked)	Transects walked	Angolan Black and white colobus	Udzungwa Mountains - West Kilombero Scarp Reserve	2000	0.52		Marshall *et al.* (2005)
Abundance (groups/km walked)	Transects walked	Angolan Black and white colobus	Udzungwa Mountains - New Dabaga-Ulangambi FR	2000	0.16	show no relationship with elevation	Marshall *et al.* (2005)
Abundance (groups/km walked)	Transects walked	Syke's Monkey	UMNP	1998-2003	0.27-0.40		Rovero *et al.* (2006)
Abundance (groups/km walked)	Transects walked	Syke's Monkey	Udzungwa Mountains - West Kilombero Scarp Reserve	2000	0.33		Marshall *et al.* (2005)
Abundance (groups/km walked)	Transects walked	Syke's Monkey	Udzungwa Mountains - New Dabaga-Ulangambi FR	2000	0.15	show no relationship with elevation	Marshall *et al.* (2005)
Abundance (groups/km walked)	Transects walked	Sanje Mangabey	UMNP	1998-2003	0.03-0.17		Rovero *et al.* (2006)
Abundance (groups/km walked)	Transects walked	Yellow Baboon	UMNP	1998-2003	0.08-0.23		Rovero *et al.* (2006)
Abundance (groups/km walked)	Transects walked	Small antelopes	UMNP	??	??		Rovero and Marshall (2005)
Abundance	Transects, PSPs	*Maesospis eminii*	Pemba - Ngezi Vumawimbi and Msitu Mkuu Nature FRs	ongoing			DCCFF& FFI

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Abundance	Recording calls, direct sighting	Pemba Scops-owl	Pemba - Ngezi Vumawimbi and Msitu Mkuu Nature FRs	ongoing			DCCFF& FFI
Abundance	Priority & comprehensive surveys	Pemba Flying Fox	Pemba - Ngezi Vumawimbi and Msitu Mkuu Nature FRs	ongoing			DCCFF& FFI
Abundance	Droppings, direct sighting	Pemba Blue Duiker	Pemba - Ngezi Vumawimbi and Msitu Mkuu Nature FRs	ongoing			DCCFF& FFI
Abundance	Recording calls, direct sighting	Tree Hyrax	Pemba - Ngezi Vumawimbi and Msitu Mkuu Nature FRs	ongoing			DCCFF& FFI
Abundance		Migratory Birds	Pemba - Ngezi Vumawimbi and Msitu Mkuu Nature FRs	ongoing			DCCFF& FFI
Change in extraction intensity of key species							
Extraction of trees and poles	Baseline forest disturbance data	Trees and poles	26 Eastern Arc Mountain Forests in Tanzania	2005	Stable?		Madoffe, Munishi and Burgess (2005)
Extraction of trees and poles	Disturbance monitoring	Trees and poles	Uluguru North	2006 cf past surveys	Stable?	5% cut trees and poles were recorded compared to past (2005) studies by Frontier (5% and 2.4% cut trees and poles respectively)	Pius *et al.* (2007)
Extraction of trees and poles	Disturbance monitoring	Trees and poles	Rondo FR	2006	N/A	Generally low extraction through cutting	Pius *et al.* (2007)
Frequency of traps	Investigation of the status of bushmeat trapping	Mammals	Arabuko-Sokoke Forest	2006 cf 2003	Increase	According to ages of the traps found, the frequency of traps seems to have increased in the Nature Reserve since the year 2003 from 50 to about 400 new traps set per year	Lutz and Newiadomsky (2007)
Frequency of traps	Disturbance monitoring	Mammals	Rondo FR	2006	N/A	Inactive snares intended to trap small ungulates were opportunitically encountered	Pius *et al.* (2007)
Resource timber stock (cubic metres)	Inventory of resource stock	*Brachylaena huillensis*	Arabuko-Sokoke Forest	??	Decline	The entire resource could be depleted in less than 2-3 decades	CIFOR (2002)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Timber and woodfuel trade	Baseline information on timber trade dynamics before completion of Mkapa Bridge	Trees	Miombo in southern Tanzania	2001	N/A	Higher accessibility to woodlands in Rufiji District has resulted in the highest harvesting pressures (85% of total harvested wood).	Milledge and Kaale (2005)
Proportions of lower value tree species in trade	Monitoring of timber trade and associated socio-economic factors: Impact of Mkapa Bridge	Trees	Rufiji District	2001 cf. past	Increase	Over-harvesting of higher value hardwood specieshas pushed traders to exploit a larger number of alternative species, mostly Class V (e.g. Hymenaea verrucosa, Trichilia emetica)	Milledge and Kaale (2005); Milledge (2004)
Harvest areas	as above	Trees	Rufiji District	2001 cf. past; 2001-2003	Increase	Harvest areas have moved southwards as areas become over-exploited; most pronounced for *Pterocarpus angolensis* and *Dalbergia melanoxylon*	Milledge and Kaale (2005); Milledge (2004)
Harvest levels of under-size trees	as above	Trees	Rufiji District	2001 cf. past	Increase	Fewer large trees remain in wild stands	Milledge and Kaale (2005); Milledge (2004)
Trade volumes	as above	Trees	Rufiji District	2003 (bridge opened) cf. past	Increase	Observations and discussions with stakeholders indicate rapid increase in trade volumes since opening of bridge.	Milledge (2004)
Extraction intensity	Comparison of past extraction values with recent	Trees	Vikindu FR, Pande GR, Pugu FR	2005 cf. past 10 years	changes in harvested and remaining tree species	Harvesting pressures subsequently targetting less profitable species and further moved to charcoal burning	Ahrends (2005)
Extraction intensity	Comparison of past extraction values with recent	Trees	Ruvu South FR, Namakutwa FR, Kiwengoma FR	2005 cf. past 10 years	changes in harvested and remaining tree species	All valuable timber species logged out	Ahrends (2005)
Extraction intensity	Comparison of past extraction values with recent	Trees	Mchungu FR	2005 cf. past 10 years	Stable	no substantial discrepancy between previous and current timber values	Ahrends (2005)
Trade volumes	An assessment of wildlife trade	Animals	East Usambara Mountains	1998-2001	Decline	Overall greatly reduced trade since 1998 although increase in trade recorded from areas further from Amani NR	Roe *et al.* (2002)
Number of traded classes and species	An assessment of wildlife trade	Animals	East Usambara Mountains	1990-2001	Increase		Roe *et al.* (2002)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
Trade volumes	An assessment of wildlife trade	Birds	East Usambara Mountains	1995-2001	Decline	Bird sales almost completely ceased after 1995	Roe *et al.* (2002)
Local prices in US Dollars	An assessment of wildlife trade	Animals	East Usambara Mountains	1990-2001	Decline	Local prices have continually declined	Roe *et al.* (2002)
Trade volumes	An assessment of wildlife trade	Reptiles and invertebrates	East Usambara Mountains	1990-1995	Increase	Trade dominated by reptiles and invertebrates	Roe *et al.* (2002)
Trade volumes	An assessment of wildlife trade	Reptiles	East Usambara Mountains	1995-1998	Decline	Decline but involving a wider diversity of species	Roe *et al.* (2002)
Forest Cover Change							
% Forest area	Analysis of forest area remaining using remote sensing		Eastern Arc Mountain forests in Tanzania	1970s-2000s	Decline	The rates of forest loss have slowed appreciably over the past 10 years.	Mbilinyi and Kashaigili (2005)
% Forest area	as above		North Pale	1970s-2000s	Decline	12% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		South Pale	1970s-2000s	Decline	15% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		West Usambara	1970s-2000s	Decline	31% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		East Usambara	1970s-2000s	Decline	21% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		Nguu	1970s-2000s	Decline	15% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		Nguru	1970s-2000s	Decline	6% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		Ukaguru	1970s-2000s	Decline	3% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		Uluguru	1970s-2000s	Decline	13% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		Rubeho	1970s-2000s	Decline	9% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		Udzungwa	1970s-2000s	Decline	5% forest loss	Mbilinyi and Kashaigili (2005)
% Forest area	as above		Mahenge	1970s-2000s	Decline	5% forest loss	Mbilinyi and Kashaigili (2005)

Indicator	Activity	Taxa	Locality	Period	General Trend or value	Other remarks	Reference /source
% Coniferous plantation forest area	as above		Taita Hills	1987-2002	Increase	The area of coniferous plantation forests increased 32%	Pellikka *et al.* (2004); Pellikka et al. (2005)
% broad-leaved forest types	as above		Taita Hills	1987-2003	Decline	The area of broad-leaved forest types (indigenous and plantation) decreased by 3% (1.6 sq.km).	Pellikka *et al.* (2004); Pellikka et al. (2005)
% Forest area	as above		Lower Tana River Forests	1994-2005	Decline	declined by 37% over 10 years with a related reduction in quality	Luke *et al.* (2005)
% Forest area	as above		Madunguni Forest (abuts Arabuko-Sokoke forest to the north)	1992-2004	Decline	Have lost 86% of closed forest	Glenday (2005a)
% Indigenous Forest area	as above		Arabuko-Sokoke Forest	1992-2004	Stable	No significant change in Area covered by indigenous forest inside ASF	Glenday (2005a)
Fire Frequency							
Number of fire points	Assessment of MODIS firepoints	Fires	Eastern Arc Mountain Forests	2000-2005	Increase	But the number of fires within forest reserves remains fairly constant with the greatest damage occuring in dry areas	Wurster and Burgess (2005)
Number of fire points	Assessment of MODIS firepoints	Fires	Forest Reserves in the Eastern Arc Mountains	2000-2005	Stable		Wurster and Burgess (2005)
Number of fire incidences	Disturbance monitoring	Fires	Uluguru North	2006	N/A	Fire incidences only found in one of four transects	Pius *et al.* (2007)
Number of fire incidences	Disturbance monitoring	Fires	Rondo FR	2006	N/A	Generally high fire incidence: occurred in all but one of four transects and 24 (30%) of 80 sections surveyed	Pius *et al.* (2007)

Appendix 2: Area of forest cover ~2000 in hectares, area deforested from ~1990 to ~2000 in hectare, and rates of forest change in units of percent forest loss per year for Kenya's Parks and Forest Reserves.

Confidence values for forest cover and change are expressed in units of percent. Entries in bold highlight parks or reserves where significant forest loss is occurring inside park/reserve boundaries. Only parks and reserves with greater than 60% confidence in ~2000 forest cover are included in this table.

Source: Tabor *et al.* 2008.

Kenya's Parks & Forest Reserves	*forest cover ~2000 (ha)*	*Confidence in estimated forest cover ~2000 (%)*	*forest loss 1990-2000 (ha)*	*rate of forest loss (%y-1)*	*Confidence in estimated forest change (%)*
Arabuko-Sokoke Forest	21671	85	28	0.02	81
Arabuko Sokoke National Park	2535	86	1	0.01	83
Bada Nyeusi	**660**	**61**	**6**	**0.11**	**47**
Buda	399	100	0	0.01	94
Gonja	64	98	0	0.00	90
Kaya Bate	1	100	0	0.00	46
Kaya Bogowa	0	100	0	0.00	4
Kaya Bore	44	98	3	0.70	77
Kaya Chombo	9	100	0	0.00	59
Kaya Dagamura	**542**	**70**	**6**	**0.14**	**68**
Kaya Diani NM	1	100	0	0.00	57
Kaya Dzombo	213	99	0	0.00	99
Kaya Fimboni/Bomu NM	59	100	0	0.00	24
Kaya Gandini	59	100	0	0.00	85
Kaya Jego	0	100	0	0.00	100
Kaya Kauma NM.CC	26	89	0	0.00	0
Kaya Mudzimuvia NM	2	78	0	0.00	3
Kaya Muhaka	38	100	0	0.00	81
Kaya Mvumoni	5	100	0	0.00	9
Kaya Singwaya	36	70	0	0.00	61
Kaya Timbwa	1	100	0	0.00	71
Kaya Tiwi NM/CC	3	100	0	0.00	15
Madunguni	**300**	**77**	**77**	**2.54**	**81**
Mkongani East	941	100	0	0.00	96
Mkongani West	792	100	1	0.00	100
Mpunguti	1	100	0	0.00	3
Mwalunganji	105	99	0	0.00	57
Mwereni Wetland	0	100	0	0.00	19
North Malindi Brachistegia	**14091**	**93**	**1195**	**1.05**	**78**
Palm Woodland, Ramisi	26	100	0	0.00	37
Shimba Hills NR/FR	9620	100	6	0.00	83

Appendix 3: Area of forest cover ~2000 in hectares, area deforested from ~1990 to ~2000 in hectare, and rates of forest change in units of percent forest loss per year for Tanzania's parks and forest reserves.

Confidence values for forest cover and change are expressed in units of percent. Table entries in bold highlight parks or reserves where significant forest loss is occurring inside park/reserve boundaries. Only parks and reserves with greater than 60% confidence in ~2000 forest cover are included in this table.

Source: Tabor *et al.* 2008.

Tanzania's Parks & Forest Reserves	*forest cover ~2000 (ha)*	*Confidence in estimated forest cover ~2000 (%)*	*forest loss 1990-2000 (ha)*	*rate of forest loss (%y-1)*	*Confidence in estimated forest change (%)*
Amani Nature Reserve	5869	100	38	0.04	99
Bamba Ridge	989	100	0	0.00	99
Bombo East 1	**119**	**100**	**45**	**1.66**	**90**
Bombo East 2	**381**	**100**	**95**	**1.19**	**94**
Bombo West	**954**	**100**	**225**	**1.15**	**96**
Chilangala	29	100	0	0.00	100
Chitoa	0	100	0	0.00	100
Garafuno	0	100	0	0.00	8
Gendagenda	214	100	0	0.00	95
Handei	40	100	0	0.00	100
Iyondo	86	100	0	0.00	100
Kambai	822	100	1	0.01	100
Katundu	436	100	0	0.00	100
Kichi Hills	12768	100	18	0.01	100
Kihuhwi	21	100	0	0.00	100
Kihuhwi Sigi	224	100	0	0.00	100
Kikale	18	96	0	0.00	69
Kilole	3	100	0	0.00	100
Kingoma	**155**	**100**	**8**	**1.03**	**98**
Kitope	2229	100	14	0.05	100
Kiwengoma	2873	100	1	0.00	100
Kizee	23	100	0	0.00	100
Kizinga	3	100	1	1.92	100
Kwamarimba	773	100	0	0.00	100
Kwamgumi	1226	100	0	0.00	100
Kwani	11	100	0	0.00	37
Liteho	13	100	1	0.88	100
Litipo	117	100	0	0.00	100
Longuza	454	100	0	0.00	100
Lungonya	**1744**	**100**	**34**	**0.16**	**100**
Magoroto	671	100	0	0.00	100
Makangala	20	100	0	0.00	100

Makonde Scarp 1	1	100	6	9.83	100
Makonde Scarp 2	60	100	3	0.50	100
Manga	1018	100	0	0.00	100
Marenda	27	100	0	0.00	97
Matapwa	**1631**	**100**	**347**	**1.95**	**100**
Mbinga	**1121**	**100**	**29**	**0.21**	**100**
Mchungu	133	96	0	0.00	93
Mfundia	48	100	0	0.00	100
Mgambo	**717**	**100**	**13**	**0.10**	**100**
Mitarure	2105	100	3	0.01	100
Mitundumbea	**2751**	**100**	**28**	**0.15**	**100**
Mlinga	392	100	0	0.01	100
Mlungui	156	100	0	0.00	100
Mpanga Village	15	100	0	0.00	100
Msumbugwe	42	95	0	0.00	64
Mtai	2824	100	10	0.02	100
Mtanza Msona	64	95	1	0.20	13
Mtita	492	87	1	0.02	85
Muhoro	947	100	0	0.00	100
Naliendele	4	100	0	1.05	100
Namakutwa Nyamulete	2769	100	12	0.04	100
Namikupa	2	100	1	2.78	100
Nampekeso	537	100	0	0.00	100
Nandimbo	1	100	0	0.00	100
Ndimba	983	100	0	0.00	100
Ngarama	16391	100	55	0.04	100
Ngarama South	305	100	0	0.00	100
Ngulakula	**405**	**100**	**4**	**0.22**	**100**
Nilo	5113	98	56	0.07	92
Nyumburuni	**631**	**95**	**5**	**0.16**	**94**
Pindiro	1887	100	0	0.00	100
Rondo	3680	100	26	0.08	100
Ruawa	**180**	**100**	**106**	**4.13**	**100**
Ruhoi River	**693**	**94**	**6**	**0.16**	**53**
Rungo	83	100	0	0.00	100
Ruvu North	**6824**	**95**	**168**	**0.48**	**86**
Ruvu South	8769	100	38	0.09	100
Saadani National Park (SANAPA)	664	68	0	0.00	6
Segoma	1170	100	0	0.00	100
Semdoe	791	100	0	0.00	100
Tamburu	3095	100	0	0.00	100
Tongomba	2614	100	17	0.05	100
Tongwe	164	100	0	0.00	93
Utete	264	100	0	0.00	100