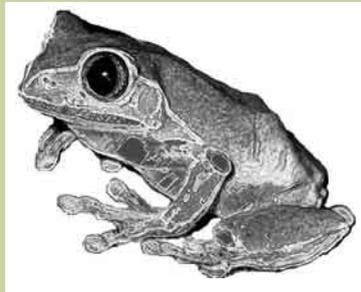




TROPICAL BIOLOGY ASSOCIATION

Field Guides

AMANI  
NATURE RESERVE  
an introduction



This guide was developed to help participants on Tropical Biology Association field courses to learn about the Amani Nature Reserve and the forests of the East Usambara Mountains. It includes an introduction to the East Usambaras and describes the ecology, flora and fauna of the area. The history of management and conservation of the Amani Nature Reserve, together with its current status, is outlined.

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For any queries concerning this document please contact:

Tropical Biology Association  
Department of Zoology  
Downing Street, Cambridge  
CB2 3EJ  
United Kingdom  
Tel: +44 (0) 1223 336619  
e-mail: [tba@tropical-biology.org](mailto:tba@tropical-biology.org)

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# EAST USAMBARA MOUNTAINS

## An overview

### Geographical history

The Amani Nature Reserve is located in the East Usambara region. This is part of the Eastern Arc Mountains, an isolated mountain chain of ancient crystalline rock formed through a cycle of block faulting and erosion that stretches from the Taita Hills in Kenya down to the Southern Highlands in Tanzania. Due to their age, status as forest “islands” and role as condensers of moisture from the Indian Ocean, the Eastern Arc forests are rich in endemic species (Hamilton, 1989). Many species have been geographically separated from their closest relatives for long periods. The mountains appear to serve both as a refuge for formerly widespread flora and fauna (Iversen, 1991) and as centres of speciation. Patches of forest such as the Amani Nature Reserve have been likened to the African equivalent of the Galápagos Islands in terms of their endemism and biodiversity. Therefore it is considered one of the most important forest blocks in Africa.

### Flora and fauna of the Usambara Mountains

Of the approximately 3450 species of vascular plants recorded in the Usambara Mountains, over one quarter are likely to be endemic or near-endemic. In addition to the variety of plants, the mountains host a number of endemic or rare fauna species, including the Usambara eagle owl and a viviparous frog species.

### Human impacts

Over the past century, depletion of forests through logging activities and increasing clearance of forest areas for small-scale farm plots has become a serious problem in forest management throughout the Usambaras. One of the most obvious and deleterious effects of this deforestation is soil erosion. The East Usambaras are an important water catchment area for lowland populations, so siltation through soil erosion causes a major problem for management in the area.



**Amani Nature Reserve: facts & figures**

**Longitude/latitude:** 5°14'10"-5°04'30" S, 38°30'34"-38°40'06" E

**Elevation:** Approximately 190-1130 m above sea level

**Topography:** Catchment of Sigi river

**Forest vegetation:** Submontane, lowland and plantation forests

**Forest area:** The largest single block of forest in the East Usambara Mountains, connected to northern forest blocks only by the Derema forest corridor on public land

**Hectares:** 8360 ha

**Status:** Nature Reserve, gazetted in 1997, and a Man and the Biosphere Reserve

**Mean annual rainfall:** 1910 mm per annum

**Mean maximum temperature:** 24.1°C

**Mean minimum temperature:** 16.3°C

**UTM:** 94 21640-94 39000 S, 45 0600-46 3200 E

**Summary of biodiversity in Amani Nature Reserve**

Please note this may not be a complete guide, but does give an idea of the species present.

Taxon	Total no. of species	% forest dependent	No. of non-forest species	No. of endemic species	No. of near-endemic species	No. of forest-dependent endemics and near-endemics
Trees and shrubs	264 <sup>1</sup> 367 <sup>2</sup> 8 <sup>3</sup>	43.0	22	19	49	53
Mammals	59 <sup>4</sup>	15.3	6	0	3	2
Birds	65	33.8	15	2	3	3
Reptiles	49	46.7	6	3	15	17
Amphibians	27	66.6	0	2	14	16
Butterflies	112	20.5	4	1	10	9
<b>Total</b>	<b>951</b>	<b>n/a</b>	<b>53</b>	<b>27</b>	<b>94</b>	<b>100</b>

(Frontier Tanzania, 2001)

<sup>1</sup> Species recorded in vegetation plots

<sup>2</sup> Species recorded opportunistically

<sup>3</sup> Species recorded in the regeneration plots only

<sup>4</sup> Includes 16 bat species



## History of Amani

Amani Nature Reserve was gazetted in 1997, amalgamating six forest reserves (Amani-Sigi, Amani-east, Amani-west, Kwamsambia, Kwamkoro and Mnyuzi Scarp), public land and 1068 ha of forest donated by the East Usambara Tea Company into Tanzania's first nature reserve.

## History of Amani Botanical Garden

The Amani Botanical Garden was set up by the Germans in 1902 as an extensive arboretum of long-term botanical trial plots for exotic plant species. Species were introduced from various parts of the world for agricultural trials with different economic interests, such as medicinal plants (i.e. *Cinchona* spp.), fruits and spices (e.g. *Garcinia* spp.), valuable timber (e.g. *Cedrela*, *Eucalyptus*), cosmetics (i.e. *Cananga*), rubber, fibre, oil (e.g. *Hevea*) and ornamental plants (e.g. fan palms). In 1950, the Botanical Garden was closed by the British. Today a lot of these botanical plots are derelict and bear local naturalization. Alien species introduced by the Botanical Garden are a major conservation issue for the Amani Nature Reserve.

The Amani Botanical Garden has a gazetted area of 244 ha; however, some parts are outside legal protection (106 ha) – the majority of which is occupied by the National Institute for Medical Research (NIMR) (62 ha) – and 44 ha are ungazetted public land. Encroachment into the Botanical Garden has occurred, especially in the non-gazetted areas. These include new buildings and human activities such as grazing and vegetable gardens, mainly around Amani village, where part of NIMR is located. The Amani Botanical Garden therefore has several stakeholders responsible for its management – the Ministry of Agriculture, the Tanzania Forestry Research Institute (TAFORI) and NIMR – which can complicate the situation.



# FLORA OF THE EASTERN USAMBARAS & AMANI

## Vegetation cover of the East Usambara Mountains

The East Usambara forests are composed of 13 forest blocks, although there are current efforts to link some of these with corridors.

Approximately 45 137 ha of the East Usambara Mountains remain as natural forest. Of this, 30.6 per cent is classified as submontane rainforest and 63 per cent as lowland forest. Altitude is the factor differentiating these forest types (Hamilton, 1989), with submontane forest generally occurring above 850 m.

Moreau (1935) stated that prior to European colonization in the 1880s, there was virtually a continuous forest cover on the mountains except for grassland habitat along the western ridge tops.

### Land-use distribution in Amani Nature Reserve

Habitat type	Area (hectares)	% of area
Dense lowland forest	2199.2	35.5
Poorly stocked lowland forest	421.3	6.8
Dense submontane forest	2816.5	45.4
Poorly stocked submontane	1.8	0.03
Peasant cultivation	36.7	0.6
Cultivation under forest	18.1	0.3
<i>Maesopsis</i> plantations	508.5	8.2
Teak plantation	83.9	1.4
Tea plantation	6.5	0.1
<i>Eucalyptus</i> plantations	1.7	0.03
Bush	96.5	1.6
Settlement	7.3	0.12
Barren	1.5	0.02
Ponds and rivers	1.1	0.02
<b>Total</b>	<b>6200.6 ha</b>	<b>100%</b>

(Frontier Tanzania, 2001)

Note: This table does not include the public land and the 1068 ha of Tea Estate forest that was incorporated into the Nature Reserve.

Also not mentioned is that within the submontane forests are small plantations of Japanese camphor (*Cinnamomum camphora*).



## Endemic plants in Amani

An estimated 23 per cent of montane plant species are endemic to the Eastern Arc. Such species include 15 wild relatives of coffee and 20 African violet species. The most commonly recorded near-endemic tree and shrub species in Amani Nature Reserve are: *Leptonychia usambarensis*, *Cephalosphaera usambarensis* and *Allanblackia stuhlmannii*.

*Allanblackia* is commonly seen around the Amani field station, with large fruits up to 12 inches in length which may contain 40–50 seeds. The kernels produce a hard white fat that can be extracted and used as soap or in cooking.

## Introduced (alien and invasive) species

Isolated “island” systems are thought to be most at risk from plant invasions. Localized naturalization is quite common around Amani Nature Reserve as a result of human encroachment and the Amani Botanical Garden. *Clidemia* and *Lantana* are major invasives in Amani Nature Reserve. They may be influencing successional processes because of their prevalence. There are other species in the Eastern Usambaras known to exhibit invasive tendencies elsewhere, e.g. *Grevillea*, *Casuarina*, *Cinnamomum*, *Cupressus*. See the following section for a more complete list of invasive plants in Amani.

### Examples of introduced plants in Amani

- ❑ *Cedrela odorata* (Meliaceae) has now spread from Amani Botanical Garden to natural forest. Local communities plant it on their farms because it produces good timber. It originates from the Neotropics and the Americas.
- ❑ \**Clidemia hirta* was introduced to Amani and has now spread to most forests in the surrounding areas – the only site in East Africa to host this species. It is a serious weed in other tropical moist areas, e.g. Hawaii. It originates from the Neotropics and the Americas.
- ❑ *Elettaria cardamomum* (Zingiberaceae) is now naturalized in derelict sites. Invasive in Sri Lanka, it originated in Asia.
- ❑ *Lantana camara* (Verbenaceae) may inhibit regeneration in larger gaps. Originally from the Neotropics and the Americas, it is also invasive in forests in southern Africa.
- ❑ \**Psidium cettolauium* (guava) was considered the worst weed of closed forests. It may be only a recent introduction to the Eastern Usambaras. It originates from the Neotropics and the Americas.
- ❑ \**Rubus* spp. The fruits of these species comprise an aggregate of drupelets.
- ❑ \**Phyllostachys bambusoides* (bamboo) from Asia.
- ❑ \**Maesopsis eminii* (see case study below).
- ❑ \**Landolphia* sp. This is commonly known as the Congo vine.

\*These are species that are considered a problem or threat (naturalized).



## Case study of an introduced species

### *Maesopsis eminii* (Rhamnaceae)

- ❑ It occurs naturally in western Tanzania.
- ❑ First planted in 1913, it was a shade tree for *Cephalospahera usambarensis* (e.g. the Kwamkoro tea plot).
- ❑ About 580 ha were also used for planting carried out to infill logging gaps.
- ❑ Seeds last approximately eight months. No one knows for sure what pollinates it.
- ❑ It was thought *Maesopsis* would not be able to regenerate naturally without management, but it is now naturalized and dominates considerable areas of forest.
- ❑ Since the introduction of *Maesopsis eminii* into the area, this species has spread rapidly in the Usambara Mountains, particularly around Amani, where there is concern that it may begin to dominate the forest (Binggeli, 1989). The high *Maesopsis eminii* density areas, e.g. near the Kwamkoro Nature Trail, are the areas of forest where the species was originally planted, and/or forest edge plots.
- ❑ There has been much debate on the potential threat of this species; however, it is largely a pioneer species which doesn't regenerate in the dense forest.



# FAUNA OF AMANI

## Vertebrates

### Endemism

- ❑ There are 74 endemic vertebrates in the Eastern Arc (and another 18 endemic to lowland coastal Eastern Arc forests).
- ❑ Most of these 74 endemic vertebrates are forest dependent, including all the strict endemic birds, mammals and amphibians.

### Mammals

The most commonly recorded small mammal species in Amani are shrews (*Crocidura* sp.) and African soft-furred rats (*Praomys* sp.). The most common larger species is the blue monkey (*Cercopithecus mitis neumanni*), while the black-and-white colobus monkey (*Colobus angolensis palliatus*) is also seen. In the evenings, bushbabies are commonly heard around the camp.

There are an estimated 16 species of bat from five families. Bat species that appear to be locally common are *Rhinolophus landeri lobatus*, *Rhinolophus hildebrandti*, *Hipposideros ruber*, *Miniopterus fraterculus* and *Pipistrellus grandidieri grandidieri*.

Six per cent of all Eastern Arc mammal species are endemic, most of which are threatened. In the Amani Nature Reserve, there are at least 24 species of mammals (excluding bats) from seven families. There are several species of special interest. These include:

- ❑ the restricted Zanj elephant shrew, *Rhynchocyon petersi*, which is common in the Usambara Mountains (Collar and Stuart, 1987) yet listed as globally “Endangered” by IUCN due to a decline in habitat extent and quality;
- ❑ the eastern tree hyrax, *Dendrohyrax validus*, listed as “Vulnerable” by IUCN (Hilton-Taylor, 2000); and
- ❑ the lesser pouched rat, *Beamys hindei*, which is also considered “Vulnerable” by IUCN (Hilton-Taylor, 2000).



## Birds

Three per cent of all bird species in the Eastern Arc are endemic. Within the East Usambara Mountains there is high diversity, with at least 110 forest bird species (Stuart, 1989). There are a few globally threatened avian species (IUCN, 1996) found in the Amani region, but at low densities.

### Endemic birds of the East Usambaras

Common name	Scientific name	IUCN threat category
Usambara eagle owl	<i>Bubo vosseleri</i>	Endemic/Vulnerable
Dappled mountain robin	<i>Arcanator orostruthus</i>	Vulnerable
Long-billed apalis	<i>Orthotomus moreaui</i>	Critically Endangered
Amani sunbird	<i>Anthreptes pallidigaster</i>	Vulnerable
Banded green sunbird	<i>Anthreptes rubritorques</i>	Vulnerable
Tanzanian mountain weaver	<i>Ploceus nicolli</i>	Endemic/Vulnerable
Sokoke scops owl	<i>Otus ireneae</i>	Vulnerable
East coast akalat	<i>Sheppardia gunningi</i>	Vulnerable
Mrs Moreau's warbler	<i>Bathmocercus winifredae</i>	Endemic/Vulnerable

## Reptiles and amphibians

With seven chameleon species and 26 snake species, the Amani Nature Reserve has a rich reptilian fauna.

The most commonly recorded reptile species are geckos (*Cnemaspis africana* and *Cnemaspis barbouri*), skinks (*Mabuya maculilabris*, *Mabuya striata*, *Lygosoma afrum*, *Leptosiphos kilimensis*) and an agama lizard (*Agama agama*).

Common chameleon species are *Bradypodion (Chamaeleo) fischeri*, *Bradypodion (Chamaeleo) tenue*, *Chamaeleo dilepis*, *Chamaeleo deremensis*, *Rhampholeon brevicaudatus* and *Rhampholeon temporalis*.

Common snake species are *Typhlops gierrai*, *Python sebae*, *Atheris ceratophorus*, *Elapsoidea nigra*, *Dendroaspis angusticeps*, *Lamprophis capensis*, *Buboma (Geodipsas) vaurocegae*, *Aparallactus wernerii*, *Natriciteres olivacea*, *Philothamnus macrops*, *Philothamnus hoplogaster*, *Crotaphopeltis tornieri* and *Thelotornis capensis mossambicanus*.

With an estimated 34 amphibian species, the Amani Nature Reserve has a particularly rich amphibian fauna, eight of which are endemic (see opposite for full list).



<b>FROGS</b>	<b>DESCRIPTION</b>
<i>Arthroleptis affinis</i>	Medium-sized, brown, forest floor, lays eggs in leaf litter
<i>A. stenodactylus</i>	Medium-sized, brown, forest floor
<i>Schoutedenella xenodactylus</i>	Small, brown, forest floor
<i>S. xenodactyloides</i>	Small, brown, forest floor
<i>Bufo brauni</i>	Large, brown, forest floor, near stream
<i>Nectophrynoides tomieri</i>	Small, brown, forest floor, live-bearing
<i>Arixalus fornasini</i>	Medium, brown, in pond, grey morphs, vertical pupils
<i>A. uluguruensis</i>	Medium, brown, in pond, grey morphs, vertical pupils
<i>Hyperolius argus</i>	Small, in pond, female: green, male: red/brown with spots, horizontal pupils, for all <i>Hyperolius</i>
<i>H. mitchelli</i>	Small, in pond, two light stripes along flanks, light spots on "heel"
<i>H. parkeri</i>	Small, green/brown, in pond, with small spots
<i>H. punctulatus</i>	Small, pond, various types of spots on an orange background, often a mask on face
<i>H. spinigularis</i>	Small, pond, green with light mask
<i>H. tuberculiguis</i>	Small, pond, brown/green, rare
<i>H. viridiflavus mariae</i>	Small, pond, red-grey, black eyes, red finger pads
<i>Kassina maculata</i>	Large, pond, under vegetation in mud, green/brown with darker spots, more heard than seen
<i>K. senegalensis</i>	Large, pond, under vegetation in mud, green/brown, with darker stripes, more heard than seen
<i>Leptopelis barbouri</i>	Medium, tree frog, green-yellow with reddish eyes, only seen after rain, when it descends
<i>L. flavomaculatus</i>	Large, tree frog, brown, commonly heard around the pond, green juveniles, vertical pupils
<i>L. parkeri</i>	Large, tree frog, grey-brown, red eyes, only seen after rain, when it descends
<i>L. uluguruensis</i>	Medium, tree frog, blue throat and light spots on brownish coat, only seen after rain
<i>L. vermiculatus</i>	Large, tree frog, green or brown, usually has a dappled dorsal coat, green juveniles
<i>Callulina krefftii</i>	Small, forest frog, but tends to be found above the ground, stout, grey, warty skin, expands as a defence mechanism
<i>Hoplophryne rogersi</i>	Small, forest frog, brown, breeds in water-filled bamboo cups, quite common
<i>Probreviceps macrodactylus</i>	Large, tree frog, stout, short legs, brown, forest floor, male releases sticky substance to attach itself to the female and as a defence mechanism



<b>FROGS</b>	<b>DESCRIPTION</b>
<i>Arthroleptides martiensseni</i>	Medium, forest floor, near streams, brown, usually with black stripe over the eyes
<i>Phrynobatrachus acridoides</i>	Small, forest floor, brown
<i>P. kreffti</i>	Medium, stream, brown, male has yellow throat, uncommonly diurnal
<i>Ptychadena mascareniensis</i>	Medium, pond, brown with green dorsal stripe, long legs
<i>Rana angolensis</i>	Large, stream, brown-grey with loud deep croak, jumps very far
<i>Xenopus muelleri</i>	Medium, muddy puddles, dark grey, only in water (aquatic), has claws and webbed feet
<i>Xenopus laevis</i>	Medium, muddy puddles, dark grey, only in water (aquatic), has claws and webbed feet with tentacles under the eyes
<hr/>	
<b>CAECILIANS (APODANS)</b>	<b>DESCRIPTION</b>
<i>Boulengerula boulengeri</i>	Approximately 15 cm, pink, burrowing, looks like an earthworm, common
<i>Scolecophorus vittatus</i>	Approximately 45 cm, dark blue with bright red on the underside, comes out on rainy nights, rare

The locally uncommon species that are both forest dependent and near-endemic or endemic should be of conservation concern due to their low population density. There are nine such reptilian and amphibian species. These are: *Bradypodion spinosum*, *Agama mossambica montana*, *Probreviceps macrodactylus*, *Urocotyledon wolterstorffi*, *Scelotes ulugurensis*, *Leptotyphlops macrops*, *Dipsadoboa werneri*, *Hyperolius viridiflavus mariae* and *Scolecophorus vittatus*.



## Invertebrates

The invertebrates are not well studied, and our current knowledge is probably strongly influenced by collecting effort. The insect fauna of the Amani region is diverse and includes some spectacular species. Butterflies are common in both open areas and in the forest, and a diverse range of species can be seen. Trails of driver ants (*Dorylus* sp., Formicidae) will be encountered on roads and tracks, and the galleries and nests of termites (Isoptera) can be seen on tree trunks. Crickets (Gryllidae) are numerous in the forest, and can be heard almost everywhere. Other Orthoptera, including several families of grasshoppers, make up a substantial component of the insect fauna.

Moths can easily be observed by using an illuminated sheet to attract a wide range at night, from large and spectacular members of the families Saturniidae and Sphingidae to tiny Microlepidoptera. Other moth families that commonly come to light include the Arctiidae, Geometridae and Noctuidae. Beating and sweeping forest vegetation yields a rich insect fauna including many species of leaf beetles (Chrysomelidae) and weevils (Curculionidae) as well as bugs (Hemiptera). Pitfall trapping and sieving litter from the forest floor are good methods for collecting ground-inhabiting fauna. The dominant beetle groups are rove beetles (Staphylinidae) and dried fruit beetles (Nitidulidae), with some ground beetles (Carabidae) and a few dung beetles (Scarabaeidae). Cockroaches (Blattodea) are common in the litter.

Those invertebrate groups that have been studied in the East Usambara Mountains show high rates of endemism, especially those whose members have limited dispersal capability. Generally there tends to be great endemism in poor dispersers such as millipedes. At least 30 of the 41 species of millipedes (Diplopoda) found around Amani are believed to be endemic to the East Usambara Mountains. Of the terrestrial molluscs (Gastropoda), the East Usambaras have 55 endemic species of gastropod.

In a family of predatory wasps (Sphecidae), a considerably more mobile group, the proportion of endemic species is still high at 21 per cent. Of the 112 species of butterflies recorded from Amani, two species are probably endemic, and a further nine are near endemic. While 20 per cent of all butterfly species recorded are forest dependent, over 80 per cent of the endemics and near-endemics are forest dependent, and all are forest species. The spectacular *Hypolimnas antevorta* (Nymphalidae) is a large, blue-black and blue butterfly with white markings that is endemic to the East Usambaras and feeds on *Urera hypselodendron* (Urticaceae). *Charaxes usambarae usambarae* (Nymphalidae) is another large species, also endemic or near-endemic, that feeds on *Albizia* (Fabaceae). Forest ground beetles are likely to be endemic, as they are often flightless; a study in the nearby Uluguru Mountains showed 94 per cent of carabid beetle species believed to be endemic.



## MANAGEMENT OF AMANI NATURE RESERVE

The forests of the East Usambaras have been under continuous exploitative human pressure for at least 2000 years (Schmidt, 1989). Until the last century, this pressure was sustainable (Kikula, 1989). However, tea estates now employ roughly 4000 people in the high season, and this growing human population is leading to increased pressure on the remaining natural forest in the area.

Amani Nature Reserve encompasses a large area within which there are numerous villages and sub-villages. People from the local communities are permitted to collect dead wood from the Nature Reserve for fuelwood twice a week. Any changes in the management of Amani Nature Reserve will affect the adjacent communities; thus management decisions are not isolated to consideration of forest issues alone. Management issues are discussed at biannual Amani Nature Reserve Board meetings attended by representatives of all interested parties, including local communities.

### Conservation

The forests of the East Usambara Mountains are recognized as being part of a Biodiversity Hotspot, an Endemic Bird Area (ICBP, 1992), a Centre of Plant Diversity (WWF and IUCN) and a Globally Important Ecoregion (WWF). They are also part of the Man and the Biosphere Reserve network (MAB). These forests are a conservation priority due to their floral and faunal diversity and the high number of endemic species.

The forests of the East Usambara Mountains have been reduced to fragments within a matrix of agricultural land. Little forest remains outside of the gazetted forest reserves. For those species that are forest dependent, the forest reserves now provide almost the only available habitat. The Amani Nature Reserve, being the largest forest block in the East Usambara Mountains, has a lower risk of population extinction than smaller, highly fragmented forest reserves. This gives Amani Nature Reserve a special value as a “pool” of individuals of species. However, Amani is largely isolated from other forest reserves in the East Usambara Mountains. The only forested connection to translocate any species to repopulate other forested areas is the Derema forest corridor. At present, no legal status protects the Derema forest



other than basic legislation regarding water catchments and the felling of specific tree species. Recently there has been extensive discussion regarding the type of legislation that should be instated to protect the Derema forest corridor. The proposals range from gazettement of the Derema forest corridor as a non-extractive forest reserve to handing complete control of the forests to the local communities. From a biological perspective, effective protection of this only forested link from the largest block of forest (Amani) to more northerly forests is of utmost importance. However, this decision is not purely based on biological considerations; social factors have to be taken into account to ensure the sustainable protection of the Derema forest corridor.



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TROPICAL BIOLOGY ASSOCIATION

## Amani Nature Reserve

This guide includes an introduction to the East Usambara Mountains and describes the ecology, flora and fauna of the area. The history of management and conservation of the Amani Nature Reserve, together with its current status, is outlined. The guide was developed to help participants on Tropical Biology Association field courses to learn about the Amani Nature Reserve and the forests of the East Usambaras.

## Tropical Biology Association

The Tropical Biology Association is a non-profit organization dedicated to providing professional training to individuals and institutions involved in the conservation and management of tropical environments. The TBA works in collaboration with African institutions to develop their capacity in natural resource management through field courses, training workshops and follow-up support.

### **European Office**

Department of Zoology  
Downing Street  
Cambridge CB2 3EJ  
United Kingdom  
Tel: +44 (0) 1223 336619  
e-mail: [tba@tropical-biology.org](mailto:tba@tropical-biology.org)

### **African Office**

Nature Kenya  
PO Box 44486  
00100 - Nairobi, Kenya  
Tel: +254 (0) 20 3749957  
or 20 3746090  
e-mail: [tba-africa@tropical-biology.org](mailto:tba-africa@tropical-biology.org)



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