

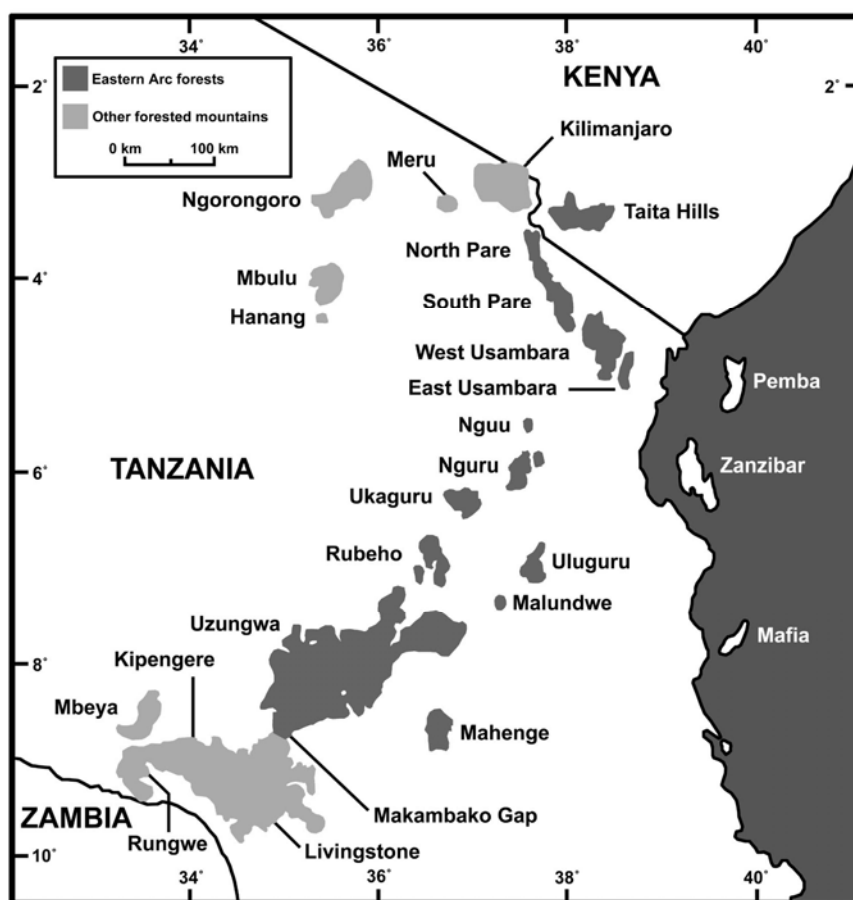


## MINISTRY OF NATURAL RESOURCES AND TOURISM

Conservation and Management of the Eastern Arc Mountain  
Forests, Tanzania: GEF-UNDP-URT/01/00015426

### EASTERN ARC MOUNTAINS STRATEGY

### BIODIVERSITY CONSERVATION THEMATIC STRATEGY



**Global  
Environment  
Facility**



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## **1. Acknowledgements**

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We thank the managers of the lands within the Eastern Arc Mountains. In particular the foresters of the 4 Regional Catchment Forest Programme Offices, the communities, and the local government staff of the 14 Districts and five Regions within the Eastern Arc.

Inputs to the development of this strategy document were also made by: Trevor Jones, Nike Doggart, Andrew Perkin, David Moyer, Andrew Marshall, Kim Howell, Michele Menegon, Francesco Rovero, Louis A. Hansen, Norbert Cordeiro, Jon Lovett, Thomas Struhsaker, Charles Msuya, Jon Fjeldså, Jasson John, Shedrack Mashauri

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## **2. Executive Summary**

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Conservation and Management of the Eastern Arc Mountain Forests (CMEAMF) is a project of the Ministry of Natural Resources and Tourism, Forestry and Beekeeping Division. The project will last for 5 years (2004-2008) and one of the outputs is the development of a holistic conservation strategy – to be produced, agreed and be under implementation within three years.

Particularly important elements of the broader strategy will be developed in more detail as thematic strategies. This is one of these thematic strategies and covers those issues that need to be addressed to understand and maintain the globally outstanding biodiversity values of the Eastern Arc Mountains. The goal of this thematic strategy is therefore to outline what needs to be done to conserve all the biological values of the Eastern Arc Mountains. It also seeks to maintain the important ecological services being provided by these mountains (mainly water supply) and also to enhance rural livelihoods - without compromising the primary goal of conserving the biological values.

The text of this thematic strategy is based upon work undertaken in 2004 and 2005 by the Forestry and Beekeeping Project 'Conservation and Management of the Eastern Arc Mountain Forests', but it also includes material derived from a wide range of other projects undertaken by many other institutions and individuals over many years. The draft of the strategy went through a process of review and consultation by email and by consultation with relevant experts. Parts of what is presented here are also included within the main Eastern Arc strategy document.

This 'biodiversity conservation' thematic strategy comprises a number of parts:

- 1) Situation analysis. Where the current situation in terms of the biological values of the Eastern Arc Mountains is outlined. This also outlines the generic threats facing the biodiversity of these mountains, and some of the underlying causes of these threats.
- 2) Proposed actions. This outlines what needs to be done, according to the best available knowledge, to maintain the biological values of the Eastern Arc Mountains. Most of these actions address the known threats, although some are about knowledge acquisition to make better decisions in the future.
- 3) Matrix. This matrix includes agreed targets and timescales for the various proposed elements of the work.

The overall conclusions are as follows:

- 1) The Eastern Arc is globally exceptional in terms of the number and density of endemic species of plants and animals that occur.
- 2) Tanzania has signed various commitments within the Convention on Biological Division and produced a National Country Study on Biodiversity and a National Biodiversity Action Plan document that highlights the importance of the Eastern Arc for conservation and also suggests ways that the country should tackle conservation.
- 3) Some elements of these national level commitments and documents are captured in the relevant sector policies and plans. For example in the 1998 national Forest Policy and the 2001 National Forest Programme.
- 4) Many of the endemic species in the Eastern Arc Mountains are regarded as being threatened by extinction, with some species being confined to a single site and Critically Endangered or Endangered in the global red list of threatened species. In at least one case – that of the Kihansi Spray Toad – it is not known if the species can

- recover from its extremely low population level and the impacts of altered habitat and disease.
- 5) The full biological value of the Eastern Arc is not yet fully known as new surveys continually discover additional species of plants, vertebrates and invertebrates. These discoveries mean that the importance of the area overall, and the constituent blocks within it, is constantly increasing. Recent advances in genetic analysis of known species is also indicating that they will ultimately be split into a number of similar species distributed among the various blocks.
  - 6) The most important conservation action that is required to safeguard the existing biological diversity of the Eastern Arc is to maintain the existing habitat cover, with as little further degradation of the habitat quality as possible. In most areas no management interventions are believed to be required beyond maintaining good quality habitat. Maintaining the habitat cover requires control of farmland encroachment into reserves, clearance and marking of the reserve boundaries, gazettement or other management agreements that see forest cover and the primary land use, and reducing the various threats that are found in the different areas.
  - 7) Various threats poses challenges to maintaining the quality of the Eastern Arc habitat and thus its suitability for the species that are found there. These threats include:
    - a. Over frequent fires that can enter forest habitats and kill the trees, burn through the leaf litter, or alter the composition of grassland areas outside the forests.
    - b. Over hunting of large and medium sized mammals that can seriously reduce populations of endemic and near-endemic species. Or can even remove species entirely from smaller forest areas – such as occurred with the Abbott's duiker.
    - c. The legal trade in some of the species of animals that are found in the Eastern Arc might pose a threat to their long term survival. This is particularly the case for the three horned chameleon species that are popular as pets in Western Countries and where hundreds to thousands are exported every year from the Eastern Arc.
    - d. Illegal collection and export of some plant species in the Eastern Arc might pose a threat to their long term survival. Particularly concerning in this regard are the various species of *Saintpaulia*, which are endemic to the Eastern Arc and coastal forests are often rare where they occur.
    - e. A number of plant species are invasive in the Eastern Arc mountains. These invasive plants are able to replace natural plant species and can dramatically reduce the biodiversity values of the forest and other habitats. Most serious in this regard are some of the invasive species of trees – such as *Maesopsis*, *Acacia* and *Eucalyptus*.
    - f. Climate change is a major issue that is likely to affect the Eastern Arc mountains to some degree – through increasing temperatures and reducing the amount of rainfall. The effects on the flora and fauna of the Eastern Arc cannot be predicted, but they may be serious.

Relevant strategies to seek to improve the status of biodiversity conservation are as follows:

Improved habitat management

- Finalise the protected area network (see below)
- Prevent farmland encroachment into the reserves (see below)
- Clarify reserve boundaries (see below)
- Provide a conservation value to the forests of the Eastern Arc (ecosystem services etc., see below).

- Upgrade existing Forest Reserves managed by FBD so that they are recognised as Protected Areas according to the IUCN categorisation system.
- Complete the gazettment process for the various proposed central, local authority and village government reserves in the Eastern Arc – totalling around 62,000 ha of habitat). Many of these gazettment processes are already underway (see FBD 2006).
- Visit areas of forest that are entirely outside of the network of reserves and ascertain the values of these areas. If they are found to contain Eastern Arc endemic flora and fauna, then they should be considered for reservation.
- Ensure that the boundaries of the various reserves are marked clearly on the ground. This entails planting the boundaries with trees and clearing these to ensure that they are easily visible to all.
- Consider maintaining boundaries of the reserves as a component of existing or future Joint Forest Management Agreements with communities. For example, if the communities own some of the boundary trees/boundary plantations and could utilise them this might motivate them to undertake the required work.
- Work with the various Village Environment Committees and others structures to educate them on the benefits of the reserves and the need to have the boundaries clearly marked.
- Develop management plans for the various Forest Reserves.
- Remove villages (legal and illegal) that have been established within the legal boundaries of Forest Reserves.

#### Enhance financing for management

- Tanzanian government to increase the resources available for Forest Reserve management through the Forestry and Beekeeping Division, to at least four times (\$200,000 per annum) what they are today. This needs to include resources so that the forest managers can either manage the resource themselves, or can monitor the management that has been devolved to communities surrounding the forests.
- Develop management plans for the various Forest Reserves according to a standard format. Current management plans are overly descriptive and do not address the key reason for the existence of the reserve, or the minimum activities that need to be undertaken to maintain those values.
- Simplify the management agreement process for villages participating in JFM agreements. The current system is lengthy and bureaucratic and does not provide suitable empowerment to the local communities in many cases.
- Establish a Forest Fund as mentioned under the Forest Act of 2002. This might be used to fund recurrent or capital expenditure in the forests.
- Seek further capitalisation of the Eastern Arc Mountains Conservation Endowment Fund, so that this can also provide a regular source of funding for the conservation of the reserves in the Eastern Arc Mountains.
- Operationalise water Payments for Environmental Services projects based on the water supplies from the Eastern Arc Mountains.
- Operationalise carbon Payments for Environmental Services projects based on the stored carbon values in the Eastern Arc forests and the potential to 'avoid deforestation' in this area through the input of targeted funds.
- Enhance the benefits to communities, either through direct payment for their work, or through enhanced access to forest resources. The operational realities of these two options have not yet been worked out. Moreover, the likelihood that central government will allow further exploitation of nationally important water catchment reserves, seems low.

### Remove key threats

- Build upon existing fire control strategies at the local level and try to spread them into other areas – for example learn from the North and South Pare Mountains and apply these elsewhere.
- Develop a sense of forest ownership within the local communities for the Forest Reserves through functioning JFM agreements, which incorporate an element of fire control.
- Harmonise the mining legislation to not allow mining in protected areas (including Forest Reserves), especially those of global biological diversity and where water supplies for people originate.
- Take strong action against miners operating illegally within catchment forest reserves, including expelling them by force if necessary.
- Work with Ministry of Mining at the local level to make sure that they understand that they should not be issuing licences for mining within reserves, and in particular close to water courses.
- For *Prunus africana* seek to domesticate the tree on farmlands. ICRAF is helping poor farmers to grow the tree and increase their incomes through sustainable harvesting of its bark. The bark will then be collectively marketed to natural remedy producers in Europe and the United States under a "green" label—one that ensures the bark has been collected without endangering *Prunus* trees.
- For *Osyris lanceolata* seek a ban on the collection and transport of this species from the wild, and try and set up a regulated system that brings benefits to the local communities. If possible seek ways to grow and domesticate this tree so that it can be used as an income generating activity for local people.
- For *Catha edulis* – seek to regulate the collection and transport of the species from the wild. Try and find ways to propagate and domesticate this tree so that it can be used as an income generating activity for local people.
- Use the results of existing medicinal plant inventories and knowledge of their values and properties, and feed these into the development of Joint Forest Management Agreements that provide a genuine benefit to local people.

### Species in trade

- Provide the relevant CITES permit authorities in Dar es Salaam with better identification tools to recognise the relevant species that should not be in trade.
- Review the quotas set for some of the rare and endemic chameleon species to determine whether they are sustainable. Of most concern are the high numbers of the various species of three horned chameleons that are being caught from the few sites where they occur and from there are being exported.
- Conduct inventory studies in areas of forest that are collected for the pet trade and those which are not collected – to assess the potential impacts of this trade.

### Invasive species

- Field work needs to be undertaken to know what species are invasive into the different forests of the Eastern Arc. This catalogue should include an idea of how serious the invasion is and what its underlying causes are. In particular it is important to know if the invasive species gain a hold in an area due to fire, clearance, or heavy disturbance of the forest.
- Detailed research is needed to know how to control or remove species of alien plant from the Eastern Arc Mountains. Some experience of this exists from southern African countries, but it is not known whether the techniques used there

are applicable to the Eastern Arc habitats. Particularly concerning species are *Cedrela*, *Rubus* and *Maesopsis*.

- As an example of a control strategy, in the East Usambara forests it has been decided that the *Maesopsis* stands should be left as they are short lived species and provide a nurse for native trees that are growing up from below. Ultimately the *Maesopsis* canopy should be replaced by natural species again, although the *Maesopsis* will never be entirely eliminated.
- Strategies to curtail the spread of other invasive species, or eliminate them entirely, are not yet formulated. These are priorities areas for further research.

#### Climate change mitigation

- Tanzania should lobby within the framework of the Kyoto protocol to make sure that other industrial countries join and adhere to the protocol. This will mean that the worst predictions of impact in the East African region are not realised.
- Tanzania should encourage research on the likely effects of climate change on the Eastern Arc Mountain forests.



### **3. Background**

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#### **3.1 General**

The “Conservation and Management of the Eastern Arc Mountain Forests” (CMEAMF) Project (GEF-UNDP URT/01/32) has its roots in the 1997 International Conference on the Eastern Arc Mountains, organised by TAFORI in Morogoro.

Following the recommendations from that conference the Forest and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism (MNRT) initiated the process of developing a full project proposal for the GEF. The GEF project is for \$12 million and contains two major elements: one developed through the World Bank for an endowment trust fund and the second developed through the UNDP to assist FBD in its work to improve conservation in the Eastern Arc Mountains.

The Eastern Arc Mountains Conservation Endowment Fund (EAMCEF) contains \$7 million World Bank GEF funds. It also has \$2 million from World Bank IDA funds that will run the establishment of the secretariat for the first 5 years.

The UNDP GEF project support through FBD contains the development of a holistic conservation strategy for the Eastern Arc (\$2.14 million), and a site-based project in the Uluguru Mountains (\$2.86 million).

Both the World Bank GEF and the UNDP GEF project elements are based in the same office complex in Morogoro.

The GEF support has been fully integrated into the Tanzania Forest Conservation and Management Project (TFCMP), which is the primary financial mechanism that has been mobilized to implement the National Forest Program (NFP). TFCMP is a \$50.1 million initiative (which includes US\$ 31.1 million in IDA financing) and it supports: the processes of institutional reform for the FBD; community-based forest and woodland protection and management; improved forest governance; and increased involvement of the private sector in the management of industrial plantations. Other donors include DANIDA, FINNIDA, and GTZ.

CMEAMF has adopted a partnership approach with all Eastern Arc stakeholders to facilitate the development and implementation of the strategy. Strong partnerships are already developed with the Catchment Forestry Programme and Monitoring and Evaluation Unit of FBD, with the Eastern Arc Mountains Conservation Endowment Fund, with the Critical Ecosystem Partnership Fund ([www.cepf.web](http://www.cepf.web)) and with environmental NGOs and projects operating in the area.

#### **Conservation and Management of the Eastern Arc Mountain Forests (CMEAMF)**

The CMEAMF project aims to improve the prospects for long term sustainable conservation of the globally important forests of the Eastern Arc. It is coordinated by the Government of Tanzania Forest and Beekeeping Division in the Ministry of Natural Resources and Tourism, with technical inputs from two NGOs - CARE and Tanzania Forest Conservation Group. The project will run for 5 years (2004-2008) and is part of a larger funding programme to assist FBD with the better management of its forest resources. CMEAMF is funded by the Global Environment Facility through UNDP.

### 3.2 Thematic strategies

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.*

This document represents one of those thematic strategies. Others will be developed on a number of other themes; 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.

### 3.3 Legal Framework

#### Convention on Biological Diversity.

The United Republic of Tanzania is among 157 countries that signed and adopted the CBD at the Earth Summit in Rio de Janeiro in 1992. Tanzania ratified the CBD in March 1996. The CBD provides for a global consensus for the contracting parties to conserve biological diversity, enhance development opportunities - banking on more sustainable uses of biological resources and promoting more equitable measures of sharing accrued benefits across local, regional, national and global stakeholders.

Obligations of the contracting parties are articulated by the CBD for successful implementation of this global consensus. The provisions, *inter alia*, focus on:

- Development of National strategies, plans or programmes for the conservation and sustainable utilization of biological resources, and the integration as far as possible and as appropriate, the conservation and sustainable utilization of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies;( Article 6 of the Convention).
- Building capacities for research, assessment, evaluation and monitoring of biodiversity at the national level with full support and participation of local communities; (Articles 7,12,13 and 14 of the Convention).
- International collaboration in transfer of technology, handling of biotechnology and other scientific linkages; (Articles 15,16,18 and 19 of the Convention).
- Exchange of information relevant to conservation and sustainable use of biological diversity as provided under Article 17 and presentation of national reports to the conference of parties; (Articles 23 & 26 of the Convention).
- Provide financial support and incentives in respect of national biodiversity programmes whereby developed countries shall provide or meet incremental costs as financial topping-up of budgets for biodiversity programmes in developing countries; articles 20 & 21 of the Convention.

By ratifying the Convention, Tanzania is committed to joining other parties in a global partnership to address the provisions of the Convention. Ratification signifies her commitment to safeguard and conserve the profusion of species, genetic materials, habitats, and ecosystems that make up the natural world. Tanzania agrees to foster development that uses biological resources sustainably, and that recognises each nation's sovereignty over the biodiversity found in its territory. By ratification, also Tanzania agrees to correct the

imbalance between who benefits from biodiversity protection and who pays. The country is committed also to find equitable ways to share biodiversity's monetary and non-monetary values, across the communities at local, regional, national and international levels, and also to spur co-operation and to establish mechanisms to finance investment in maintaining the diversity of life on earth.

#### National Country Study on Biological Diversity and National Biodiversity Strategy and Action Plan.

Article 6 of the CBD specifies that countries need to develop national biodiversity strategies and action plans. These are the key vehicles in implementing the Convention and they are intended to help a country to articulate her own priorities for domestic actions and for international co-operation. Tanzania has developed a National Country Study on Biodiversity (Department of Environment, 1997) and a National Biodiversity Strategy and Action Plan (Department of Environment, 2001). The latter document outlines the following Cross Sectoral Goals for biodiversity conservation in the country:

1. Ensure sustainability, security and equitable use of biological diversity for meeting the basic needs of the present and future generations by developing and implementing a holistic NBSAP for the conservation of biological diversity and sustainable use of its components,
2. Co-ordinate the planning and implementation of a biodiversity conservation program by ensuring that relevant activities harmonise with those of other government and non-governmental organisations, private sector, religious groups, local communities and other civic organizations,
3. Institutionalise the practice of biological conservation and the sustainable use of resources through legislative, administrative, fiscal and other regulatory measures,
4. Promote public education, understanding and awareness of the values and benefits of biodiversity conservation and of the merits of sustainable development,
5. Enhance capacity building through formal and informal education, training, research and institutional facilitation as well as financing and,
6. Enhance and facilitate collaboration between national and international community for the sustainable utilisation and conservation of biological resources,

#### Sectoral Biodiversity Conservation Plans

The preparation of conservation and development strategies and their related action plan is not new in Tanzania. Sectoral biodiversity related programmes are numerous. The NBSAP report has enumerated some of these and the leading sectors in the conservation of biodiversity related programmes. These include forestry, wildlife, fisheries, agriculture (including livestock) and water.

The overall aim of many of these conservation programmes is to meet one or more of the following objectives:

- Strengthening and improving the capacity to manage and conserve biodiversity through research and training,

- Restoring or rehabilitating terrestrial and/or aquatic habitats.
- Creating and promoting general awareness about Tanzania ecosystems, the species they contain and the benefits they bring.
- Enhance participation of local people, especially those living near the ecosystems in the conservation programmes, and
- Promote sustainable utilization of natural resources.

Of particular relevance to the Eastern Arc Mountains is the National Forest Policy of 1998 and the National Forest Programme of 2001.

Forest Policy (1998). Tanzania has been rapidly developing its policies and laws relating to forests and forest reserves over the past 10 years, with the publication of the National Forest Policy in 1998, the National Forest Programme in 2001, and the new Forest Act in 2002 (Act 14 of 2002). Careful reading of these documents shows that biodiversity conservation is now very much one of the functions of these reserves. For example the National Forest Policy has four separate policy statements on the conservation of biodiversity within Forest Reserves:

*Policy statement (15): New forest reserves for biodiversity conservation will be established in areas of high biodiversity value. Forest reserves with protection objectives of national strategic importance may be declared as nature reserves.*

*Policy statement (16): Biodiversity conservation and management will be included in the management plans for all protection forests. Involvement of local communities and other stakeholders in conservation and management will be encouraged through joint management agreements.*

*Policy statement (17): Biodiversity research and information dissemination will be strengthened in order to improve biodiversity conservation and management.*

*Policy statement (22): Management of forest reserves will incorporate wildlife conservation. Wildlife resource assessment will be intensified.*

National Forest Programme (2001). The National Forest Programme notes in Section 3.3, Section 7.4.4.2, Section 10.2 and Appendix 4, that Tanzanian forests harbour globally important biodiversity values – mentioning specifically the Eastern Arc Mountains and coastal forests as ‘globally exceptional’ for biodiversity conservation. Finally, the new Forest Act states that one of its objectives (Part II, section 3 c) is : *to ensure ecosystem stability through conservation of forest biodiversity, water catchment and soil fertility.* There are options for declaring reserves under central government control (and thus of national importance) as: forest reserves or ‘nature’ forest reserves. Hence, the government of Tanzania has clearly recognised the potential role of its forest reserves for the conservation of biodiversity, and has stated this in its several legal documents.

## **4. Situation Analysis**

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### **4.1 Biodiversity values**

The Eastern Arc Mountains have been recognised as globally important area for the conservation of biological diversity in many different analyses undertaken by international NGOs, intergovernmental bodies such as IUCN and UNEP, and by funding agencies such as the GEF and CEPF. Examples of these international analyses are found in publications by Birdlife International (ICBP 1992; Stattersfield et al., 1998) Conservation International (Mittermeier et al., 1998; 1999; 2004) and the World Wide Fund for Nature (Olson and Dinerstein 1998; Burgess et al., 2004; 2006). A brief summary of the main conclusions of these publications is presented below:

Endemic Bird Areas. BirdLife International is a global federation of conservation organisations, represented in Tanzania by the Wildlife Conservation Society of Tanzania. This organisation has identified the regions of the world that are of exceptional importance for the conservation of bird species. This analysis has shown that the lowland coastal forests of Kenya and Tanzania (EBA *East African coastal forests*) and the mountains of the Eastern Arc (excluding the North Pare Mountains) and down through the Southern Highlands and into Malawi Rift Mountains (EBA *Tanzania-Malawi Mountains*) are regions of high importance for bird conservation.

Biodiversity Hotspots. Conservation International is a USA-based conservation organisation actively trying to prevent species extinctions and conserve important sites for conservation. Their conservation strategy is based upon an analysis of plant distribution patterns and the identification of regions of the world where there are at least 1,500 narrowly endemic plant species (approximately 0.5% of the world's plant species), and where at least 75% of the original habitat has been removed. Thirty four hotspots have been defined in the latest version of this analysis (Mittermeier et al., 2004) and the Eastern Arc is included as a part of a broader 'East African Mountains' hotspot (Brooks et al., 2004).

Global – 200 priority ecoregions. The World Wildlife Fund (USA) has worked with the WWF network to define a set of ecological regions of the world that possess exceptional values in terms of biodiversity of plants and animals. This analysis also includes considerations of non-species biodiversity values – such as the presence of ancient species groups, migrations of large numbers of mammals or birds, etc (Burgess et al., 2004). In Tanzania, the Eastern Arc Mountains as defined in this document is recognised as a Global – 200 priority ecoregion as are the coastal forests. By factoring in threat to the analysis WWF is also able to define that the Eastern Arc is a critically threatened ecoregion of global importance for biodiversity conservation (Burgess et al., 2006).

Priorities for Vertebrates (University of Copenhagen in Denmark). A team, of researchers at the University of Copenhagen in Denmark has mapped the distributions of all species of birds, mammals, snakes and amphibians in Africa South of the Sahara. Analyses of these databases indicates the high level of importance of the Eastern Arc region within Africa, for both species richness, endemism, and density of species threatened by extinction (Burgess et al., in press) (Figure 1).

Priorities for plants (University of Bonn in Germany and University of York in UK). A team of researchers based in Europe but collaborating with scientists from all over the world has mapped the distribution of almost 4,000 species of plants in Africa South of the Sahara. Analyses of these databases also indicates the high level of importance of the Eastern Arc

region for species richness, endemism and for the density of species threatened with extinction (Figure 2).

Important Bird Areas/Important Plant Areas/Key Biodiversity Areas. The original concept for Important Bird Areas was to identify sites of importance for the conservation of bird species. The concept was developed and promoted by BirdLife International (local partner in Tanzania – Wildlife Conservation Society of Tanzania) and a series of criteria was developed to decide if an area was an IBA or not (Fishpool and Evans, 2001). In Tanzania, an initial inventory by WCST has identified 77 sites as IBAs, including most of the Eastern Arc Mountain blocks (Baker and Baker, 2002). Over the past few years the concept of Important Bird Areas has been broadened to include other taxon groups. The NGO Plantlife International has also adopted the same approach and using a revised set of criteria has started to identify Important Plant Areas around the world (see [www.plantlife.org.uk](http://www.plantlife.org.uk)). IPAs are backed up at the international level through recognition in the 'Global Strategy on Plant Conservation' that was adopted by the Convention on Biological Diversity at the COP7 meeting in 2002. In a further development, several of the worlds conservation organisations have proposed to look across all taxon groups to identify 'Key Biodiversity Areas' globally. To date the KBAs of Tanzania have not been identified, but it is expected that most of the remaining forest sites in the Eastern Arc Mountains would qualify for such a designation.

Alliance for zero extinction. The Alliance for Zero Extinction is a consortium of NGOs and others interested in the prevention of species extinction globally (Ricketts et al., 2005). Their work has focussed on the identification of those species that are either Critically Endangered or Endangered on the global red list ([www.redlist.org](http://www.redlist.org)) and confined to a single site. In Tanzania there are 17 such species, mainly amphibians and birds. Of these 16 are found in the Eastern Arc Mountains. These species are believed to be those most likely to become globally extinct, and hence indicate the high degree of threat facing the Eastern Arc fauna.

Figure 1. Priority regions of sub-Saharan Africa in terms of a) vertebrate species richness (over 5,000 species mapped), b) vertebrate endemism and c) density of threatened species of birds, mammals and amphibians. High values are indicated by red and low values by blue with a gradation in-between these extremes.

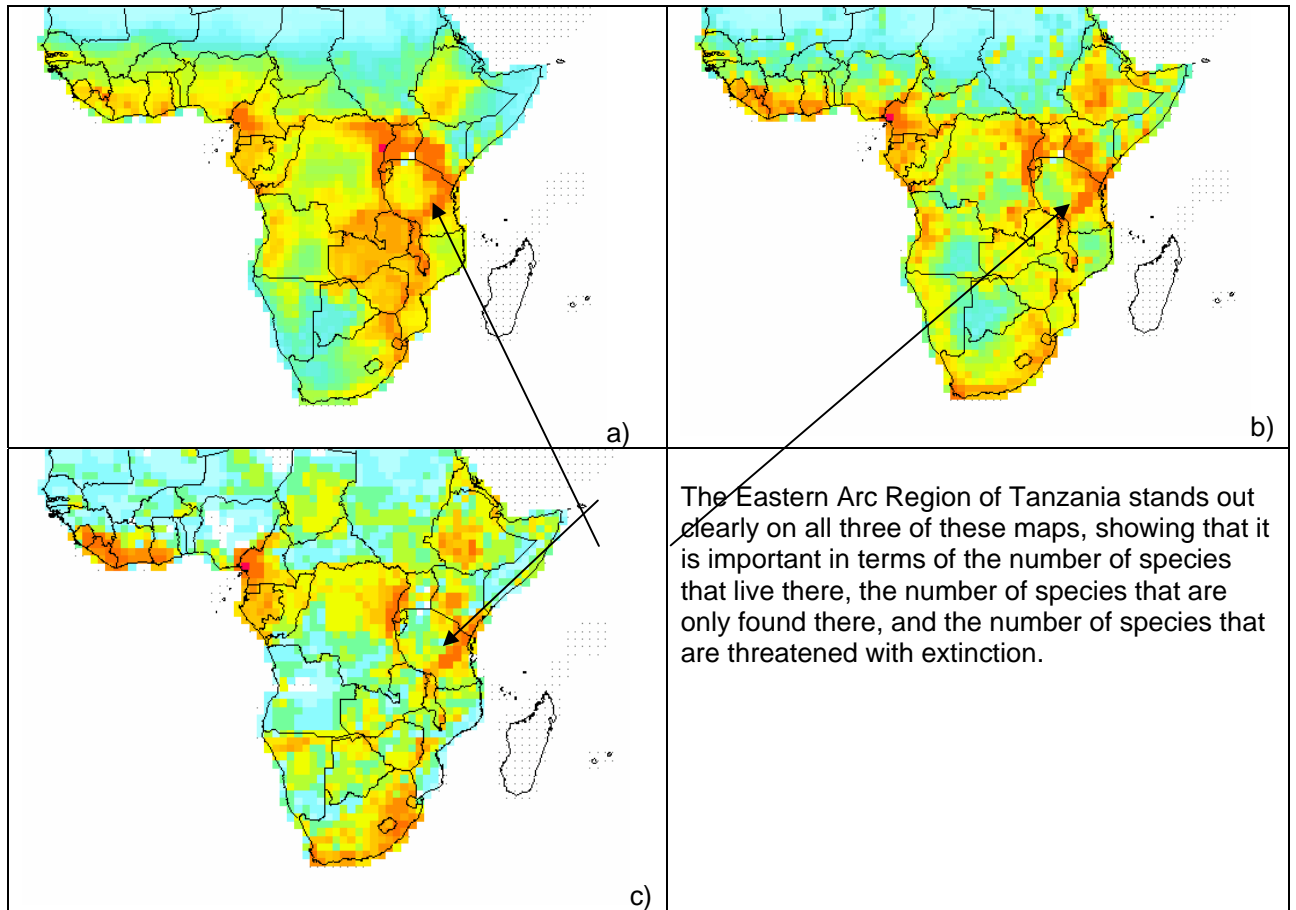
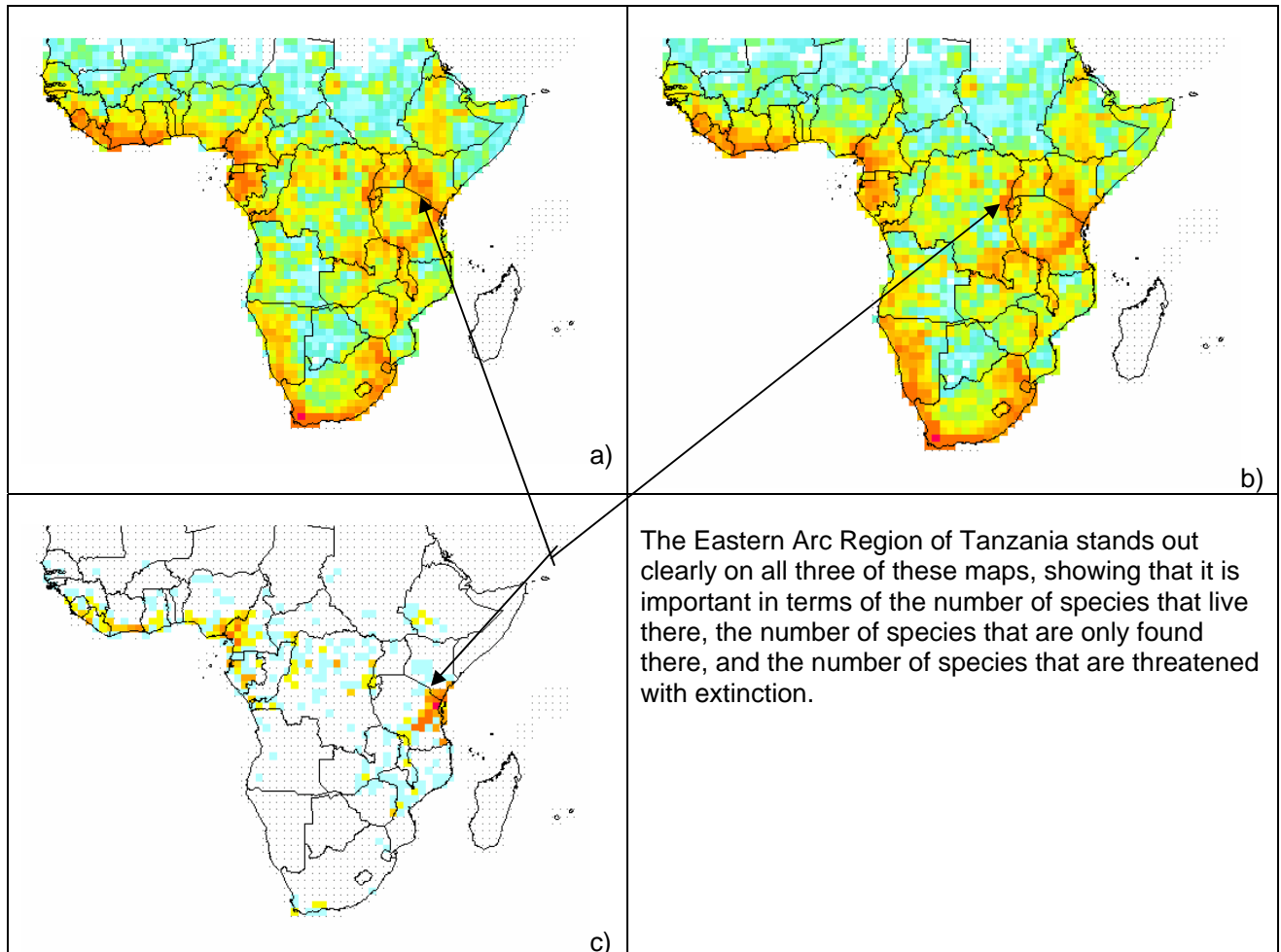


Figure 2. Priority regions of sub-Saharan Africa in terms of a) plant species richness (5,600 species – 15% of the African flora - mapped), b) plant endemism and c) plant threatened species (the process to list threatened plants is very incomplete for Africa). High values are indicated by red and low values by blue with a gradation in-between these extremes.



#### 4.2 Priorities for Endemic Species

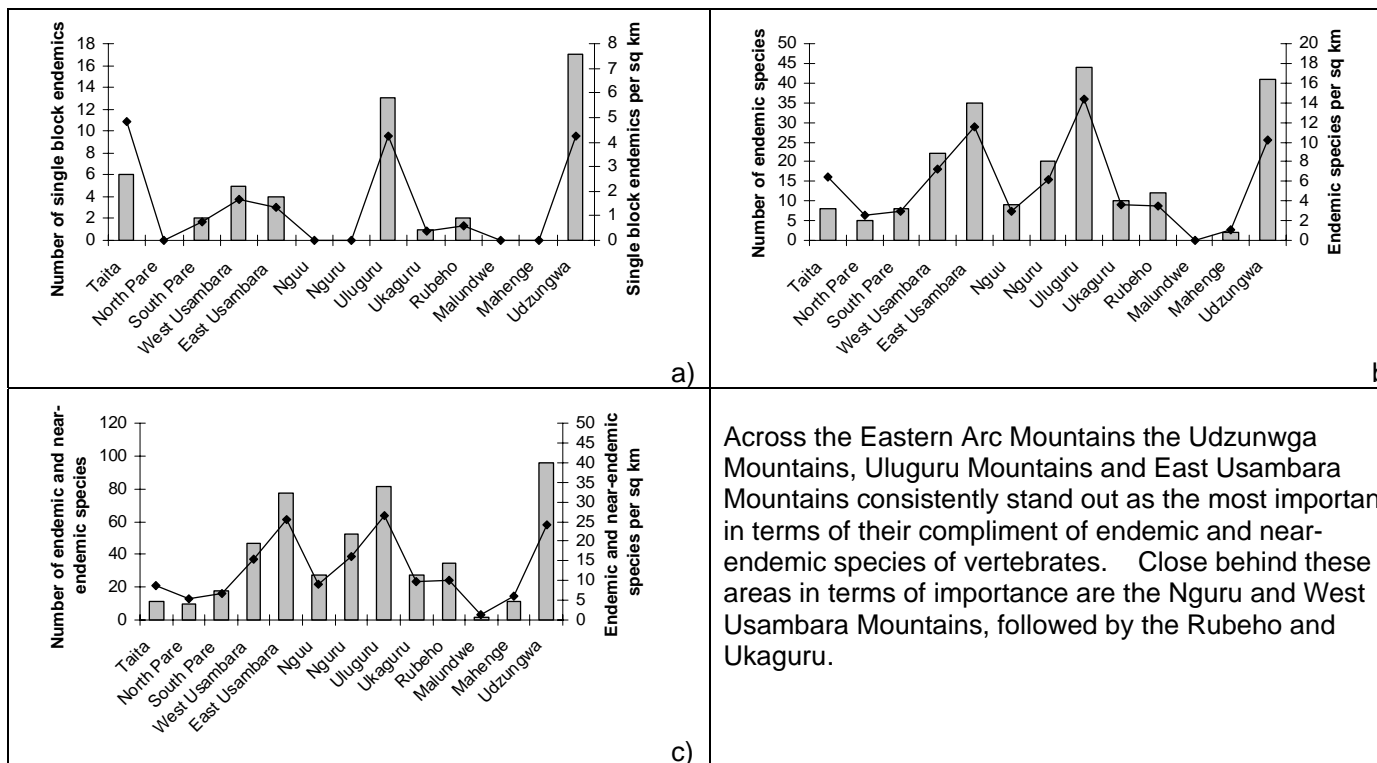
Endemic species are those which are only found in the Eastern Arc Mountains and no-where else in the world. Near-endemic species are also found in a few other areas, typically either in the lowland coastal forests, in the mountain forests of Kilimanjaro or Meru, or in the Southern Highlands. All other species are not regarded as near-endemic as their distributions are too broad.

The Eastern Arc Mountains support at least 96 endemic vertebrate species, split as follows: 10 mammals, 19 bird, 29 reptile and 38 amphibian species. A further 71 vertebrate species are near-endemic. At least 800 endemic vascular plant species are endemic, almost 10% of these being trees. An additional 32 species of bryophytes are also endemic. Many hundreds of invertebrates are also likely to be endemic, with data for butterflies, millipedes and dragonflies indicating potential trends in importance.



Looking at the various Eastern Arc blocks it is possible to assess which are of the higher importance for conservation in terms of the number of endemic and near-endemic species they support. We have looked at species that are found in a single mountain block, those that are found only in the Eastern Arc, and those which are also found in near-by forest areas (Figure 3).

**Figure 3. Ranked importance of the various Eastern Arc Mountain Forests in terms of a) number of species confined to a single mountain, b) number of Eastern Arc endemic species, c) Number of Eastern Arc endemic and near-endemic species. Grey bars are values uncorrected for the effect of varying forest area, and the black lines are the same data corrected for the effects of different forest areas between the blocks.**



Across the Eastern Arc Mountains the Udzungwa Mountains, Uluguru Mountains and East Usambara Mountains consistently stand out as the most important in terms of their complement of endemic and near-endemic species of vertebrates. Close behind these areas in terms of importance are the Nguru and West Usambara Mountains, followed by the Rubeho and Ukaguru.

Data are too incomplete, or not yet fully assembled, to allow a prioritisation among the separate forest patches of the Eastern Arc Mountains.

### 4.3 Priorities for Threatened Species

Species that are in danger of going extinct are termed 'threatened species' and there is an official global list of the worlds threatened species ([www.redlist.org](http://www.redlist.org)). There are various categories of threat. These range from an assessment that a species has already gone extinct and then to the three important categories for 'threatened species' (Critically Endangered, Endangered and Threatened). Below that are a number of categories for species that are 'Near-threatened', widespread or for some reason cannot or have not been assessed against the *red list* criteria. The IUCN red list is also widely used in international and national schemes aiming to measure the changing status of wild nature.

**Table 1. Categories of species threat – from the April 2005 document ‘Guidelines for Using the IUCN Red List Categories and Criteria’**

**EXTINCT (EX)**

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon’s life cycles and life form.

**EXTINCT IN THE WILD (EW)**

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

**CRITICALLY ENDANGERED (CR)**

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

**ENDANGERED (EN)**

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

**VULNERABLE (VU)**

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

**NEAR THREATENED (NT)**

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

**LEAST CONCERN (LC)**

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

**DATA DEFICIENT (DD)**

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If

the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

**NOT EVALUATED (NE)**

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

These *red list* categories have to be used in conjunction with five criteria (A-E) that are used to establish whether a species belongs in a threatened category (Critically Endangered, Endangered, Vulnerable) (Appendix 1).

The application of these criteria to the species of the Eastern Arc Mountains has not been completed, but according to the 2005 version of the red list seventy-one of the endemic or near-endemic Eastern Arc vertebrates are threatened by extinction (8 Critical, 27 Endangered, 36 Vulnerable), with an additional seven wide ranging threatened species (such as elephant). This assessment is based only upon the birds, mammals and amphibians as the reptiles have not been assessed in any systematic way, and nor have the many plants that are endemic to the region.

Even within the birds, mammals and amphibians there are 9 species that have been recently discovered and have not yet been assessed for the red list and 8 species where information is too incomplete and they are currently assessed as 'Data Deficient' (Appendix 2; Table 3). Across taxa there is considerable variation in the number of threatened species, species that have not yet been assessed, or where data are too incomplete for the species to be assessed (Table 3). As almost all reptiles and plants have not been formally assessed, we can only provide very rough estimates of the potential number of threatened species.

**Table 3. Threatened and potentially threatened species of birds, mammals and amphibians from the Eastern Arc Mountains**

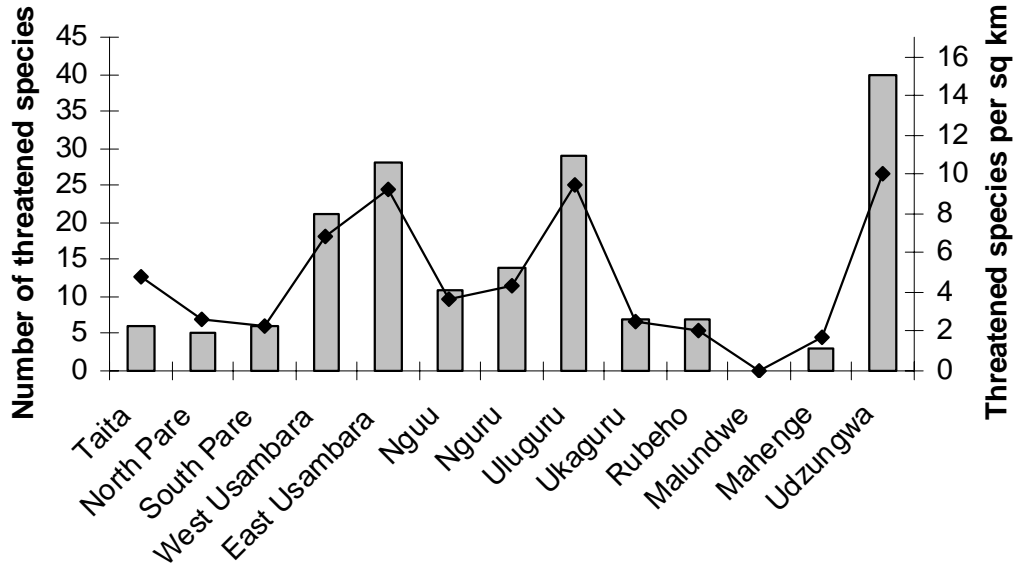
Threat category	Bird	Mammal	Reptile*	Amphibian	Plant*
<b>EX</b>	0	0	-	0	-
<b>EW</b>	0	0	-	0**	-
<b>Critically Endangered</b>	3	0	-	5	-
<b>Endangered</b>	8	5	-	14	-
<b>Vulnerable</b>	10	8	-	18	-
<b>Data Deficient</b>	0	5	-	3	-
<b>Potentially threatened</b>	4	4	Perhaps several tens of species	1	Perhaps 1,000 species (Luke and Gereau, unpublished)

\*\* the wild population of the Kihansi spray toad is dangerously low (early 2006)

Ranking the number of threatened species across the various Eastern Arc Mountain blocks provides a further set of priorities for conservation intervention (Figure 4). This shows that the Udzungwa Mountains, followed by the Uluguru and East Usambara have the largest number of threatened species and are therefore logical priorities for investments that aim to prevent extinction.

**Figure 4. Ranking Eastern Arc Mountain blocks in terms of threatened species of birds, mammals and amphibians. Grey bars are actual numbers of threatened species**

and black lines are the same data corrected for variations in forest area to show threatened species per unit area of forest



A variation of this list has recently been proposed by a group of concerned NGOs and scientists forming the 'Alliance for Zero Extinction' ([www.zeroextinction.org](http://www.zeroextinction.org)). In that system all Critically Endangered and Endangered species that are found in a single site have been identified, globally. This sub-set of the red list is believed to represent those species that are most in risk of going extinct in coming years, and thus represent the highest set of priorities for conservation attention in order to stop species disappearing. Within the Eastern Arc AZE species are found in the Udzungwa Mountains (5 species), Uluguru, East Usambara, West Usambara Mountains (3 species each) and Rubeho and Ukaguru Mountains (1 each).

## **5. Proposed Actions to Conserve Biodiversity**

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In this section we look at what needs to be done to ensure that biodiversity values of the Eastern Arc persist. Much of what is written has been recommended by local stakeholders involved with various conservation processes within Eastern Arc team during 2004 and 2005. These include 14 District stakeholder meetings, 5 meetings with groups of District and National stakeholders, 4 Eastern Arc Coordination Committee meetings at national level, participation in the development of the 'ecosystem profile' and portfolio of projects funded by CEPF, and a smaller role in the 'situation analysis' of the Eastern Arc Mountains Conservation Endowment Fund. The text is based on a synthesis of what has arisen from these various activities and has been distilled into a concrete set of actions which, if implanted, would enhance the chances of Eastern Arc biodiversity values persisting into the future.

### **5.1 Filling knowledge gaps**

*The issue.* Although a considerable amount of biological survey work has been undertaken in the Eastern Arc Mountains, there are still a number of Mountain blocks that are poorly known, and many reserves have never been surveyed for anything other than birds (and some unknown even for birds). This means that the full biological values of these mountains are not known, and a species thought to be confined to a single site and in risk of extinction may turn out to be more widespread and far less threatened. Desk review in 2003 indicated that the least known Eastern Arc Blocks were the North Pare Mountains, the Nguu Mountains, the Rubeho Mountains, the Mahenge Mountains and the Malundwe Mountain within the Mikumi National Park. In addition to the geographical gaps in knowledge for these mountains, taxonomic understanding was regarded as inadequate for invertebrate animals and plants more broadly across the Eastern Arc.

*Impact on biodiversity.* Current conservation investment is targeted into those areas with the highest known rates of biodiversity. However, if knowledge is incomplete and biased towards a few places, then these investments might target the wrong areas in terms of maximising conservation outcomes for a given amount on funding. Further to this, if areas of forest outside of the reserve network have never been studied biologically it cannot be decided if they are an urgent priority to include within the reserve network, or not.

*Proposed solutions.* During 2004 proposals were drafted by various civil society organisations to the Critical Ecosystem Partnership Fund (CEPF) to cover these gaps. Projects became operational on the ground during 2005. Five separate large scale investments are being made by CEPF (totalling over \$1 million USD) which will close many of these biological knowledge gaps. In addition to these large scale investments, targeted surveys totalling around \$150,000 have also been funded by UNDP GEF (Uluguru and Nguu), TFCG/CARE (Nguru) and on some bird taxa in the East Usambara Mountains and Udzungwa Mountains (CEPF). Some additional targeted biological assessments are proposed on Critically Endangered and Endangered species, also through CEPF.

Once all these studies have been completed and the results made publicly available, then it will be time to do the following:

- Re-analyse the priorities for conservation within the Eastern Arc Mountains, and adjust field conservation programmes accordingly.
- Appraise the level of knowledge in the Eastern Arc and decide where any remaining gaps might then be.

- Undertake a further programme of targeted research to fill in any further remaining gaps in the survey knowledge.
- Publish the results that have been obtained from all the new work and make this publicly available.

The above steps will not be necessary until around the end of 2008 as the current funded programme of study will run until then. However, the continuing discovery of new species over the past 2 years and the potential for using genetic analysis to further define the species of the Eastern Arc holds the likelihood that there will be a further need for additional biological study in these mountains for many more years to come.

## **5.2 Maintaining habitat cover**

*The issue.* The endemic, near-endemic and threatened species of the Eastern Arc Mountains are primarily confined to closed canopy forest at various altitudes. Seventy three of the 96 endemic and near endemic vertebrate species (76%) are found only in forest habitats. Across the Eastern Arc Forest area has declined from 3,660 sq km in the 1970s to around 3,230 sq km today. Forest loss has been disproportionately occurring at the mid altitudinal ranges (sub-montane forest band). For example in the Uluguru Mountains 81 % (40 sq km) of the forest loss from 1955-1977 was in the sub-montane altitudinal band (800-1500 m). As deforestation proceeds then the forests on individual mountain blocks tend to also become more fragmented and isolated from each other, for example in the West Usambara Mountains where a formerly continuous block of forest has lost 73% of its forest cover and is now found in 18 separate fragments, most less than 25 sq. km in total area. The process of declining forest area, disproportionate loss of sub-montane forest, and forest fragmentation makes it more likely that species will no-longer be able to survive in a given forest.

In terms of other habitat types where endemic and near-endemic species are found – the montane grasslands and upland wetlands are the most important, supporting at least two endemic vertebrates a number of endemic plants and 35 butterflies (found in Eastern Arc and further south), although endemic plants are also found on dry rocky outcrops. Although there is no concrete data, it is known that montane grasslands are being converted to cropland and are also being afforested by softwoods (primarily in the Udzungwa Mountains). Some natural grassland areas are found within the network of Forest Reserves and although perhaps burnt too frequently through human set fires, these areas still provide suitable habitat for the species that depend upon them.

*Impact on biodiversity.* There is a well-known relationship between forest area and the species present, and work in the East Usambara Mountains has clearly shown how species can disappear as forest patch size and connectivity is reduced. The same general relationship is true for areas of grassland or other habitats – as patch size declines, and fragmentation increases, then species tend to disappear.

*Proposed solutions.* The proposed solutions are as follows:

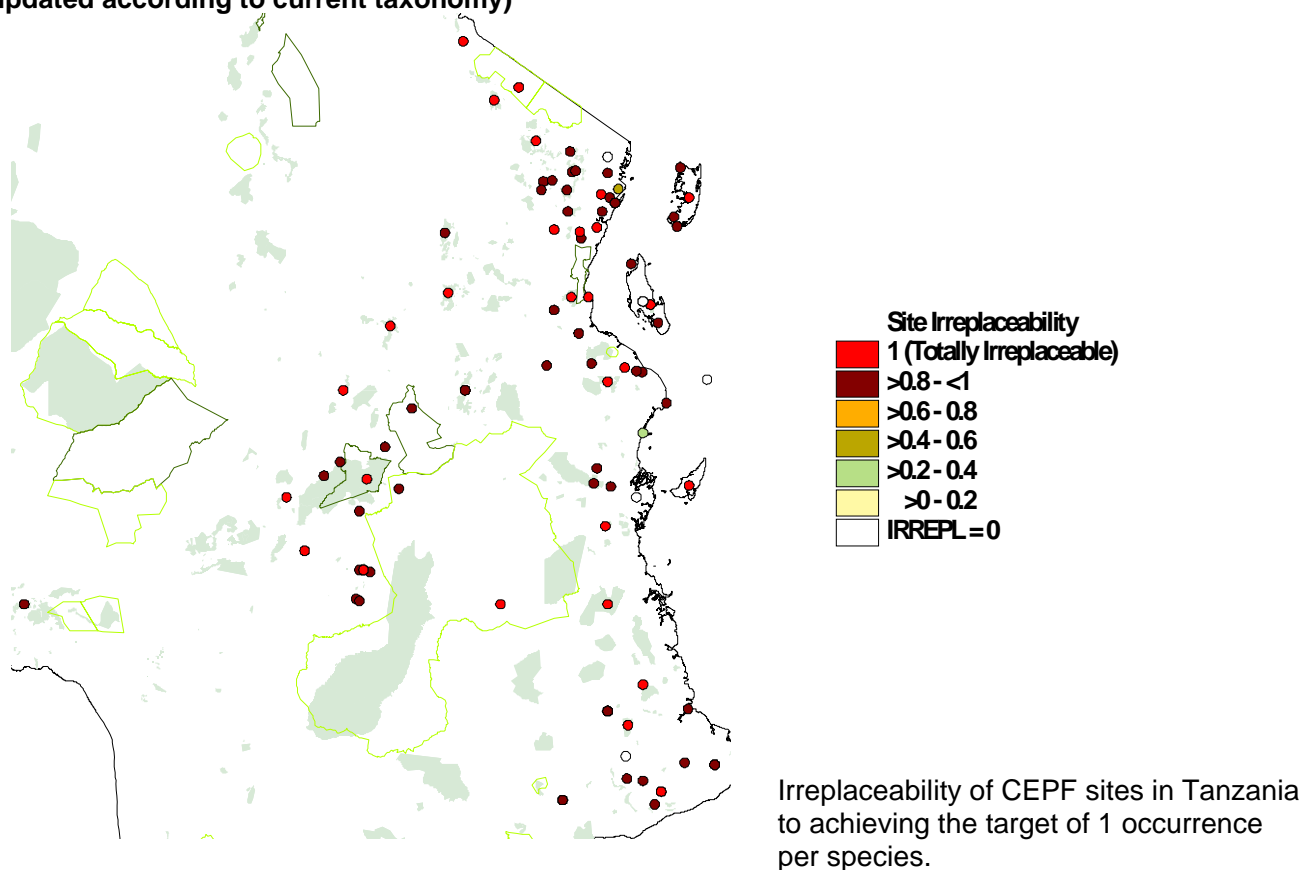
- Finalise the protected area network (see below)
- Prevent farmland encroachment into the reserves (see below)
- Clarify reserve boundaries (see below)
- Provide a conservation value to the forests of the Eastern Arc (ecosystem services etc., see below).

### 5.2.1 Finalising the protected area network

*The issue.* As indicated in the protected area thematic strategy developed by FBD for the Eastern Arc Mountains, there are a number of gaps in the protected area network in this region, and these gaps need to be closed if the full biological value of the area is to be maintained. The internationally recognised protected area network includes only the Udzungwa Mountains National Park and the Mikumi National Park. These two Parks contain 23 of the endemic species occurring in the Eastern Arc, with 93 of the 96 endemic species found outside these Parks. Only 2 of the known endemic species of animals are not within any form of reserve.

At a more theoretical level, recent work using the computer planning software C-plan (developed in Australia) also helps to show which areas of the Eastern Arc are necessary to conserve to develop a comprehensive protected area network. This methodology uses the existing distributional data on threatened species that is found in the database developed by the Critical Ecosystem Partnership Fund for the region ([www.cepf.net](http://www.cepf.net)). The analyses used calculates areas that are irreplaceable and also those which are part of a minimum set of areas that are required if the goal is to conserve every threatened species in at least 1 place.

**Figure 5. Results of preliminary C-Plan analysis in the Eastern Arc Mountains of Tanzania (based on the data in the CEPF – Ecosystem profile document of 2003, updated according to current taxonomy)**



*Impact on biodiversity.* Land protected in using legal mechanisms that aim to maintain the natural habitat cover off the best way to maintain the biodiversity values of the Eastern Arc Mountains. Eastern Arc habitats support endemic species and the species turnover between patches is very high – with narrow endemic species found in all patches where detailed study has been undertaken. The fact that important habitats are found outside of any legally designated status is a concern because it is highly likely that they also contain narrowly endemic species. Hence a failure to provide the remaining few patches of habitat outside of reserves with some form of status might result in future species extinctions if the areas are cleared for farmland, or otherwise destroyed in some way.

*Proposed solutions.* There are several ways to finalise the protected area network in the Eastern Arc.

- First, the existing Forest Reserves managed by FBD need to be upgraded so that they are recognised as Protected Areas according to the IUCN categorisation system.
- Second, the gazettment process needs to be completed for the various proposed central, local authority and village government reserves in the Eastern Arc – totalling around 62,000 ha of habitat). Many of these gazettment processes are already underway (see FBD 2006).
- Third, areas of forest that are entirely outside of the network of reserves and proposed reserves need to be visited by biologists and their values ascertained. If they are found to contain Eastern Arc endemic flora and fauna, then they should be considered for reservation.

### **5.2.2 Preventing farmland encroachment and clarifying reserve boundaries**

*The issue.* In the ranking proposed by stakeholders, farmland encroachment is not regarded as a serious threat. This is because most areas of forest outside of the reserve network has already been cleared and converted to farmland. Most villagers know that the reserves exist for a reason and they respect the borders to a considerable degree. However, in some areas where reserve boundaries are not clear, farmland encroachment has taken place. There are also problems with people living inside, or farming inside, some of the reserves. These problems need to be solved, either through people leaving the forest, or the reserve boundaries being changed. Those reserves facing the greatest problems of encroachment are outlined below.

*Impacts on biodiversity.* In those reserves facing problems of farmland encroachment, the effects on the habitat and the species living there are catastrophic. Farmland encroachment reduces the area of natural habitat remaining. A reduction in forest area will make the patches of forest less able to support the full compliment of species, especially those with large home ranges and also those which are specialised to the interior conditions of Eastern Arc Mountain forests.

*Proposed solutions.* The legislation on encroachment is clear, as are the opinions of most people living around the reserves – it should not be allowed and people who are farming within the reserves are breaking the law. Eastern Arc reserves facing extensive problems of encroachment and where solutions are urgently needed are: Nguru South in the Nguru range (Ubeni village inside reserve, considerable underplanting of forest with cardamom); Mangalisa in the Rubeho range (considerable farmland encroachment); Mamiwa-Kisara South in the Ukaguru range (considerable farmland encroachment within reserve); Mselezi in



Mahenge range (considerable encroachment along road bisecting the reserve, including establishment of many houses, a school etc). Similar problems, although on a smaller scale are found in many of the remaining Eastern Arc forest reserves. Some of the ways that are required to reduce encroachment are:

- Ensure that the boundaries of the various reserves are marked clearly on the ground. This entails planting the boundaries with trees and clearing these to ensure that they are easily visible to all.
- Consider maintaining boundaries of the reserves as a component of existing or future Joint Forest Management Agreements with communities. For example, if the communities own some of the boundary trees/boundary plantations and could utilise them this might motivate them to undertake the required work.
- Working with the various Village Environment Committees and others structures to educate them on the benefits of the reserves and the need to have the boundaries clearly marked.

### **5.2.3 Planning infrastructure development**

*The issue.* Although not mentioned by any of the stakeholder groups as a conservation issue in the Eastern Arc, infrastructure development has the potential to impact biodiversity values. This is particularly the case if the infrastructure is large scale and not built according to an Environmental Impact Assessment.

*Impact on biodiversity.* A large scale infrastructure development that caused significant negative environmental impact is associated with the development of the Kihansi hydropower station development in the southern Udzungwa Mountains. Here the diversion of the Kihansi river in the southern Udzungwa Mountains dramatically changed the micro-climate in the Kihansi gorge, and even though mitigation measures were taken the population of this critically endangered species has crashed and it is not sure if the remaining individuals constitute a viable population in the longer term. In other areas the construction of roads that pass directly through a Forest Reserves – e.g. Mselezi in the Mahenge block – have allowed access by people who have established settlements and cleared to forest to start farms.

*Proposed solutions.* Solutions to some of the issues surrounding the development of large scale infrastructure in the Eastern Arc mountains are found in the new Environment Act (2005) and the draft regulations for Environmental Impact Assessments. Ways to reduce the impact of infrastructure developments in the forests of the Eastern Arc Mountains are as follows:

- Publish and operationalise the Tanzanian EIA regulations.
- Develop management plans for the various Forest Reserves.
- Remove villages (legal and illegal) that have been established within the legal boundaries of Forest Reserves.
- Ensure that the building of permanent homes, schools, clinics, churches/mosques is not allowed in any reserve in the future, through working with relevant planning offices at the District level.

### **5.3 Maintaining habitat quality**

Across the Eastern Arc Mountains there are a number of activities going on that are reducing the quality of the remaining forest. In ranked order these are wild fires that can enter and

damage forest edges, cutting of trees for timber, cutting of woody plants (trees and shrubs) for firewood, and cutting of smaller woody plants for building poles ([www.easternarc.or.tz](http://www.easternarc.or.tz)). These activities and threats are found in almost every forest in the Eastern Arc, with the intensity varying according to factors such as management status (whether owned by private sector, central, local or village government) and capacity for management (funding, staffing levels).

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 the trees are cut and just over 10% of the poles are cut on average across all forests. Of course in some forests with weak management and many surrounding people who lack alternatives, rates of cutting can be higher and in a few places (e.g. some forests managed by the District authorities) almost all larger trees have already been cut for various forms of utilisation, some on the basis of legal licences, but mostly illegally. In other forests (remote or well managed) the levels of disturbance are lower than this average.

Data are sparse on which species are affected by changes in forest quality, although a measurable effect on endemic bird species due to disturbance has been demonstrated in the Udzungwa Mountains (Fjeldså 1999). Similar results are obtained in the East Usambara mountains when an increase in the 'edge' habitat makes conditions less suitable to some of the key birds found there (Newmark 2002). The general picture is that, in addition to the problem of reducing forest area, a reduction of forest quality presents a further challenge to some of the endemic and near-endemic species that require dense forest interior habitats.

### **5.3.1 Improving protected area management**

*The issue.* One of the challenges to the management authorities in the Eastern Arc (at the central government, local government, village government, clan, individual or private sector levels) is to have sufficient resources to manage remaining Eastern Arc habitats effectively. At current levels of operational funding from FBD (less than \$50,000 per annum spread across 14 Districts and more than 100 forest reserves), little field conservation can be undertaken beyond solving the most immediate and pressing threats. The financial situation is considerably better in the two National Parks covering Eastern Arc habitats, and active field conservation programmes are in operation at both sites. Management in this context does not entail expensive habitat or species manipulation programmes, rather it concentrates on preventing undue human exploitation, and seeing that relevant laws and agreements (central, local and village) are enforced. Given that the government has inadequate resources for the protection tasks it is expected to perform, various forms of controlled use are often permitted locally through negotiation with villagers on the basis of Joint Forest Management agreements, in exchange for local assistance with the management of the reserves.

*Impact on biodiversity.* An improved ability to manage the existing network of reserves would have a number of benefits for biodiversity conservation. These would primarily be measured in an expected reduction in the level and geographical extent of key threats.

*Proposed solutions.* The potential solutions to improved protected area and forest reserve management are many and include the following.

- Tanzanian government to increase the resources available for Forest Reserve management through the Forestry and Beekeeping Division, to at least four times (\$200,000 per annum) what they are today. This needs to include resources so

that the forest managers can either manage the resource themselves, or can monitor the management that has been devolved to communities surrounding the forests.

- Develop management plans for the various Forest Reserves according to a standard format. Current management plans are overly descriptive and do not address the key reason for the existence of the reserve, or the minimum activities that need to be undertaken to maintain those values.
- Simplify the management agreement process for villages participating in JFM agreements. The current system is lengthy and bureaucratic and does not provide suitable empowerment to the local communities in many cases.
- Establish a Forest Fund as mentioned under the Forest Act of 2002. This might be used to fund recurrent or capital expenditure in the forests.
- Seek further capitalisation of the Eastern Arc Mountains Conservation Endowment Fund, so that this can also provide a regular source of funding for the conservation of the reserves in the Eastern Arc Mountains.
- Operationalise water Payments for Environmental Services projects based on the water supplies from the Eastern Arc Mountains.
- Operationalise carbon Payments for Environmental Services projects based on the stored carbon values in the Eastern Arc forests and the potential to 'avoid deforestation' in this area through the input of targeted funds.

There is also a need to clarify the strategy being promoted by the Tanzanian Government, donors and NGOs with regard to Joint Forest Management in the high biodiversity catchment Forest Reserves managed by the central government Forestry and Beekeeping Division. JFM has been promoted for the past decade in more than 20 catchment forest reserves, and legal agreements have been signed in the Udzungwa Mountains between two communities living adjacent to two central government Forest Reserves. However, research on the functioning of these agreements indicates that the tangible benefits available to participating communities are small, a result that seems to be supported by work undertaken elsewhere in the Eastern Arc. It is recommended that the following is done to improve the JFM within the catchment forests, based on work undertaken by a special Task Force of the Forestry and Beekeeping Division:

- Enhance the benefits to communities, either through direct payment for their work, or through enhanced access to forest resources. The operational realities of these two options have not yet been worked out. Moreover, the likelihood that central government will allow further exploitation of nationally important water catchment reserves, seems low.

### **5.3.2 Reducing incidence of fire**

*The issue.* The biggest threat facing the Eastern Arc forests is, according to various lines of evidence, uncontrolled fires that enter within the forests and burn areas of grassland, forest understorey and even the forest margin trees. Fires are today greatly more abundant than in the past due to various human activities, but especially farmland clearance in the dry season in preparation for new sowing of crops. Although existing for many years, the central government laws that regulate fires have little impact on the practice and it is only where strong locally derived rules and by-laws are in place that fires are under control. Hence, fires are much less frequent in North and South Pare Mountains where fire control is institutionalised at the village level, than in the Uluguru or Nguru ranges where it is not and where wild fires are sometimes encouraged.

*Impacts on biodiversity.* Over time, fires may enter forest margins and reduce forest cover and quality, especially in drier forest areas where natural forest stands can be totally destroyed by fire and replaced by invasive species (e.g. in the North and South Pare Mountains). The direct impacts of fire on biodiversity values in the short term are more difficult to quantify, as there is little research trying to assess what these impacts are, what species might be affected and whether they are species of note in the Eastern Arc. A reduction in forest area will make the patches of forest less able to support the full compliment of species, especially those with large home ranges and also those which are specialised to the interior conditions of Eastern Arc Mountain forests.

*Proposed solutions.* A separate thematic strategy is being developed for fire management in the Eastern Arc, The suggested ways to reduce the incidence of fire in the Eastern Arc Mountains are as follows:

- Build upon existing fire control strategies at the local level and try to spread them into other areas – for example learn from the North and South Pare Mountains and apply these elsewhere.
- Develop a sense of forest ownership within the local communities for the Forest Reserves through functioning JFM agreements, which incorporate an element of fire control.

### **5.3.3 Reducing the unsustainable harvesting of wood**

*The issue.* The next most important threat is the cutting of trees for timber, trees and shrubs for firewood, and young trees as building poles. Within the catchment forest reserves these practices are illegal, but very widespread. In terms of the timber harvesting, many rumours indicate that corrupt forestry officers allow the trade to continue for their personal benefit, and for the benefit of others within the government system. Elsewhere, timber harvesting cannot be controlled due to the remote nature of the forests and the lack of funds and materials for forestry staff to make the necessary field visits. Fire wood collection and pole cutting is undertaken by local populations surrounding the forest reserves. Where controls are weak almost all fuel and building materials are obtained in this way and there is no incentive to have trees on farmlands outside the reserves (for example in the Uluguru and Nguru ranges). In areas with better government or village control over the forests, and a lack of corruption, has resulted in alternatives to the use of the forests to provide these materials being developed (for example in North Pare, Mufindi, parts of the East Usambaras).

*Impacts on biodiversity.* Intense cutting of trees for timber, or for firewood changes the structure of the forest dramatically with middle sized trees being removed leaving some ancient forest giants and many younger trees, shrubs and a tangle of lianas and scramblers. Opening up the canopy changes the micro-climate and may also facilitate the invasion of the forest by non-native plant species. The impacts of the process of forest degradation are not well known but in general it seems that the Eastern Arc forests can tolerate a certain degree of disturbance, probably with no loss of biodiversity values. Indeed in the past large mammals would have maintained some disturbance regime and this may be required by certain species. Beyond an unknown limit forest disturbance seems to have a negative impact on biodiversity values – with rare endemics being replaced by wide spread and common species – and a greater tendency for the forest to be invaded by aggressive non-native plant species.

*Proposed solutions.* A separate thematic strategy for sustainable forest use is under development. The broad conclusions of that work as they relate to timber harvesting are as follows:

- Further resources are required within the Forestry and Beekeeping Division to police the illegal practices occurring in the various Forest Reserves.
- Government officers (forestry and others) who are found to be involved with illegal logging need to be sacked and/or put in jail.
- Additional plantations need to be developed at the village level across the Eastern Arc Mountains. These should aim to provide timber and fire wood needs to local people. Such plantations could be incorporated within the framework of Joint Forest Management Agreements, potentially on the buffer zones of relevant Forest Reserves.
- Additional trees need to be planted on farmland areas throughout the Eastern Arc Mountains. In many places there are almost no trees remaining on the farmlands. There are problems with the tenure and ownership of trees on farmland, but fast growing species have been shown to be successful in many areas. There may, however, be concerns over planting some tree species (e.g. *Cedrela* or some Eucalyptus species that might be invasive within the natural forest).

#### **5.3.4 Reducing mining within reserves**

*The issue.* Mining is also a significant problem in a number of reserves, especially in the East and West Usambara, Nguu, Nguru and Uluguru ranges. This includes mining for gold, sapphire, tourmaline, rhodolite garnet and marble. A central problem is that the current Tanzanian mining legislation does not distinguish types of land where mining can, and cannot, take place. Hence permits can be issued for forest reserves that are established for water catchment purposes. Mining activities destroy river beds, marginal swampy habitats, wetlands, and associated tree and other vegetation types. They also dramatically affect water quality and may render water sources unsuitable for human consumption. In 2004 the President of Tanzania issued a statement that 'water is more precious than gold'. The Forestry and Beekeeping Division's catchment and mangroves management programme has followed up on the words of the President and has been working to solve the mining issue since 2004. Much effort has been expended to expel gold miners from the central government catchment Forest Reserves, but the numbers tend to go up and down rapidly – where strong controls are put in place numbers of miners declines, but when a new area with much gold is discovered, and where controls are weak thousands of miners can arrive in an area and wreak havoc until they are removed again.

*Impact on biodiversity.* The impact of mining within the Eastern Arc Mountain forests on biodiversity is unquantified, but it likely to be severe for aquatic species, especially over the period when the miners are active in an area. In reserves where mining is intensive, areas of forest and other habitats are removed. A reduction in the area of habitat remaining will have an impact on the ability of a species to survive in an area.

*Proposed solutions.* The strategy on mining developed for the Government of Tanzania recommends the following needs to be done:

- Harmonise the mining legislation to not allow mining in protected areas (including Forest Reserves), especially those of global biological diversity and where water supplies for people originate.
- Take strong action against miners operating illegally within catchment forest reserves, including expelling them by force if necessary.
- Work with Ministry of Mining at the local level to make sure that they understand that they should not be issuing licences for mining within reserves, and in particular close to water courses.

### 5.3.5 Ensuring sustainability in medicinal plant collection

*The issue.* Medicinal plants are collected from all forests in the Eastern Arc Mountains, and provide an important service to the surrounding communities. This is particularly important in the rural areas where most people use medicinal plants due to the high cost of (or lack of) western medicines. Medicinal plant collectors target a large number of species, but only a few are harvested to excess so that it impacts on their populations. Those most heavily impacted species are *Prunus africana* (African cherry), *Osyris lanceolata* (East African sandalwood (Table 4)) and *Catha edulis* (khat). These species can be harvested to extinction where they occur, and are traded internationally at considerable profit. Other species that are very widely collected include *Ocotea usambarensis*, *Milicia excelsa*, *Olea capensis*, *Cordia africana*. These and many other species are typically used locally, or exported to towns within Tanzania. Some are also exported abroad (Table 5).

**Table 4.** Sandalwood processing factories operating in Tanzania

S/No.	Company	Location	Capacity (Tons/month)
<b>New Companies</b>			
1	Indo-African Essential Oils	DSM	60
2	Equator Natural Essential Oils	DSM	50
3	SIERRA Limited and Variety	Babati	30
4	Rainbow Limited	DSM	41
5	Promising Traders	DSM	36
6	Bajwa Farmers and Traders	Babati	200
<b>Old Companies</b>			
7	Coastal Consortium Mombo	Mombo	30
8	Tanga Sandalwood Factory	Tanga	40
<b>Total per month</b>			<b>487</b>

**Table 5.** A list of the heavily used medicinal tree species in the West Usambara Mountains

Species botanical name	Disease treated	Remarks
<i>Artemisia afra</i>	Malaria	Over exploited locally
<i>Deinbollia borbonica</i>	Chronic cough, stomach ache, swelling legs	Has got only one tap-root which is the one needed.
<i>Tabernaemontana pachysiphon</i>	Not mentioned	Exported to USA
<i>Zanthoxylum chalybeum</i>	Stomach ache, <i>degedege</i>	Over exploited locally
<i>Microglossa oblongifolia</i>	Malaria, tooth ache	Excessive harvesting
<i>Trema orientalis</i>	Thought to treat cancer	Exported to USA for cancer treatment test
<i>Warburgia salutaris</i>	Hookworm	Exported to USA for AIDS treatment test.
<i>Prunus africana</i>	Hernia, neck ache	Exported to USA for unknown reasons.

*Impacts on biodiversity.* Most of the heavily harvested species within the Eastern Arc are not confined to this area, but have broader distributions in Africa or even elsewhere in the tropical regions of the world. Hence these practices are not likely to cause the global extinction of these species. However, the collection of *Prunus africana*, *Osyris lanceolata* and *Catha edulis* is resulting in the local extinction of these species. It is not known if medicinal plant collection is having a major impact on any Eastern Arc endemic plants.

*Proposed solutions.* A number of solutions have been proposed to the issue of unsustainable harvesting of medicinal plants from the Eastern Arc forests: Sustainable use strategies for *Prunus africana* are underway through the work done by ICRAF scientists. These are as follows:

- For *Prunus africana* seek to domesticate the tree on farmlands. ICRAF is helping poor farmers to grow the tree and increase their incomes through sustainable harvesting of its bark. The bark will then be collectively marketed to natural remedy producers in Europe and the United States under a "green" label—one that ensures the bark has been collected without endangering *Prunus* trees.
- For *Osyris lanceolata* seek a ban on the collection and transport of this species from the wild, and try and set up a regulated system that brings benefits to the local communities. If possible seek ways to grow and domesticate this tree so that it can be used as an income generating activity for local people.
- For *Catha edulis* – seek to regulate the collection and transport of the species from the wild. Try and find ways to propagate and domesticate this tree so that it can be used as an income generating activity for local people.
- Use the results of existing medicinal plant inventories and knowledge of their values and properties, and feed these into the development of Joint Forest Management Agreements that provide a genuine benefit to local people.

### 5.3.6 Hunting for food

*The issue.* People in the rural areas of Tanzania are often dependant on wild caught animals for part of their protein intake. In the Eastern Arc Mountains the keeping of cattle is not common in many of the mountain blocks. Protein sources are therefore limited to chicken, goats and beans, with some locally keeping of pigs, rabbits and guinea-pigs. Wild caught animals are an addition source of animal protein for most villagers, and hunters are found widely across the area.

In most Eastern Arc blocks in the north and central part of the range, hunting of mammals is restricted to medium sized and smaller species. This is because the largest species were hunted out long ago. In many of the heavily hunted areas the density of the medium sized mammals – such as duikers – is also low and effort focuses on catching the smaller, or more resilient species such as Hyrax, Bush Pig, and larger species of rodents. However in the south-central section (especially the eastern Udzungwa Mountains) mammals as large as elephant still persist and are occasionally hunted.

The intensity of hunting varies dramatically across the Eastern Arc. In the New Dabaga Forest Reserve in the Udzungwas 32 traps / sq km of forest have been recorded (Frontier-Tanzania 2003), whereas almost no trapping was recorded in the more remote West Kilombero Scarp Forest Reserve. In the Uluguru surveys by Frontier-Tanzania (2005) indicate that there is little hunting in Uluguru North (3 monkey traps and 2 rodent traps on 15.1 km of transect) whereas in Uluguru South there was 4 large mammal and 18 small mammal traps along 27.9 km of transect. A more detailed investigation of hunting practices around Uluguru South Forest Reserve indicates that the hunting is well organised and that consumption of smaller forest rodents is a traditional activity of the Waluguru, but is only occurring in some segments of the village population.

Hunting of birds seems to be more of an activity associated with sub-adult males in the rural areas, although some ground dwelling birds might be snared along with the smaller mammals (potentially including the endemic and Endangered Udzungwa partridge –

*Xenoperdix udzungwensis*) and its sister species the Rubeho forest partridge (*Xenoperdix obscurata*). No data are known on the density of this activity in different forests of the Eastern Arc.

*Impacts on biodiversity.* The primary conservation issue is that hunting in the Eastern Arc forests is indiscriminate, often operating at high density, and uses various forms of traps. These capture several Eastern Arc endemic and near-endemic species of mammal, for example the near endemic and Vulnerable Abbotts duiker (*Cephalophus abboti*), the near endemic and Vulnerable Eastern Arc Tree Hyrax (*Dendrohyrax validus*), the endemic Sanje Mangabey (*Cercocebus sanjei*) and Udzungwa Red Colobus (*Procolobus gordonorum*), the near-endemic and Endangered Black and Rufous Elephant Shrew (*Rhynchocyon petersi*).

For some of these species, especially Abbotts duiker, hunting can removed the species from a forest or entire Mountain block. For this species hunting seems to have been the reason for its disappearance from the East Usambara, North and South Pare and perhaps even Uluguru Mountains - where it has not been confirmed for a number of years. Populations of monkeys, including Udzungwa red colobus and Sanje mangabey, tree hyrax, and even elephant shrews can also be heavily impacted through hunting.

*Proposed solutions.* Hunting of elephant is illegal and well controlled. It is stopped wherever it is discovered. The development of local by-laws preventing the hunting of Abbott's duiker would, if implemented, make a significant impact on the conservation prospects for this species. Other solutions to the impact of hunting on rare and endemic mammals need to involve improving the ability of local populations to raise adequate numbers of domestic animals to meet their needs at a sufficiently low cost that hunting animals from the forest becomes an unattractive option for them. For birds, the species that might be worst affected by hunting is the Udzungwa forest partridge and its sister species - the Rubeho forest partridge.

### 5.3.7 Collection of animals for the pet trade

*The issue.* Wild animals, especially chameleons, some species of birds, some amphibians and large insects are collected from the natural forests of the Eastern Arc for export to Western countries as pets. Specialist collectors are active in many of the Eastern Arc Mountain forests, collecting these live animals for export. Although this trade is regulated by CITES listing of certain species and export quotas, many species of chameleon and amphibian look similar and the lack of easy identification means that rare endemic Eastern Arc species might be mistakenly (or deliberately) exported under the name of common species.

In terms of hard data 19 chameleon species that are found in Tanzania (and mostly endemic to the country) are exported from Tanzania. For the most popular species several hundred to several thousand chameleons are exported every year. The three most popular (see below) are all Eastern Arc endemics known from only a few sites. The only bird that is traded significantly from the Eastern Arc is the Livingstone's Turaco, which is found across all sites in the Eastern Arc. Occasionally there are records of Hornbills and also Red-faced Crimson Wing.



**Table 4. Species in trade from the Eastern Arc Mountains (1998-2002). CITES trade statistics derived from the "UNEP-WCMC CITES Trade Database, the UNEP - World Conservation Monitoring Centre, Cambridge, UK." Quota data from the Wildlife Division, Tanzania.**

Animal Group	Species	Quota	Mean 1998-2002
Bird	<i>Bycanistes brevis</i>	1000	?
Birds	<i>Tauraco livingstonii</i>	200	220 exported
Bird	<i>Andropadus masukensis</i>	200	?
Bird	<i>Zosterops poliogaster</i>	2000	?
Bird	<i>Cryptospiza reichenovii</i>	8000	?
Reptile	<i>Cnemaspis africana</i>	400	?
Reptile	<i>Bradypodion fischeri</i>		4,200 exported
Reptile	<i>Bradypodion spinosum</i>	28	?
Reptile	<i>Bradypodion tenue</i>	21	?
Reptile	<i>Chamaeleo deremensis</i>	500	580 exported
Reptile	<i>Chamaeleo wernerii</i>	500	660 exported
Reptile	<i>Bradypodion fischeri</i>	3000	?
Reptile	<i>Rhampholeon brevicaudatus</i>	600	?

Other species in trade include some large species of insects – especially Stag Horn and other large beetles – mainly obtained from the Usambara Mountains but also collected from the Ulugurus.

*Impacts on biodiversity.* The impacts of biodiversity of collection for the pet trade are not that well established, but in some areas it is suspected that forests have been emptied of some species of chameleon (for example in easily accessible areas of the East Usambara mountains and Ulugurus).

*Proposed solutions.* A number of potential solutions have been identified to the issue of wildlife trade from the Eastern Arc Mountains:

- Provide the relevant CITES permit authorities in Dar es Salaam with better identification tools to recognise the relevant species that should not be in trade.
- Review the quotas set for some of the rare and endemic chameleon species to determine whether they are sustainable. Of most concern are the high numbers of the various species of three horned chameleons that are being caught from the few sites where they occur and from there are being exported.
- Conduct inventory studies in areas of forest that are collected for the pet trade and those which are not collected – to assess the potential impacts of this trade.

### 5.3.8 Collection of Plants for international trade

*The issue.* The Eastern Arc is a global centre of plant endemism and supports a number of species that are popular in other countries. There is believed to be a small international trade (generally illegal) in some species for example *Saintpaulia* (African violet), *Impatiens* (busy lizzie), *Encephalatos hildebrandtii* (a cycad), *Aloe* (a succulent).

*Impacts on biodiversity.* The small trade in plants from the Eastern Arc probably does not represent a serious threat to many of the species. However, this may not be the case for the

African violet (*Saintpaulia*) where some species are already very rare and even the collection of a few individuals can pose a significant threat to their long term survival.

*Proposed solutions.* International trade in wild *Saintpaulia* is already heavily restricted in Tanzania. These restrictions should be maintained and people breaking the laws by collecting and exporting plants without going through the relevant procedures, should be held accountable. The same should be enforced for the various cycads that are within trade.

### 5.3.9 Invasive species

*The issue.* Eastern Arc forest and grassland habitats are not immune to invasion by plant species that are not native to the region. In the drier mountains of North and South Pare the forest, if disturbed or burnt, can be rapidly invaded by Eucalyptus (*Eucalyptus* species) and Black Wattle (*Acacia mearnsii*). In the East Usambara Mountains the opening of the forest canopy during commercial logging allowed the invasion of various species from the Amani Botanical garden. This includes *Maesopsis emenii*, *Lantana camara* and *Clidemia hirta*, which were recorded as early as 1930s. Species more recently identified as new threats include *Pyrostegia venusta*, *Selaginella* sp., *Castilla elastica* and *Arenga pinnata*. A short article reporting the spread of these species has recently been published in [Aliens](http://members.lycos.co.uk/WoodyPlantEcology/invasive/aliens.htm) (<http://members.lycos.co.uk/WoodyPlantEcology/invasive/aliens.htm>).

Further south, *Rubus* species are invading areas of heavily disturbed forest on the Uluguru Mountains and western Udzungwa Mountains (Mufindi District) and *Lantana camara* is found in many sites where there are high levels of disturbance.

*Impacts on biodiversity.* Where forest is replaced by non-native plant species the impact on biodiversity values is likely to be extreme. However, this impact is not well quantified outside of the East Usambara Mountains – where it is serious in some places. Elsewhere the degradation of the natural forest through the invasion by another species is likely to also have negative impacts on the biodiversity value – for example the *Rubus* invasion in the Uluguru Mountains. Again there are no data to substantiate the actual impacts of these invasive species.

*Proposed solutions.* There are a number of solutions to this growing problem:

- Field work needs to be undertaken to know what species are invasive into the different forests of the Eastern Arc. This catalogue should include an idea of how serious the invasion is and what its underlying causes are. In particular it is important to know if the invasive species gain a hold in an area due to fire, clearance, or heavy disturbance of the forest.
- Detailed research is needed to know how to control or remove species of alien plant from the Eastern Arc Mountains. Some experience of this exists from southern African countries, but it is not known whether the techniques used there are applicable to the Eastern Arc habitats. Particularly concerning species are *Cedrela*, *Rubus* and *Maesopsis*.
- As an example of a control strategy, in the East Usambara forests it has been decided that the *Maesopsis* stands should be left as they are short lived species and provide a nurse for native trees that are growing up from below. Ultimately the *Maesopsis* canopy should be replaced by natural species again, although the *Maesopsis* will never be entirely eliminated.
- Strategies to curtail the spread of other invasive species, or eliminate them entirely, are not yet formulated. These are priority areas for further research.

#### 5.4 Mitigating effects of climate change

*The issue.* Climate change is now accepted as a reality, caused by the burning of fossil fuels to provide energy that also releases carbon dioxide into the atmosphere and, together with some other gas emissions, causes the temperature of the earth to increase. Various models have been developed on the degree that global warming will actually occur. These models indicate that the temperature will increase slightly in Eastern Africa, and rainfall will decline to some degree. Rainfall data compiled for the past 50 years suggests that this decline might already be occurring in the Eastern Arc region, with a c.1% drop in rainfall over the Ruvu River Basin, and a c.1.5% decline in the Sigi river basin. This is reflected in a decline in river flows – for example a 5 fold decline in the dry season flow of the Ruvu River during the dry season.

*Impacts on biodiversity.* Some of the predicted consequences of climate change for the Eastern Arc forests and their species are that many species will need to move to higher altitudes as the temperature rises and rainfall declines. It is predicted that some species will not survive because their climatic tolerances will be exceeded and they will have no-where left to go. This issue is the subject of much detailed study around the world at the present time as some of the predictions suggest there will be a massive extinction of narrowly endemic and habitat specific species. If the worst predictions for climate change are true, then this one factor might result in a huge decline in the biological values of these mountains, regardless of whatever other management interventions are undertaken.

*Proposed solutions.* Reducing climate changes and preventing some of the more catastrophic scenarios occurring is largely outside of the influence of Tanzania. Changes will be mitigated most effectively if the emission of greenhouse gasses, primarily carbon dioxide from burning fossil fuels is dramatically reduced in the Western countries – particularly in USA. The Kyoto protocol provides a framework for actions to solve this problem, and most industrial countries and many developing countries have now signed up to this convention. The USA has not signed the convention, preferring to address the issue in its own way.

- Tanzania should lobby within the framework of the Kyoto protocol to make sure that other industrial countries join and adhere to the protocol. This will mean that the worst predictions of impact in the East African region are not realised.
- Tanzania should encourage research on the likely effects of climate change on the Eastern Arc Mountain forests.

6. Matrix of Actions and Targets

<b>Issue</b>	<b>Target</b>	<b>Responsible</b>	<b>Progress</b>	<b>Completion Date</b>
<b>Incomplete biodiversity knowledge</b>	<b>All Forest blocks adequately surveyed for main taxon groups by end 2008</b>	CEPF funded projects. UNDP-GEF and DANIDA funded projects.	UNDP GEF funded Frontier-Tanzania to survey of Uluguru North and South FR. UNDP-GEF funded bird surveys in three Forest Reserves in Nguru block. DANIDA funded TFCG to complete surveys of Nguru South FR in Nguru block. CEPF funding in place to survey forests in Mahenge block, Nguru block, Rubeho block, Ukaguru block, North Pare block and Mufindi component of Udzungwa block. CEPF funding also available for Derema proposed FR in East Usambara and for some targeted surveys of critically endangered or endangered species.	All work to be completed and written up before the end of 2008. Also before that date to be captured within CEPF, UDSM and FBD databases and made available online to relevant users.
<b>Protected area network incomplete</b>	<b>Protected area strategy developed by FBD is implemented</b>	FBD and supporting agencies.	Strategy developed and under implementation. See separate protected area strategy document which outlines what needs to be done, and where.	Goals outlined in protected area strategy document completed before end of 2008
<b>Farmland encroachment</b>	<b>Farmland encroachment stopped and reversed within reserves</b>	FBD and other management agencies	Encroachment into Uluguru South FR (c.10 ha) halted in 2005. Scale of encroachment into other reserves (Nguru South, Mangalisa, Mamiwa-Kisara South) catalogued. No solutions yet.	Encroachment issued to be solved by FBD and supporting projects by end 2008.
<b>Infrastructure development</b>	<b>Major infrastructure in Eastern Arc completes EIA according to law</b>	NEMC	EIA embedded within Environment Act. EIA regulations almost completed.	
<b>Inadequate Forest Reserve management</b>	<b>Sources of adequate funding for management secured before end of 2008. Strategy for Joint</b>	FBD and supporting agencies. (Assumption is	Scale of problem better appreciated. Possible sources of sustainable funding identified. Priority of Eastern Arc Mountains for national development and alleviation of	Eastern Arc Forest Reserve funding and staffing situation measurably improved

	<b>Forest Management in the Eastern Arc Mountains confirmed before end 2006.</b>	that TANAPA and privately managed areas are adequately managed)	poverty recognised more widely.	by the end of 2008, leading to enhanced management effectiveness.
<b>Uncontrolled fire</b>	<b>Separate strategy for fire reduction developed and under implementation</b>	FBD, District Councils and villages	Fire reduction strategy under development	Fire reduction strategy developed and under implementation in the Eastern Arc by end of 2008
<b>Unsustainable wood harvesting</b>	<b>Limits of sustainability are defined and whether current levels of timber and firewood harvesting assessed against that.</b>	Consultants. FBD and projects	Sokoine University conducted inventory of timber stocks in reserves and public lands in 2005. Sokoine University contracted to address sustainable use question 2006.	A measurable reduction in the levels of forest disturbance by end 2008.
<b>Mining</b>	<b>Mining within Forest Reserves stopped</b>	FBD and Ministry of Mining	Scale of mining problem catalogued in 2003/04. Actions to remove miners taken in 2005. Problem resumed in 2006.	Change in Mining legislation over long term to prevent licences in Forest Reserves. Current mining in reserves solved by end 2008.
<b>Medicinal plant collection</b>	<b>Limits to sustainability of medicinal plant collection defined.</b>	Researchers and FBD	Scale of the problem only known in a few key places.	Sustainable use defined during 2006.
<b>Hunting for food</b>	<b>Limits to sustainability of hunting defined. Species threatened by hunting determined.</b>	Researchers	Bushmeat studies completed in two FRs in Udzungwa and Uluguru South FR.	Species threatened by hunting
<b>Collection of animals for the pet trade</b>	<b>Limits to sustainability of collection defined. Species threatened by collection for pet trade determined.</b>	Researchers, TRAFFIC	TRAFFIC monitors the situation and reports its findings to various other bodies.	Catalogue of species in trade compiled and updated information provided to CITES authorities and into quota system by end

				2008
<b>Collection of wild plants for international trade</b>	<b>Current strict controls over African violet research and collection maintained. Scale of the issue for other species needs to be maintained.</b>	Researchers, CITES authorities	CITES authorities	Catalogue of species in trade compiled and provided to relevant CITES authorities.
<b>Invasive species</b>	<b>Scale of the invasive species problem, and species involved, assessed.</b>	Researchers, FBB	Tropical Biology Association studying issue in East Usambara Mountains. Sokoine University further addressing issue elsewhere in Eastern Arc.	Catalogue of invasive species produced and targeted actions to solve problems underway by 2008
<b>Climate change</b>	<b>Potential impact of climate change of Eastern Arc understood</b>	Researchers	Funding available for students at York University in UK to work on climate change modelling.	PhDs in next three years. An ongoing issue.

## 7. Conclusions

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The document outlines the biodiversity values of the Eastern Arc Mountains and the problems that the area faces in terms of threats to the habitats and the species contained within those habitats. The main conclusions are as follows:

- 8) The Eastern Arc is globally exceptional in terms of the number and density of endemic species of plants and animals that occur.
- 9) Tanzania has signed various commitments within the Convention on Biological Division and produced a National Country Study on Biodiversity and a National Biodiversity Action Plan document that highlights the importance of the Eastern Arc for conservation and also suggests ways that the country should tackle conservation.
- 10) Some elements of these national level commitments and documents are captured in the relevant sector policies and plans. For example in the 1998 national Forest Policy and the 2001 National Forest Programme.
- 11) Many of the endemic species in the Eastern Arc Mountains are regarded as being threatened by extinction, with some species being confined to a single site and Critically Endangered or Endangered in the global red list of threatened species. In at least one case – that of the Kihansi Spray Toad – it is not known if the species can recover from its extremely low population level and the impacts of altered habitat and disease.
- 12) The full biological value of the Eastern Arc is not yet fully known as new surveys continually discover additional species of plants, vertebrates and invertebrates. These discoveries mean that the importance of the area overall, and the constituent blocks within it, is constantly increasing. Recent advances in genetic analysis of known species is also indicating that the will ultimately be split into a number of similar species distributed among the various blocks.
- 13) The most important conservation action that is required to safeguard the existing biological diversity of the Eastern Arc is to maintain the existing habitat cover, with as little further degradation of the habitat quality as possible. In most areas no management interventions are believed to be required beyond maintaining good quality habitat. Maintaining the habitat cover requires control of farmland encroachment into reserves, gazettement or other management agreements that see forest cover and the primary land use, and reducing the various threats that are found in the different areas.
- 14) Various threats poses challenges to maintaining the quality of the Eastern Arc habitat and thus its suitability for the species that are found there. These threats include:
  - a. Over frequent fires that can enter forest habitats and kill the trees, burn through the leaf litter, or alter the composition of grassland areas outside the forests.
  - b. Over hunting of large and medium sized mammals that can seriously reduce populations of endemic and near-endemic species. Or can even remove species entirely from smaller forest areas – such as occurred with the Abbotts duiker.
  - c. The legal trade in some of the species of animals that are found in the Eastern Arc might pose a threat to their long term survival. This is particularly the case for the three horned chameleon species that are popular as pets in Western Countries and where hundreds to thousands are exported every year from the Eastern Arc.
  - d. Illegal collection and export of some plant species in the Eastern Arc might pose a threat to their long term survival. Particularly concerning in this regard are the various species of *Saintpaulia*, which are endemic to the Eastern Arc and coastal forests are often rare where they occur.

- e. A number of plant species are invasive in the Eastern Arc mountains. These invasive plants are able to replace natural plant species and can dramatically reduce the biodiversity values of the forest and other habitats. Most serious in this regard are some of the invasive species of trees – such as *Maesopsis*, *Acacia* and *Eucalyptus*.
- f. Climate change is a major issue that is likely to affect the Eastern Arc mountains to some degree – through increasing temperatures and reducing the amount of rainfall. The effects on the flora and fauna of the Eastern Arc cannot be predicted, but they may be serious.



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## **APPENDIX 1. Key issues affecting the conservation of individual species or groups of species endemic or near-endemic to the Eastern Arc**

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This section indicates some of the conservation issues facing Eastern Arc endemic or near endemic species. These are different from the generic issues that face many of the species in the area (outlined above) as these issues are of particular concern to an individual species (or small group of species) and are dramatically affecting the prospects for survival of this taxon.

### **8.1.1 Birds**

Uluguru bush shrike (*Malconotus alius*). The Uluguru bush shrike is confined to a single Forest Reserve and some public land forest on the Uluguru Mountains. Over the past decade the public land forest has been heavily logged, and cleared for underplanting with banana and other crops. Much of the forest has either been lost or heavily degraded. The known population of this bird is around 1,200 pairs (from year 2000). A repeat population estimate is planned for 2006. This should indicate if the species is facing further population declines and whether the heavily degraded public land forest provides suitable habitat for the species more.

Usambara hyliota (*Hyliota usambara*). The Usambara hyliota is confined to the lowlands and medium altitudes of the East Usambara Mountains. It has a small and fragmented area of occupancy, within which it is rare. It appears largely restricted to lowland and foothill forest, and is probably sensitive to habitat alternation and degradation. It is therefore considered Endangered ([www.redlist.org](http://www.redlist.org)).

Usambara akalat (*Sheppardia montana*). There is no recent information on the size and trend of this species' population, but it is probably declining. Clearance and degradation of its forest habitat apparently continue and its range is very small. It is therefore classified as Endangered ([www.redlist.org](http://www.redlist.org)).

### **8.1.2 Mammals**

*Abbots Duiker*. This is one of the larger mammals in the Eastern Arc Mountains range, and also occurs in Kilimanjaro and in the southern Highlands to Mt Rungwe. In mountain blocks surrounded by a high human population density the species has been heavily hunted and it is believed to have been removed from some areas. For example, it has not been recorded recently from the East Usambara, Uluguru, Pare, West Usambara and Nguru Mountains. In areas with low human population density (e.g West Kilombero Scarp Forest Reserve), or where hunting is strictly controlled (for example Kilimanjaro National Park and Udzungwa Mountains National Park) populations remain healthy.

### **8.1.3 Reptiles**

*Chameleons*. The Eastern Arc Mountains has at least 10 endemic species of chameleon. All of these species are regulated by CITES. But the majority are also being collected for the international pet trade. It is suspected that the quotas set by government and monitored by TRAFFIC are being broken on a regular basis.

### **8.1.4 Amphibians**

*Nectophrynoides asperginis* (*Kihansi Spray Toad*). This species is only known from the Kihansi Falls, in the Kihansi Gorge, in the Udzungwa Mountains, eastern Tanzania, at 600–940 m asl. This is within the Uzungwa Scarp FR and the land is managed under agreement between TANESCO and FBD. Its global range covers a tiny area around the Kihansi Falls,

and searches for it around other waterfalls on the escarpment of the Udzungwa Mountains have not located any additional populations. It was formerly abundant in a tiny area. However, some reports suggest that the species has been in steep decline, and reports in late 2003 suggest that it might now be extinct. The population, which was said to be originally around 17,000 animals, had declined to 1,000 by 2002, and by late 2003, no animals could be found. Other reports indicate that the species fluctuates naturally in its population size. These reports suggest that the population was at a high in May 1999, at a low in 2001, and at a high in June 2003. More work is needed to determine whether or not the species is in decline, or whether its population size fluctuates naturally. It lives only in soaked herbaceous vegetation in the spray zone of the Kihansi Falls. It breeds by internal fertilization, the females retaining the larvae internally in the oviduct until little toadlets are born ([www.redlist.org](http://www.redlist.org)).

*Parhoplophryne usambarica*. This species is known only from the hills west of Amani, in the East Usambara Mountains, in northeastern Tanzania, probably at around 900 m asl. It is known only from a single specimen. There have been no records since the late 1920s, despite extensive herpetological work in the Amani area (but perhaps not quite in the area where this species occurs) ([www.redlist.org](http://www.redlist.org))

*Stephopaedes usambarae*. This species is known only from the foothills of the East Usambara Mountains in northeastern Tanzania. All records have been from below 410 m asl. It is not uncommon within its very small known range ([www.redlist.org](http://www.redlist.org)).

*Arthroleptis nikeae*. This species is known to be only from the Mafwemiro Catchment Forest Reserve in the Rubeho Mountains in eastern Tanzania, at 1,900 m asl. It presumably occurs more widely, at least within the northern part of the Rubeho Mountains. It is a recently discovered species known from only two specimens collected in 2001 ([www.redlist.org](http://www.redlist.org)).

*Hyperolius kihangensis*. This species is known only from the Udzungwa Mountains in eastern Tanzania. It is so far known only from the Luhega Forest in the Udzungwa Scarp Forest Reserve at 1,740 m asl. It is probably more widespread in the Udzungwa Mountains, though it appears to be absent from apparently suitable sites close to the type locality. It is common in its only known locality ([www.redlist.org](http://www.redlist.org)).

*Nectophrynoides poyntoni*. This species is known only from the Mkalazi Valley at 1,200 m in the Udzungwa Scarp Forest Reserve, Udzungwa Mountains, in eastern Tanzania. Surveys of the other parts of the Udzungwa Forest Reserve did not locate this species. It is reasonably common within its tiny range, though much less numerous than the sympatric *Nectophrynoides tornieri* ([www.redlist.org](http://www.redlist.org)).

*Nectophrynoides wendyae*. This species is known from one tiny area, in the Udzungwa Scarp Forest Reserve, above Chita, on the escarpment of the Udzungwa Mountains, in eastern Tanzania. It is found from 1,500–1,650 m asl. It has not been found at other localities in the Udzungwa Mountains. It is quite common in one tiny area, 300 m x 300 m. Searches for it elsewhere in the Udzungwa Mountains have not succeeded in locating any animals ([www.redlist.org](http://www.redlist.org)).

*Nectophrynoides cryptus*. There have been no records of this species since the original collections in 1926 and 1927 in the Uluguru Mountains. In view of the amount of herpetological work that has taken place in this area, it would appear to be a very rare species.

*Nectophrynoides pseudotornieri*. This species is known only from the Uluguru North Forest Reserve on the eastern slopes of the northern part of the Uluguru Mountains, eastern Tanzania, at 1,080–1,345 m asl. It appears to have a very restricted distribution. It is known from only two specimens, collected in 1996 and 2000 ([www.redlist.org](http://www.redlist.org)).

*Nectophrynoides vestergaardi*. This species is known only from the West Usambara Mountains in northeastern Tanzania. There are records from the Shume-Magamba Forest Reserve, the Mazumbai forest Reserve, and the Ambangulu Estate between 1,230 and 2,000 m asl. The fact that 23 specimens have been found widely over the West Usambara Mountains, despite limited survey effort, suggests that it is not uncommon in suitable habitat within its small range ([www.redlist.org](http://www.redlist.org)).

*Churamiti maridadi*. This species is known only from Ukaguru Mountains in eastern Tanzania. The only specimens were collected at 1,840 m asl. The species has not been found in other, better-surveyed parts of the Eastern Arc mountain chain. Only two specimens are known. No male specimen has been found ([www.redlist.org](http://www.redlist.org)).

*Hyperolius tannerorum*. This species is known only from just outside the Mazumbai Forest Reserve at 1,410 m asl in the West Usambara Mountains, in northeastern Tanzania. It might occur more widely in the West Usambara Mountains, although there is little remaining undisturbed forest at this altitude. There is very little information. Only one small population is known, though it might occur more widely. It possibly has no advertisement call, so it might be easily overlooked ([www.redlist.org](http://www.redlist.org)).

#### **8.1.5 Plants**

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**APPENDIX 2. Summary of the five criteria (A-E) used to evaluate if a taxon belongs in a threatened category (Critically Endangered, Endangered or Vulnerable)**

Use any of the criteria A-E <b>Vulnerable</b>	<b>Critically Endangered</b>	<b>Endangered</b>	<b>Endangered</b>
<b>A. Population reduction</b> Declines measured over the longer of 10 years or 3 generations			
<b>A1</b>	> 90%	> 70%	> 50%
<b>A2, A3 &amp; A4</b>	> 80%	> 50%	> 30%
<b>A1.</b> Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND ceased based on and specifying any of the following:			
(a) direct observation			
(b) an index of abundance appropriate to the taxon			
(c) a decline in AOO, EOO and/or habitat quality			
(d) actual or potential levels of exploitation			
(e) effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.			
<b>A2.</b> Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible, based on any of (a) to (e) under A1			
<b>A3.</b> Population reduction projected or suspected to be met in the future (up to a maximum of 100 years) based on any of (b) to (e) under A1.			
<b>A4.</b> An observed, estimated, inferred, projected or suspected population reduction (up to a maximum of 100 years) where the time period must include both the past and the future, and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible, based on any of (a) to (e) under A1.			
<b>B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy)</b>			
	<b>Critically Endangered</b>	<b>Endangered</b>	<b>Vulnerable</b>
<b>B1.</b> Either extent of occurrence	< 100 km <sup>2</sup>	< 5,000 km <sup>2</sup>	< 20,000 km <sup>2</sup>
<b>B2.</b> or area of occupancy	< 10 km <sup>2</sup>	< 500 km <sup>2</sup>	< 2,000 km <sup>2</sup>
and 2 of the following 3:			
(a) severely fragmented or # locations	=1	=2-5	=6-10
(b) continuing decline in (i) extent of occurrence (ii) area of occupancy, (iii) area, extent and/or quality of habitat, (iv) number of locations or subpopulations and (v) number of mature individuals.			
(c) extreme fluctuations in any of (i) extent of occurrence, (ii) area of occupancy, (iii) number of locations or subpopulations and (iv) number of mature individuals.			
<b>C. Small population size and decline</b>			
	<b>Critically Endangered</b>	<b>Endangered</b>	<b>Vulnerable</b>
Number of mature individuals and either <b>C1</b> or <b>C2</b> :	< 250	<2,500	<10,000
<b>C1.</b> An estimated continuing decline of at least up to a maximum of 100 years	25% in 3 years or 1 generation	20% in 5 years or 2 generations	10% in 10 years or 3 generations
<b>C2.</b> A continuing decline and (a) and/or (b)			

(a i) # mature individuals in largest subpopulation < 50	< 250	< 1,000
(a ii) or % individuals in one subpopulation = 90-100%	95-100%	100%
(b) extreme fluctuations in the number of mature individuals		

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**D. Very small or restricted population**

	<b>Critically Endangered</b>	<b>Endangered</b>	<b>Vulnerable</b>
Either (1) number of mature individuals < 50	< 50	< 250	< 1,000
or (2) restricted area of occupancy A	na	na	typically:

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**E. Quantitative Analysis**

	<b>Critically Endangered</b>	<b>Endangered</b>	<b>Vulnerable</b>
Indicating the probability of extinction in the wild to be at least	50% in 10 years or 3 generations	20% in 20 years or 5 generations (100 years max) (100 years max)	10% in 100 years

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**APPENDIX 3. Threatened and potentially threatened species of birds, mammals, reptiles and amphibians in the Eastern Arc Mountains**

Species	Type of animal	Threat category	AZE species	Notes
<i>Apalis fuscigularis</i>	Bird	CR	Yes	Confined to the Taita Hills in Kenya. Only 300 ha habitat remains
<i>Artisornis moreaui</i>	Bird	CR	Yes	Confined to tangled areas within the forests of the East Usambara Mountains – especially Amani Nature Reserve.
<i>Turdus helleri</i>	Bird	CR	Yes	Confined to the Taita Hills in Kenya. Only 300 ha of habitat remains.
<i>Churamiti maridadi</i>	Amphibian	CR	Yes	Confined to the Ukaguru Mountains in Tanzania. Newly discovered.
<i>Nectophrynoides asperginis</i>	Amphibian	CR	Yes	Confined to the Kihansi Gorge in the Udzungwa Mountains within the Uzungwa Scarp FR. Dramatically affected by installation of hydropower plant and almost Extinct in the Wild.
<i>Nectophrynoides poyntoni</i>	Amphibian	CR	Yes	This species is known from a small area of the West Usambara Mountains.
<i>Nectophrynoides wendyae</i>	Amphibian	CR	Yes	Confined to a small area of the Udzungwa Mountains. Little to nothing is known of the ecology of this species.
<i>Parhoplophryne usambarica</i>	Amphibian	CR	Yes	The status of this species is unclear.
<i>Hyliota usambarae</i>	Bird	EN	Yes	Confined to the forests of the East Usambara Mountains
<i>Malaconotus alius</i>	Bird	EN	Yes	Confined to medium altitude forests of the Uluguru Mountains
<i>Sheppardia montana</i>	Bird	EN	Yes	Confined to the forests of the West Usambara Mountains
<i>Xenoperdix udzungwensis</i>	Bird	EN	Yes	Confined to the Nyumbanito and Ndundulu Mountains of the Udzungwas
<i>Xenoperdix obscurata</i>	Bird	EN	Yes	Confined to the forests of the Rubeho Mountains
<i>Ploceus nicolli</i>	Bird	EN		
<i>Anthreptes pallidigaster</i>	Bird	EN		
<i>Zosterops silvanus</i>	Bird	EN		
<i>Crocidura desperata</i>	Mammal	EN		
<i>Crocidura telfordi</i>	Mammal	EN		
<i>Crocidura usambarae</i>	Mammal	EN		
<i>Myosorex kahaulei</i>	Mammal	EN		
<i>Rhynchocyon petersi</i>	Mammal	EN		
<i>Arthroleptides martiensseni</i>	Amphibian	EN		
<i>Arthroleptides yakusini</i>	Amphibian	EN		
<i>Arthroleptis nikeae</i>	Amphibian	EN		
<i>Bufo brauni</i>	Amphibian	EN		



<i>Hoplophryne rogersi</i>	Amphibian	EN		
<i>Hyperolius kihangensis</i>	Amphibian	EN		
<i>Hyperolius tannerorum</i>	Amphibian	EN		
<i>Nectophrynoides cryptus</i>	Amphibian	EN		
<i>Nectophrynoides minutus</i>	Amphibian	EN		
<i>Nectophrynoides pseudotornieri</i>	Amphibian	EN		
<i>Nectophrynoides vestergaardi</i>	Amphibian	EN		
<i>Phrynobatrachus krefftii</i>	Amphibian	EN		
<i>Phrynobatrachus uzunguensis</i>	Amphibian	EN		
<i>Stephopaedes usambarae</i>	Amphibian	EN		
<i>Anthreptes rubritorques</i>	Bird	VU		
<i>Apalis chariessa</i>	Bird	VU		
<i>Bubo vosseleri</i>	Bird	VU		
<i>Cinnyricinclus femoralis</i>	Bird	VU		
<i>Nectarinia rufipennis</i>	Bird	VU		
<i>Scepomycter winifredae</i>	Bird	VU		
<i>Sheppardia lowei*</i>	Bird	VU		
<i>Sheppardia gunningi</i>	Bird	VU		
<i>Swynnertonia swynnertoni</i>	Bird	VU		
<i>Zosterops winifredae</i>	Bird	VU		
<i>Cephalophus spadix</i>	Mammal	VU		
<i>Crocidura tansaniana</i>	Mammal	VU		
<i>Dendrohyrax validus</i>	Mammal	VU		
<i>Galagoides zanzibaricus</i>	Mammal	VU		
<i>Myonycteris relicta*</i>	Mammal	VU		
<i>Paraxerus vexillarius</i>	Mammal	VU		
<i>Procolobus gordonorum</i>	Mammal	VU		
<i>Sylvisorex howelli</i>	Mammal	VU		
<i>Afrivalus uluguruensis</i>	Amphibian	VU		
<i>Afrivalus morerei</i>	Amphibian	VU		
<i>Arthroleptis tanneri</i>	Amphibian	VU		
<i>Arthroleptis xenodactylus</i>	Amphibian	VU		
<i>Boulengerula niedeni</i>	Amphibian	VU		
<i>Bufo uzunguensis</i>	Amphibian	VU		
<i>Hoplophryne uluguruensis</i>	Amphibian	VU		
<i>Hyperolius</i>	Amphibian	VU		

<i>minutissimus</i>				
<i>Leptopelis barbouri</i>	Amphibian	VU		
<i>Leptopelis uluguruensis</i>	Amphibian	VU		
<i>Leptopelis vermiculatus</i>	Amphibian	VU		
<i>Leptopelis parkeri</i>	Amphibian	VU		
<i>Nectophrynoides viviparus</i>	Amphibian	VU		
<i>Phlyctimantis keithae</i>	Amphibian	VU		
<i>Probreviceps macrodactylus</i>	Amphibian	VU		
<i>Probreviceps rungwensis</i>	Amphibian	VU		
<i>Probreviceps uluguruensis</i>	Amphibian	VU		
<i>Scolecormorphus vittatus</i>	Amphibian	VU		
<i>Crocidura monax sensu lato</i>	Mammal	DD		
<i>Galagoides orinus</i>	Mammal	DD		
<i>Myosorex geata</i>	Mammal	DD		
<i>Rhinolophus deckenii</i>	Mammal	DD		
<i>Rhinolophus maendeleo</i>	Mammal	DD		
<i>Hyperolius tornieri</i>	Amphibian	DD		
<i>Nectophrynoides frontierei</i>	Amphibian	DD		
<i>Nectophrynoides laevis</i>	Amphibian	DD		