

the Eastern Arc, many of which are dense forest specialists (de Jong and Congdon, 1993; and see notes in Appendix 9). In comparison, the coastal strip of eastern Africa supports a total of 92 endemic taxa. However, only 75 of these taxa are true endemics of Coastal Forests, with a few representatives extending to lowland forests at the base of the Eastern Arc Mountains; the rest also occur in other habitats in the low country of the coastal area. A further 20 taxa with strong Coastal Forest affinities were excluded from this figure as they also occur at low to sub-montane elevations chiefly in the Eastern Arc Mountains; examples of such taxa are indicated in Table 4.8.2. An indication of the relative importance of the Coastal Forests and the Eastern Arc forests can be found by analysing the fauna in terms of the endemic taxa and genera they support (Table 4.8.3).

Table 4.8.2 Examples of some endemic Eastern Arc montane butterfly species that descend into adjacent lowland forests in Tanzania.

Species	Forest
<i>Catuna sikorana</i>	lowland Usambaras, Ulugurus, Ngurus, etc.
<i>Charaxes pollux mirabilis</i>	Mtai (East Usambaras)
<i>Charaxes usambarae</i>	Mtai
<i>Pseudacraea dolomena usagara</i>	Mtai
<i>Salamis temora virescens</i>	Kimboza (Ulugurus)
<i>Coeliades chalybe</i>	Mtai and Kimboza
<i>Ceratrachia bonga</i>	Mtai, Kwangumi and Kimboza
<i>Chondrolepis niveicornis</i>	Mtai and Kwangumi

Table 4.8.3 Comparison between the rates of species and generic endemism in the Coastal Forests and Eastern Arc forests, in relation to area of remaining forest.

Forest type	Forest area (km ²)	Total species	Endemic taxa (spp. and ssp.)	Endemic genera	Endemic taxa/area	Endemic genera/area
Coastal Forest	3170	c.400	75	2	2.4×10^{-2}	6.7×10^{-4}
Eastern Arc	9000	c.700	123	0	1.4×10^{-2}	0

Note: The number of Eastern Arc endemic taxa was 123 (de Jong and Congdon, 1993). This figure has since risen considerably but as the senior author had last updated these data (see text) in mid 1995, the junior author chose to exclude the newly described taxa (e.g. see Rydon, 1996; White, 1996) from this figure as he is not sure which of the newly described taxa were included in the previous update.

There remain problems with such analyses (Table 4.8.3) as in both areas there are probably further endemic species to be discovered, taxonomic clarifications may either increase or decrease the number of endemics, and the highly uneven survey coverage may also be important. However, in broad terms it is clear that with the present information the Coastal Forests are of lower relative importance than the Eastern Arc mountain forests for endemic butterfly species. Nevertheless, when the area of forest remaining is considered then the Coastal Forests can be shown to be of similar, if not higher, importance for endemic taxa per unit area of forest than those of the Eastern Arc mountains. In fact the ratio of endemic taxa per unit area for the Coastal Forests to the Eastern Arc mountains is about 1.8 times greater, indicating that on a broad scale more endemics are restricted to the smaller Coastal Forests. We believe that this is important to consider when comparing and contrasting the values of the two forest types for butterfly conservation.

Table 4.8.4 Single site endemism of butterfly taxa in the Coastal Forests of Kenya and Tanzania.

Sites	Endemic species and sub-species*	Total endemic taxa*	Near endemic taxa	Survey effort
Arabuko-Sokoke	0	0	3	High
Shimba Hills	1ssp	1	1	Medium/high
East Usambaras	2sp	2	2**	Low/medium
Kimboza (Ulugurus)	1sp, 1ssp	2	3	Low/medium
Rondo Plateau***	1sp, 3ssp	4	3	Low/medium
Pemba Island	1sp, 8ssp	9	1	High
Zanzibar Island	2sp, 5ssp	7	1	High
Mafia Island	1sp, 1ssp	2	0	Low

Key: sp = species; ssp = subspecies.

Notes:

* It is important to note that a few species considered as Coastal Forest endemics, especially those from the Islands, are not exclusive forest dwellers and are thus recorded from some other habitats.

** One species included in this total, *Hypolimnas antevorta*, also occurs in submontane forest at Amani, East Usambara Mountains.

*** *Baliocbila* sp. nov.? and *Euphaedra castanoiedes* sp. nov.? (see Appendix 9), both of which are probably distinct but undescribed taxa, were not included in the number of total endemics for the Rondo Plateau.

It is also possible to assess the importance of individual forests in terms of the presence of endemic butterfly species. For the Eastern Arc mountains this has already been done by de Jong and Congdon (1993), and has been updated by the senior author in this Chapter. The most important forest areas in terms of endemic butterfly species and subspecies (taxa) in the Eastern Arc are the Usambara Mountains (27 taxa), Udzungwa Mountains (25 taxa), Uluguru Mountains (19 taxa), Nguru, Kanga and Nguu Mountains (19 taxa), and Rubeho and Ukaguru Mountains (nine taxa). There are also a further 24 taxa which are confined to several forests within the Eastern Arc mountains.

In comparison with the best of the Eastern Arc forests, individual Coastal Forests contain few endemic species and subspecies (Table 4.8.4). The highest levels of single-site endemism are found on the islands of Pemba, Zanzibar and Mafia, in the East Usambara and Uluguru lowlands, and on the Rondo Plateau in the south of Tanzania. Some of the East Usambara and Uluguru records include species and subspecies which are mainly found in montane forests but also occur in the lowlands (and *vice versa*).

This low level of single site endemism is probably related to two main factors:

- The Coastal Forests were probably more continuous and species were more widely distributed than at present. The various Eastern Arc Forests have been physically isolated from one another for much longer (see Lovett and Wasser, 1993).
- The butterfly species of the Coastal Forests are ecologically less isolated than those in the Eastern Arc Mountains. In the coastal area butterflies may still be able to move between forests by passing through thicket, woodland and scrub habitats at the same altitude and under similar climatic regimes. In comparison the butterflies in the Eastern Arc Mountains are highly isolated as the next area of montane forest may be tens of kilometres away and travel in between means moving through lower and hotter altitudes. In such areas species are far less likely to move between forests and hence isolated populations are more capable of evolving into separate species.

However, there are also dispersal barriers between and from many of the areas of Coastal Forest supporting endemic taxa. Particularly for the butterflies of Pemba, Zanzibar and Mafia such dispersal means crossing the sea. We do not consider the higher altitudes of the Rondo Plateau to present a serious barrier to dispersal of the butterfly species, as the forest extends to low altitudes at this site. Reasons for the number of endemics at this forest are therefore not known, but concur with levels of endemism in other taxonomic groups.

Discussion and conclusions

The eastern African Coastal Forests, although not as species rich and as high in endemics as the Eastern Arc Mountains, are comparable in terms of endemic taxa per unit area. They also hold a unique butterfly fauna with many species that are currently known from only one to three sites on a global basis, and at least two genera that are endemic and one believed to be near-endemic to the region. Although these numbers do reflect a significant difference between the two areas, many of the Eastern Arc mountains have received greater attention than the Coastal Forests in the past and it is only recently that much work has been done in the Coastal Forests of, for example, Tanzania. After the recent discoveries of several new species and subspecies in the lowland forests of the East Usambaras and Ulugurus, there is little doubt that further emphasis on the smaller, less conspicuous genera will yield additional new taxa.

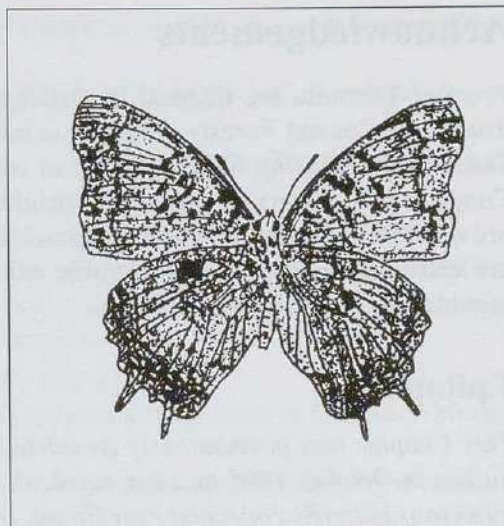


Figure 4.8.2 *Charaxes jahlusa mafiae*, endemic to Mafia Island, Tanzania.

To some extent the calculation of numbers of overall species and endemic species in both the Eastern Arc and the Coastal Forests is affected by the current taxonomy of some butterfly genera, especially those in the families Lycaenidae and HesperIIDae. Endemic genera such as *Eresinopsides* and *Euthecta*, although apparently monophyletic, are within a complex group of butterflies and are closely related to the genera *Teriomima* and *Baliocbila*. This entire group, comprising the four genera, is greatly in need of revision as many species remain undescribed whilst others (even genera) may be sunk through further study. One must keep this in mind when studying the biogeography of such taxonomically difficult groups in the Coastal Forests and Eastern Arc mountains.

Another great difficulty in the study of organisms as mobile as Lepidoptera is to assign species to strict habitat categories. The current list of Coastal Forest butterflies comprises species that are mainly restricted to lowland forest in the coastal region of eastern Africa. Many species, although generally restricted to Coastal Forest habitats, may occur in adjacent woodland habitats or even montane forests depending on the ecological requirements of the species in question. It is therefore important to note that species categorised as strictly Coastal Forest dwellers in this Chapter may be considered otherwise with further research, and also that the reader should not consider this list to be one that is clearly definitive of the Coastal Forest butterfly fauna.

In conclusion, the Coastal Forest butterfly fauna has considerable biodiversity and conservation value. Forests that require particular conservation attention are the Shimba Hills and Arabuko-Sokoke in Kenya, the patches on the islands off Tanzania, the lowland forests of the East Usambara and Uluguru Mountains and sites such as the Rondo Plateau and Pugu Forest. All of these sites not only show a high species richness but also maintain populations of several unique taxa known only from one or two sites in the world. Other sites, many of which have been less well studied, may prove to produce comparable numbers of endemics in the future. It is therefore imperative to preserve them for their unique butterfly fauna as well as other organisms and to emphasise the need to search for smaller and less conspicuous species in both well studied and poorly studied forest sites in eastern Africa. Although Kenya and Tanzania have clearly made progress in this direction, there is still a further need to train local people in this field as well as to promote additional research in nearby war-torn countries such as Mozambique and Somalia.

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Epitaph

This Chapter was posthumously completed by the junior author following the death of the senior author in October 1995 in a car accident. Jan Kielland was travelling in Tanzania on one of his numerous butterfly collection expeditions, on that last occasion to the western section of the country. We hope that this Chapter provides a form of tribute to Jan who devoted most of his life to the study of Tanzania's butterflies. He will be sorely missed. Please note that the junior author shall take responsibility for any discrepancies or errors.

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4.9 Global importance and patterns in the distribution of Coastal Forest species

N.D. Burgess

From the preceding Chapters (4.1–4.8) on the flora and fauna of the Coastal Forests, it can be seen that these forests possess large numbers of endemic or threatened species in all the biological groups studied. In this Chapter, a summary of the numbers of endemic species of each major taxonomic group is presented, focussing on the species apparently confined to the Coastal Forests. Moreover, an attempt is also made to assess the main biogeographical patterns in Coastal Forest species, and to define some of the overall priority areas in terms of concentrations of endemic and threatened plants and animals.

Although the focus here is on endemics and rarities, it should be remembered that in most groups these form the minor proportion of the flora and fauna. The remainder is comprised of species which are also recorded in other forest types and woodland/grassland vegetations of eastern Africa, and some may be even more widely distributed in the tropical areas of the world.

Overall species endemism in the Coastal Forests

Numbers of forest endemic species, as a proportion of the total number of forest species in the Coastal Forests, gives one measure of the importance of the Coastal Forests (Table 4.9.1).

Table 4.9.1 Rates of endemism for seven biological groups within the Swahilian *sensu lato* regional centre of endemism, and for forest species found in the eastern African Coastal Forests.

Group	Global total species*	Swahilian region <i>sensu lato</i> total sp.	Forest species in Coastal Forests	Number of Swahilian endemics	Number of CF endemics	Percentage Swahilian endemism	Percentage CF endemism
Plants	250,000	4500	c.1500	1366	554	30	37
Birds ¹	9,672	c.300	85	11(15)	5(9)	3.6(5)	5.8(10.5)
Mammals ²	4,330	c.250	84	7(10)	3(6)	2.8(4)	3.5(7.1)
Reptiles ³	6,550	—	47	—	24(27)	—	51 (57)
Amphibians	4,000	—	14	—	5	—	36
Molluscs	70,000	c.1200	125	207	86	17	68
Butterflies	20,000	—	400	—	75	—	18.75

Notes:

¹Figures in parentheses include the species on Pemba Island.

²Only the described species are presented here, there may be a further 8 Coastal Forest endemic small mammals when descriptions have been published. Figure in parentheses includes the species in the Tana river forests.

³Figure in parentheses includes the species found in the Tana river forests.

*Assessment of global species totals from various chapters in WCMC (1992) and Heywood and Watson (1995). Only the lower number of described species have been used here. For Molluscs the total is for all Molluscs, not just the slugs and snails studied in Chapter 4.7.

The highest rates of endemism are found in invertebrate groups such as the millipedes (perhaps >80%), molluscs (68%, 86 species), and forest butterflies (19%, 75 species). Rates are typically lower in vertebrate groups such as birds (10.5%, nine species) and mammals (7.1%, six species), although they are higher in the forest reptiles (57%, 24 species), and forest amphibians (36%, five species). The vascular plant forest flora is also rich in endemic species (37%, 554 species), and genera (see Chapter 4.1). In total, 786 known species in eight biological groups are strictly endemic to the Coastal

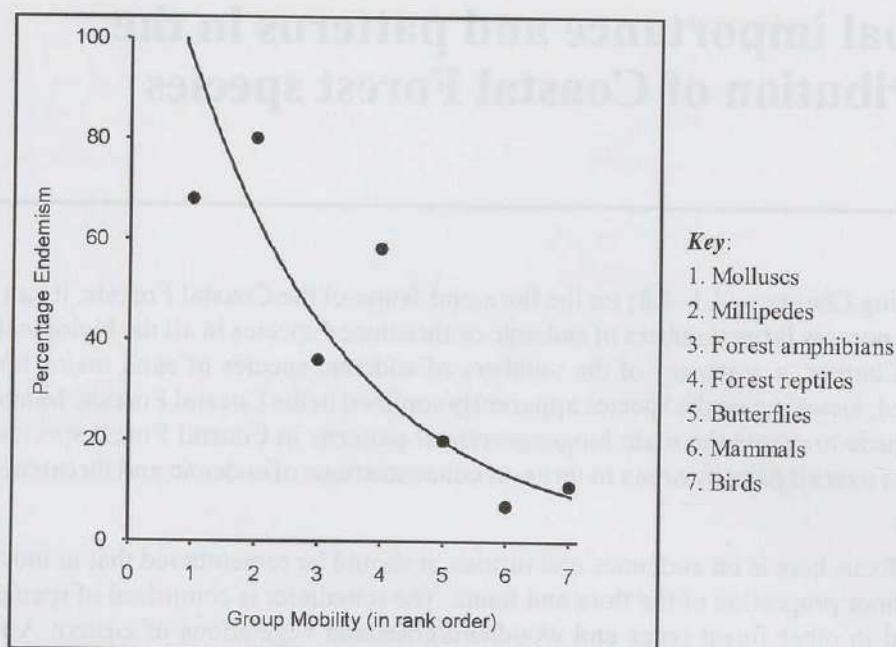


Figure 4.9.1 Relationship between percentage local endemism in the Coastal Forests of eastern Africa and a ranked index of the mobility of the different taxa, derived from data in Table 4.9.1. Assessment of taxa mobility is by the editors.

Forests (776 if Pemba and Tana River endemics are excluded). In comparison, the adjacent Eastern Arc forests contain 827 known endemic species in the same groups (Table 4.9.1). In the Coastal Forests (and the Eastern Arc) the percentage of species endemism is inversely proportional to the mobility of the groups (Figure 4.9.1).

Table 4.9.2 Percentage of global endemic species totals confined to Coastal Forest and Eastern Arc forests of eastern Africa.

Biological group	Global total number of species described in each group	Coastal Forest strict endemics	Percentage of global total unique to Coastal Forests	Eastern Arc strict endemics	Percentage of global total unique to Eastern Arc
Plants	250,000	c.554 species	0.226	550 species ^a	0.220
Birds	9,672	5 species	0.051	11 species ^b	0.113
Mammals	4,330	3 species	0.069	4 species ^c	0.092
Reptiles	6,550	24 species	0.370	26 species ^d	0.396
Amphibians	c.4,000	5 species	0.125	28 species ^e	0.700
Millipedes	7,000	>20 species	0.280	30+ species ^f	0.430
Molluscs	70,000	86 species	0.123	55 (E.Usambara) ^g	0.078
Butterflies	20,000	75 species	0.375	123 species ^h	0.615
Totals/averages		c.776 species	0.202	c.827 species	0.366

Sources:

^a Myers (1988 and 1990); Lovett (1993); Chapter 4.1. ^b Tanzanian Biodiversity Database in the Department of Zoology of the University of Dar es Salaam (and Stuart *et al.* (1993); ICBP (1992); Chapter 4.2 and Collar *et al.*, (1994)).

^c Tanzanian Biodiversity Database (and Kingdon and Howell (1993); Chapter 4.3). ^d Tanzanian Biodiversity Database (and Howell (1993); Chapter 4.4). ^e Tanzanian Biodiversity Database (and Howell (1993); Chapter 4.5). ^f Hoffman (1993); Chapter 4.6. ^g Chapter 4.7. ^h de Jong and Congdon (1993); Chapter 4.8.

As a second measure of the importance of the Coastal Forests for endemic species, total numbers of endemics are compared with described global total numbers of species for each group (Table 4.9.2). Coastal Forest endemics comprise an average of 0.202% of the summed global species totals in the eight groups studied, while the Eastern Arc forests contain an average of 0.366% of all known species in these groups. This may seem low, but represents a far greater concentration than would be expected

if the number of endemic species were distributed in proportion to the area of forest. Most sources (e.g. Barnes, 1989; May, 1990; WCMC, 1992; Heywood and Watson, 1995) state that the global species totals presented in Table 4.9.2 are far too low, but this may not change the overall rates of endemism compared with global totals. An assessment of the potential number of endemics in some other invertebrate groups, calculated from the estimated global totals, is presented in Table 4.9.3.

The Eastern Arc Mountains are already considered to be one of the top three areas for species endemism in Africa (Myers, 1988 and 1990; Stuart *et al.*, 1990; ICBP, 1992; WWF and IUCN, 1994). The levels of endemism in the Coastal Forests (Tables 4.9.1–4.9.3) would also rank these forests as one of the top ten priority ecosystems for biodiversity conservation on the continent. Indeed, a recent analysis for the World Bank regarded the Eastern Arc and Coastal Forests as one centre of endemism and ranked this area as the most important for the conservation of endemic species in the whole of tropical Africa (Mittermeier *et al.*, 1998).

An additional assessment of the importance and urgency for conservation action can also be made by considering the area of forest remaining. In the Coastal Forests there are 786 endemic species and when divided by the 3170 km² of forest remaining gives 0.25 endemic species/km² forest. For comparison, when the 827 endemic species in the Eastern Arc mountain forests are divided by the 9000 km² of forest remaining (Lovett, 1990), this gives 0.092 endemic species/km² forest. Hence in terms of the urgency of conservation action to protect endemic species, the Coastal Forests may be a higher priority for attempts to reduce the loss of forest cover, than the Eastern Arc.

Table 4.9.3 Estimated potential numbers of endemic species of Coleoptera, Hymenoptera, Diptera and Arachnida in the Coastal Forests (0.202% average endemism) and the Eastern Arc Mountain forests (0.366% average endemism).

Biological group	Global species totals*	Potential Coastal Forest endemics	Potential Eastern Arc endemics
Coleoptera	404,600	817	1480
Hymenoptera	130,900	268	479
Diptera	120,700	243	441
Arachnida	76,500	153	257

Note:

* Global totals are derived from the estimates of described species presented in WCMC (1992). (Total for all species = c1.7 million).

Biogeographical patterns in the Coastal Forests

Biogeographical patterns in the Coastal Forests are complex and still poorly understood. The following major patterns are currently evident:

1. Distribution patterns within the Coastal Forests

a) Endemic or near-endemic species distributed throughout the Coastal Forests

Very few of the Coastal Forest endemic species are distributed throughout the range of these forests. Examples are the trees *Dialium holtzii*, *Bombax rhodognaphalon*, *Commiphora zanzibarica* and marginally *Sterculia appendiculata*. This situation is also true for the near-endemics, with only the birds Fischer's Greenbul *Phyllastrephus fischeri*, Green Tinkerbird *Pogoniulus simplex*, Spotted Ground Thrush *Zoothera fischeri* and Tiny Greenbul *Phyllastrephus debilis* having a wide distribution.

b) Northern and southern species

A number of the Coastal Forest species have distinctly 'northern' (Somalia to the Rufiji River in Tanzania) or 'southern' (Rufiji River to Mozambique) distributions. The most important divide is the Rufiji River although this is mainly true at the sub-species level (for birds see Chapter 4.2). Vertebrate species with a northern distribution are the birds Clarke's Weaver *Ploceus golandi*, Sokoke Pipit *Anthus sokokensis*, Sokoke Scops Owl *Otus ireneae*, Little Yellow Flycatcher *Erythrocerus holochlorus*, Fischer's Turaco *Tauraco fischeri* and Mombasa Woodpecker *Campethera mombassica*, and the mammals Golden-rumped Elephant-shrew *Rhynchocyon chrysopygus* (southern Kenya only) and *Taphozous hildegardae*. Vertebrate species with a southern (Tanzanian) distribution are the bird Reichenow's Batis *Batis reichenowi*, the mammal *Galago* sp. nov. and the amphibian *Stephopaedes loveridgei*. There are also many plants found only in the northern, or the southern forests (see Chapter 4.1). In addition there are isolated pockets of a few endemics in the Coastal Forests of Malawi, Zimbabwe and Mozambique.

c) Species with disjunct or scattered distribution patterns

Some of the Coastal Forest endemic and near-endemic species have disjunct or scattered distributions. Examples are the mammals Ader's Duiker *Cephalophus adersi* (Zanzibar and Arabuko-Sokoke) and Lesser Pouched Rat *Beamys hindei* (preferring forests on sandy soils, see FitzGibbon *et al.*, 1995), the birds Sokoke Pipit, Plain-backed Sunbird *Anthreptes reichenowi*, Uluguru Violet-backed Sunbird *Anthreptes neglectus* and the coastal race of the East Coast Akalat *Sheppardia gunningi sokokensis* (various forest patches). The pattern is also found in the amphibians (e.g. *Stephopaedes* sp. nov. from Mafia and the East Usambaras, *Mertensophryne micranotis* from various forest patches), several reptiles and plants (Chapters 4.1 and 4.4), and presumably also in other groups. There does not appear to be any recurring pattern in these disjunctions.

d) Smaller scale distributional patterns

Available evidence indicates that the plants and smaller and less mobile invertebrate groups show smaller scale patterns of endemism than are found in the larger species (Figure 4.9.1). For example, in Tanzania there is a 70% difference in the Millipede fauna and a 80% difference in the vascular plant flora from sites separated by only 100km distance (Chapters 4.1 and 4.6). Also, the large number of morphospecies of molluscs which were found by Emberton *et al.* (1997) to be unique to different forested areas implies that there is also substantial local endemism in that group. Similar patterns are reported from the isolated montane blocks of the Eastern Arc (Rodgers and Homewood, 1982; Hoffman, 1993; Scharff, 1993).

2. Relationship of Coastal Forests to the Eastern Arc Forests

There is current debate on whether these forests are best regarded as distinct units, or the lowland and montane equivalents of the same broad forest type (see Chapters 2.1 and 3.4; Lovett, 1993 and 1996). The close relationship is emphasised by the species which are found in both forests, but not elsewhere, and the degree of separation is indicated by the many species uniquely confined to each forest type.

Species found in Coastal Forests and lower altitude portions of the Eastern Arc Forests include the mammals Black and Rufous Elephant-shrew *Rhynchocyon petersi*, the bats *Myonycteris relicta*, *Kerivoula africana* and *Mops brachypterus*, the Zanzibar Galago *Galagoides zanzibaricus* and the *hindei* ssp. of *Beamys hindei* (also Kilimanjaro area). Birds in this category are Usambara Eagle Owl *Bubo vosseleri*, Fischer's Turaco, Uluguru Violet-backed Sunbird, White-winged Apalis *Apalis chariessa* and Amani Sunbird. The following reptiles also fall in this category *Lygodactylus conradti*, *L. uluguruensis*, *Cnemaspis barbouri*, *C. unguwae*, *Rhampholeon brevicaudatus* and *Dipsadoboa werneri*, and the amphibians *Arthroleptis affinis* and *Mertensophryne micranotis*. There are also large numbers of plants shared by the Coastal Forests and lower altitude parts of the Eastern Arc Forests (Chapters 3.4 and 4.1). Altitudinal gradation patterns in plants are complex with different species ranging higher or lower than others such that clear boundaries cannot easily be drawn (Lovett, 1996).

3. Relationship to the West and Central African Guineo-Congolian forests

Some species found in the eastern African Coastal Forests are outliers of much larger populations in the Guineo-Congolian forests to the west, particularly among the forest birds (Chapter 4.2), but much less so among the forest amphibians or reptiles (Chapters 4.4 and 4.5). Other species have outliers of their populations in the Coastal Forests. For example, western African mammalian elements in the Coastal Forests comprise the bats *Rousettus angolensis* and *Hipposideros cyclops*, which both extend marginally to the Coastal Forests around the East Usambaras, but not further north or south. Although the species linkage with the Guineo-Congolian forests is not particularly high, there are often stronger relations at the generic level which supports evidence for an ancient connection between these forests (e.g. discussion in Lovett and Wasser, 1993; Fjelds , 1994; Fjelds  and Lovett, 1997; Fjelds  *et al.*, 1997; Chapter 4.1). For example, the Sokoke Scops Owl *Otus ireneae* seems to have strong affinities to the West African *O. icterorhynchus*, and the same pattern is seen in Clarke's and Weyns's Weavers (*Ploceus golandi* and *P. weynsi*). There are also a number of plant genera where closely-related sister species are found in the Coastal Forests of eastern Africa and in the lowland forests of West and Central Africa (e.g. Fjelds  and Lovett, 1997; Chapters 3.4 and 4.1).

4. Relationship to other forested areas

In the plants there is some relationship between the species found in the Coastal Forests and those of Madagascar (Chapter 4.1). For bryophytes a considerable shared element has been found between the Eastern Arc forests and those of Madagascar (P cs, 1975), which seems to indicate a shared flora which predates the formation of volcanoes such as Kilimanjaro (as these have a much poorer Madagascan element in their bryophytes). Unfortunately, the degree to which the bryophytes of the Coastal Forests of eastern Africa are shared with Madagascar is not known. There may also be some affinity in the mollusc fauna with that of Madagascar (Emberton *et al.*, 1997).

Sub-centres of endemism within the Coastal Forests

Most Coastal Forests have at least one endemic species. However, there are some areas where species endemism occurs in much higher concentrations than elsewhere. Areas with more than 100 endemic species (not only plants) are here defined as local centres of endemism (*sensu* White, 1993). Less rich areas, where there is at least one endemic vertebrate, or at least 10 endemic plants, or at least two endemic butterflies are here defined as 'minor' centres of endemism. Areas with an even lower concentration of endemism (at least two endemic plant, vertebrate or butterfly taxa), but which are geographically definable, are here described as 'marginal' centres of endemism (Figure 4.9.2).

1. Local centres of endemism

The 'Usambara-Kwale' local centre of endemism (03 20' S, 39 45' E to 05 45' S, 38 30' E)

The 'Usambara-Kwale' local centre of endemism ranges from the Shimba Hills to the southernmost kaya forests in southeast Kenya, and then to the lowland East Usambaras in Tanzania and south to the hills of Tongwe and Gendagenda (Figure 4.9.2). This area

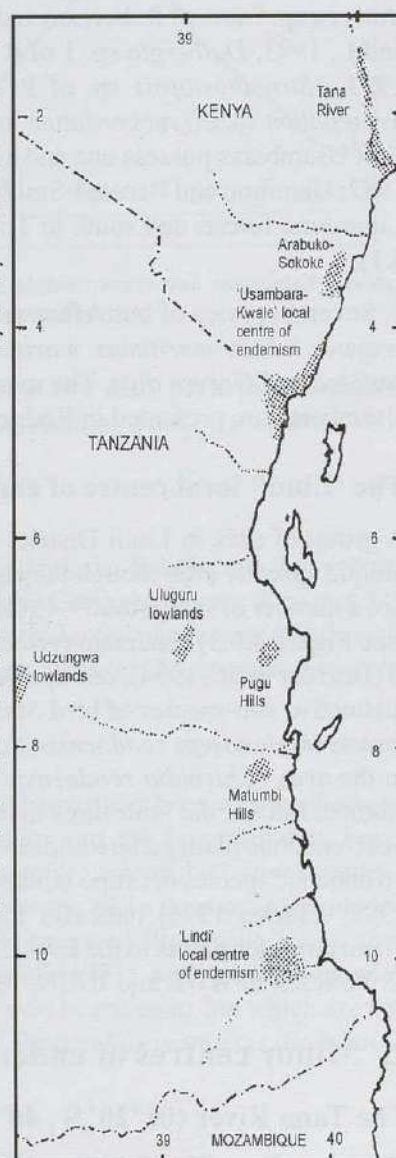


Figure 4.9.2 Sub-centres of endemism within the eastern African Coastal Forests of Kenya and Tanzania.

encompasses the majority (the southern portion) of the ranges of the six birds characteristic of the Kenyan and Tanzanian Coastal Forests Endemic Bird Area (ICBP, 1992).

The patterns of endemism in this area are complex. Several species are confined to more restricted parts of the area, and there are forest sites which possess high numbers of endemic species in their own right. Further sub-division of the area is probably possible.

For mammals one species found throughout the area is the bat *Taphozous hildegardeae*, and in the more southern part of the area there are *Galago* sp. nov. A in the East Usambaras (Bearder *et al.*, 1994), an undescribed species of bat *Rhinolophus* sp. nov. (East and West Usambaras and Amboni Caves) and two undescribed species of shrews *Crocidura* sp. (Gendagenda and Tongwe).

Several amphibians and reptiles are also endemic or near-endemic to this area. These are the amphibian *Hyperolius rubrovermiculatus*, the reptiles *Gastropholis prasina*, *Aparallactus turneri* (also Tana River), *Prosymna semifasciata* (lowland Usambaras), *Lygodactylus kimhowellii* (Amboni Caves), *L. conradti* (also E. Usambara Mts.), *Dipsadoboa werneri* (E. Usambaras and Tanga) and *Typhlops platyrhynchus* ('Tanga'). The amphibian *Stephopaedes* sp. nov. A is also near-endemic to the lowland East Usambaras (also Mafia Island).

In terms of plants there are 12 endemic species in the Shimba Hills (*Uvariadendron* sp. 3 of FTEA, *Rinorea* sp. ?nov. of Robertson and Luke (R and L), 1993, *Combretum* sp. ?nov. aff. *apiculatum* of R and L, 1993, *Dalbergia* sp. 1 of R and L, 1993, *Salacia* sp. cf. *elegans*, *Simirestis* sp. 1 of R and L, 1993, ?*Strombosiosis* sp. of R and L, 1993, *Pancovia* sp. aff. *ugandensis* of R and L, 1993, *Synsepalum* sp. cf. *subcordatum* of R and L, 1993, *Pavetta tarenoides*). The lowland forests of the East Usambaras possess one endemic plant genus and 17 endemic species (Rodgers and Homewood, 1982; Hamilton and Bensted-Smith, 1989; Iversen, 1991), and there are further endemics in the Tanga Limestone forests and south to Tongwe (Hawthorne, 1993; Clarke and Stubblefield, 1995; Chapter 4.1).

Several species of butterflies are endemic to this area (Chapter 4.8). These are *Charaxes blanda kenyae*, *Iolais maritimus maritimus*, *Aphnaeus coronae littoralis*, *Acraea matuapa*, *Coeliades keithloa* and *Goryra diva*. The many endemic molluscs, spiders and millipedes known from the East Usambaras are presented in Rodgers and Homewood (1982) and Scharff (1993).

The 'Lindi' local centre of endemism (10°2–10° S, 39°10–29° E)

A group of sites in Lindi District (Figure 4.9.3) are of great importance for their assemblages of unique species, even though they have not been particularly well-studied. The most important areas are a number of small (total <150km²) forest patches, mainly located on elevated plateaux in the area (see Figure 4.9.3). Endemic vertebrates comprise an undescribed species of *Galago* *Galago* sp. nov. B (Bearder *et al.*, 1994), one species of bird *Batis reichenowi* (also some other forests in the area), a distinctive sub-species of bird *Stactolaema olivacea* ssp. *hylophona*, three species of reptile in the forests (*Melanoseps rondoensis*, *Scolecoseps litipoensis*, *Typhlops rondoensis*) and two other species in the area (*Chirindia rondoensis* and *Chirindia ewerbecki*). The invertebrates have not been well studied, but for the butterflies there are two endemic species. There are also two endemic and two near-endemic plant genera and c.60 endemic plant species in Rondo and one near-endemic genus and 16 endemic species in Litipo (Chapter 4.1). Recent discoveries of further new plant species (Vollesen, 1992; Clarke, 1995) indicates that this figure may be even higher, making the area of similar importance for plants to the East Usambara Mountains (compare Rodgers and Homewood, 1982 and K. Vollesen in WWF and IUCN, 1994).

2. Minor centres of endemism

The Tana River (01°20' S, 40°00' E to 02°40' S, 40°40' E)

The lower Tana River in coastal Kenya comprises an area of forest and woodland/grassland. Tana River endemic vertebrates comprise two monkeys *Procolobus rufomitatus* and *Cercocebus galeritus*, one bat *Chalinolobus kenyacola*, two birds, the Tana river *Cisticola* *Cisticola restricta* (non-forest) and a sub-species of the White-winged Apalis *Apalis chariessa chariessa*, three reptiles

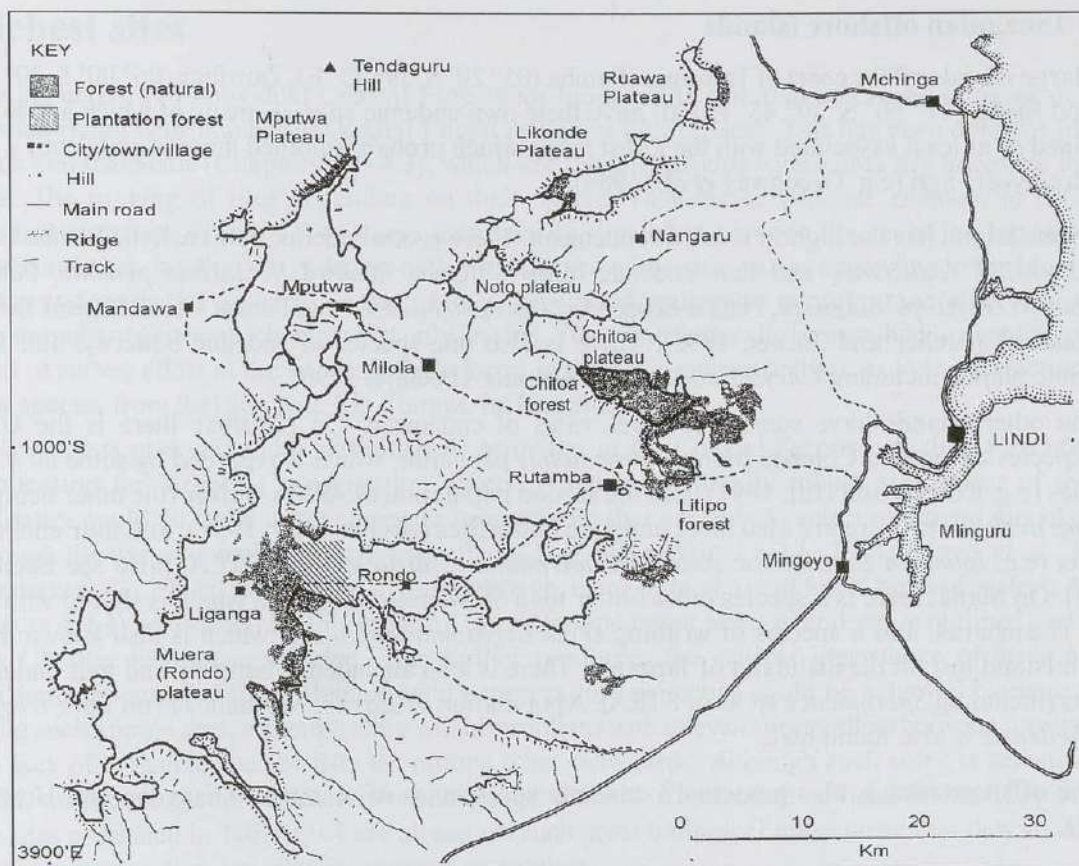


Figure 4.9.3 The Lindi local centre of endemism, showing the main plateau areas and associated forests. Villages and area names known for endemic plants (e.g. Mlinguru) are marked.

Meizodon krameri, *Lygosoma tanae* and *L. mabuiiformis* (last two also perhaps in southern Somalia). There are also at least four endemic plants (*Dichapetalum* sp.1, *Cynometra lukei*, *Cyphostemma* sp. nr *bambuseti*, *Cyphostemma ternatum*).

Arabuko-Sokoke area (03° 20' S, 39° 55' E)

Vertebrate species confined to the Kenyan coast, and centred on Arabuko-Sokoke are the mammal Golden-rumped Elephant-shrew (see FitzGibbon, 1994), and the bird Clarke's Weaver (Chapter 4.2). In terms of plants there are at least four endemic species in the Arabuko-Sokoke forest (*Mildbraedia* sp. A of the Flora of Tropical East Africa (FTEA), *Dichapetalum fadenii*, *Elachyptera parvifolia*, *Taxillus wiensii*).

The Pugu Hills (06° 54' S, 39° 05' E)

The Pugu Hills are located close to Dar es Salaam in Tanzania and hence have been well-studied over many years (e.g. Howell, 1981). There is forest in both the Pugu and the Kazimzumbwi Forest Reserves and data for these are combined. There are two presently undescribed new species of mammals from the Kazimzumbwi Forest Reserve, a shrew *Crocidura* sp., and a dormouse *Graphiurus* sp. nov. There is also an endemic sub-species of bird, the Pale-breasted Illadopsis *Trichastoma rufipennis puguensis*, the endemic invertebrates presented in Howell (1981), and one endemic plant genus and 12 endemic plant species (Chapter 4.1). Species which may be endemic, but which are very poorly known include the reptile *Scolecoseps acontias* and the bat *Pipistrellus permixtus* (both known only from 'Dar es Salaam').

The Matumbi and Kichi Hills (08° 22' S, 38° 56' E)

This area of high land just south of the Rufiji river in Tanzania is rather poorly studied, but has been shown to be important. So far known are an undescribed species of shrew *Crocidura* sp. (in Tong'omba), at least three endemic species of plants, an endemic butterfly, and at least 16 undescribed species of millipedes (Kiwengoma).

The Tanzanian offshore islands

The large islands off the coast of Tanzania (Pemba (05° 20' S, 39° 45' E), Zanzibar (06° 00' S, 39° 30' E) and Mafia (07° 50' S, 39° 45' E)) all have their own endemic species, many of which are forest confined or at least associated with the forest cover which probably clothed these islands until a few hundred years ago (e.g. Greenway *et al.*, 1988).

Pemba Island has the highest levels of endemism. There is one endemic mammal, the Pemba Fruit Bat *Pteropus voeltzkowi*, and four endemic birds – Pemba Sunbird *Nectarinia pembae*, Pemba White-eye *Zosterops vaughani*, Pemba Scops Owl *Otus pembaensis* and Pemba Green Pigeon *Treron pembaensis* (Archer and Turner, 1993). There is also one species of endemic butterfly, and four endemic plants, including *Chrysalidocarpus pembanus* (Beentje, 1990).

The other islands have somewhat lower rates of endemism. On Zanzibar there is the *kirkii* sub-species of the Red Colobus Monkey *Procolobus pennantii*, which is regarded by some as a full species (e.g. Corbett and Hill, 1991), and the second population of Ader's Duiker (the other being at Sokoke in Kenya). There are also three endemic butterflies (Archer *et al.*, 1991), and four endemic plants (e.g. *Ipomoea zanzibarica*, *Acalypha boiviniana*, *Ardisia* sp. A of FTEA) (also see Beentje, 1990). On Mafia, there is a species of leaf-litter toad *Stephopaedes* sp. nov. which is shared with the East Usambaras, and a species of writhing skink *Lygosoma mafianum* which is also known from Kisiju Island just off the mainland of Tanzania. There is also an endemic butterfly and four endemic plants (including *Spermacoce* sp. D of FTEA). A population of the rare Seychelles Fruit Bat *Pteropus seychellensis* is also found here.

The offshore islands also possess 13 endemic sub-species of mammals (Kingdon and Howell, 1993).

The Uluguru lowlands (06° 59' S, 37° 48' E)

There are a number of forest patches at the base of the Uluguru Mountains. The only one which has been studied is in the Kimboza Forest Reserve, and this site has a number of endemic species. These include the lizard *Lygodactylus williamsi*, the butterflies *Triclema kimboza* and *Celaenorrhinus kimboza*, and two endemic plant genera and 16 endemic plant species (Rodgers *et al.*, 1983).

The Udzungwa lowlands (07° 45' S, 36° 40' E)

The lower altitude forests on the eastern side of the Udzungwa Mountain range possess a number of endemic sub-species (see Stuart *et al.*, 1993; Kingdon and Howell, 1993; Dinesen *et al.*, 1993 and 1994). The precise relationship between these forests and the Coastal Forests described here is not clear, but the forests have greater affinity to Coastal Forests than to Eastern Arc mountain forests, and possess at least 10 species of endemic plants (six in Magombera alone).

3. Marginal areas of endemism

The Bazaruto archipelago (22° S, 36° E)

This area is found to the south of Mozambique and thus is far removed from the core Coastal Forest areas in Kenya and Tanzania. Three endemic species of reptile are known from Bazaruto – *Scelotes duttoni*, *Scelotes insularis* and *Lygosoma lanceolatum* (Broadley, 1990 and 1992). There are probably other locally endemic species in this area.

Easternmost Malawi and Zimbabwe (16–20° S, 32–35° E)

There are small areas of lowland forest in the eastern margins of Malawi and Zimbabwe which have their strongest affinities to the Coastal Forests (see Chapter 1.2). These lowland forests support several endemics, for example the chameleons *Bradipodion mlanjense*, *Rhampholeon chapmani* and *R. platyceps* are found only in Malawi. Other species, which are not strictly endemic to the Coastal Forests, have a distribution which includes parts of the Malawi/Zimbabwe/western Mozambique forests, in addition to forests further north. Examples are the bat sub-species *Scotophilus nigrila alvenslebeni* and the *Beamys hindei/major* species complex (FitzGibbon *et al.*, 1995).

Richest sites

The importance of individual Coastal Forests for biodiversity can also be ranked in terms of their species-richness or number of Coastal Forest endemics they possess. This has been done for plants, birds and mammals (Chapters 4.1–4.3), which are the only groups where data are adequate for the task. The ranking of sites depending on their species richness or endemic richness in different taxonomic groups (Table 4.9.4) shows that priority sites often recur in the set of the top ten most important sites, but that the ordering of the importance of the sites varies according to the biological group and to whether richness or endemism is considered as the most important variable. Also, there are a number of sites which appear in only one list. These can generally be ascribed to a much greater level of survey effort at the site (e.g. Gede forest in the birds endemism list), or to the collection of a new species from that site (e.g. Mt. Tongwe in Tanzania).

These lists give some idea of biological priorities in the Coastal Forests, which has an obvious application for targeting conservation efforts. A more statistically robust assessment of overall priorities could be made using computer programmes that are able to select minimum sets of areas through the use of complementarity algorithms (e.g. Vane-Wright *et al.*, 1991; Pressy *et al.*, 1993; Kershaw *et al.*, 1994). An example of this approach, using a database of forest birds of eastern Africa (Figure 4.9.4), shows that for this group all the major and minor areas of endemism outlined earlier in this Chapter have been selected. This further reinforces the critical importance of these areas. Further refinement of the biological (and conservation) priorities could be achieved by more work using such approaches, although there will be problems with uneven survey effort between forests, and the lack of complete species lists for groups other than birds. Although such work is scientifically valid, we believe that the local, minor and marginal areas of endemism outlined in this Chapter, and the sites presented in Table 4.9.4 are already of such great biological importance that they should all receive conservation attention in one way or another.

Summary

Overall rates of species endemism in the different groups in the Coastal Forests vary from 7.1 to 80+%, with the lowest rates in the mammal and bird vertebrates and the highest rates in the invertebrates. Percentage endemism is inversely correlated with generalised mobility of the group concerned, in common with endemism patterns observed in the nearby Eastern Arc forests. The overall rate of endemism for eight groups of animals and plants is 0.202% of the known worldwide species totals for those groups, and for the Eastern Arc this is 0.366%. This rate in the Coastal Forests is c.100 times greater than would be expected if the world's species were distributed evenly across the available land surface.

The geographical ranges of most endemic species in the Coastal Forests are small, with single-site endemism being commonplace. There are also several marked concentrations of endemics, which tend to be replicated across taxonomic groups. Two local centres of endemism (with more than 100 endemic species) are found in the Coastal Forests, in southern Kenya and northernmost Tanzania – the 'Kwale' local centre of endemism, and in southern Tanzania – the 'Lindi' local centre of endemism. Seven other more 'minor' centres of endemism exist (with over 10 endemic plants), and are only in Tanzania. 'Marginal' centres of endemism occur at the southern limits of these forests in western Mozambique and easternmost Malawi and Zimbabwe. The relatively low rates of exploration of the flora and fauna of northern Mozambique may account for the lack of evidence of concentrations of endemics in this area.

Comparisons of numbers of species (species-richness) and numbers of Coastal Forest endemic species in individual forest sites shows varying priorities between the groups studied here, although the same 'top' sites generally appear in most lists. Complementarity analyses to define sets of areas which are needed for conservation of biodiversity have not been attempted for most groups because of the patchy nature of collection and the lack of comprehensive species lists for most forests. However, where such an analysis is undertaken for the forest birds of eastern Africa the set of priority areas defined for the Coastal Forests includes all the local and minor centres of endemism described in this Chapter using our simple prioritisation methods.

Table 4.9.4 Ranked priority sites for vascular plants, birds, mammals and reptiles in terms of species richness and species endemism. Note that these are not corrected for forest area.

Rank	Vascular Plants		Birds		Mammals		Reptiles	Amphibians***
	Species richness*	Species endemism**	Species richness*	Species endemism**	Species richness*	Species endemism**	Species endemism**	Species endemism**
1	Shimba Hills (1087)	Rondo (60)	Pugu Hills (62)	Arabuko-Sokoke (16)	Arabuko-Sokoke (44)	Gendagenda (6)	Rondo and Litipo (5)	Shimba Hills
2	Rondo (800 est.)	E. Usambaras (17)	E. Usambaras (60)	Shimba Hills (12)	E. Usambaras (42)	Zanzibar (6)	Kiwengoma (4)	Pugu-Kazimzumbwi
3	Tana River NPR (663+)	Kimboza (16)	Arabuko-Sokoke (59)	Rondo (12)	Gendagenda (42)	E. Usambaras (5)	Arabuko-Sokoke (4)	Rondo
4	Arabuko-Sokoke (511+)	Litipo (16)	Rondo (54)	E. Usambaras (11)	Pugu Hills (42)	Tong'omba (5)	Bazaruto (4)	Mpora (Mafia Island)
5	Gongoni (409+)	Pugu-Kazimzumbwi (12)	Shimba Hills (54)	Pugu Hills (11)	Jubba Valley (39)	Tana river (4)	E. Usambaras (4)	E. Usambaras
6	Kiwengoma (367)	Shimba Hills (12)	Litipo (47)	Tana river (11)	Zaraninge/Kiono (39)	Tongwe (4)	Kilulu (3)	
7	Boni (335+)	Matumbi/Kichi (6)	Mrima (47)	Gede (10)	Mkwaja (37)	Pugu Hills (4)	Zaraninge/Kiono (3)	
8	Zaraninge (288)	Pemba, Zanzibar, Arabuko-Sokoke and Mafia (4 each)	Ngarama (46)	Gongo (10)	Tana river (37)	Rondo (4)	Zanzibar Island (3)	
9	Witu (287)	Pande (3)	Tana River (46)	Gendagenda (10)	Rondo (35)	Zaraninge/Kiono (4)	South Mlanje (3)	
10	Pangani Falls (271)	Noto (3) and Chitoa (3)	Zaraninge/Kiono (46)	Msubugwe (10), Zaraninge/Kiono (10), Litipo (10)	Kiwengoma (31)	Arabuko-Sokoke, Kilulu, Mkwaja, Ruvu South, Kiwengoma, Litipo, Pindirol (3 each)	11 sites with 1 CF endemic species present	

Notes:

* Species richness = the name of the forest site and the number of species recorded (in parentheses). For mammals this figure includes bats, which gives some bias as not all sites have been studied for bats.

** Species endemism = the name of the forest site and the number of Coastal Forest endemic species which have been recorded from it (in parentheses) except for plants where single site endemics only are listed (see Table 4.2.3 for list of bird endemism scores, Table 4.2.5 for birds, Appendix 4 for mammals, Appendix 5 for reptiles and Appendix 6 for amphibians).

*** Sites cannot be ranked for amphibians, but some important sites are listed.

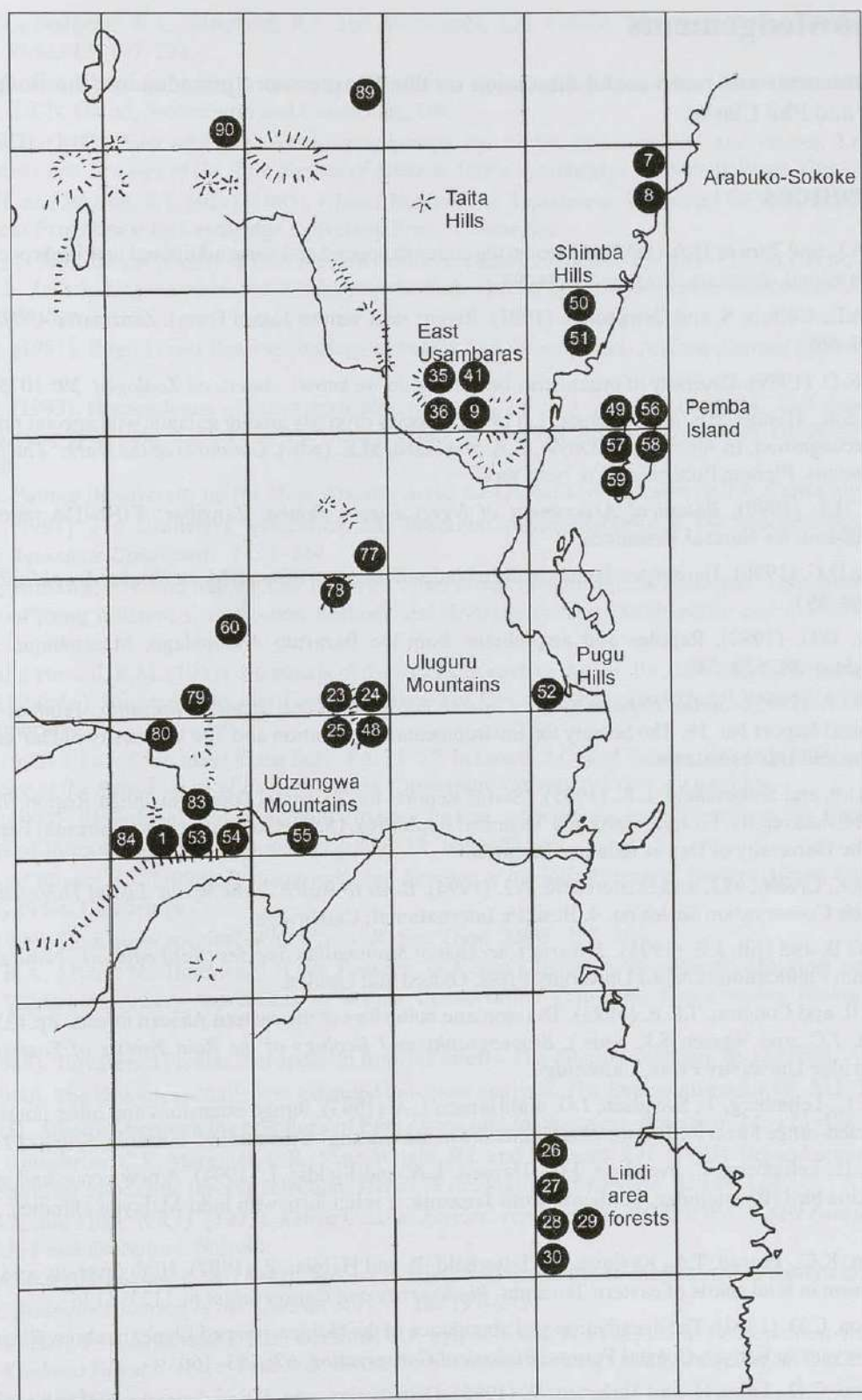


Figure 4.9.4 Part of a minimum set of 0.25 degree squares (represented here as numbered circles) in eastern Africa required to conserve forest birds in five (or less in the case of more restricted species) separate sites. Data are from a provisional distributional database for eastern African bird species, with the database being most accurate for the Coastal and Eastern Arc forests represented here. Numbering within the circles is the rank order of the sites, from a list of 130 irreplaceable and flexible areas. All calculations were performed using WORLDMAP IV, developed by Paul Williams of the Natural History Museum in London. It should be noted that the Taita Hills endemics are here regarded as sub-species, else that site would also be one of the areas represented.

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5.1 History of coastal forests

5.1.1 Introduction

Introduction

Section 5

Human and forest interactions

This section summarises the interaction between humanity and the Coastal Forests. In the first Chapter, the history of the influence of the human population on the forest cover of the area is discussed in relation to the changes since hominids first appeared around five million years ago, concentrating on the harnessing of fire by modern humans around 150,000 years ago, on the influence of cultivation, and on the effect of the arrival of the major colonial powers which exploited the area from the 16th century to the 1960s. The following Chapter is devoted to a detailed presentation of the history of modern forestry over the past 100 years when the German, British and Independent governments instigated and maintained systems to demarcate, manage and exploit the forest resources in the area. In the third Chapter, a detailed discussion is presented on the current uses of, threats to, and human attitudes towards these forests. Finally in the last Chapter a summary of recent conservation initiatives in these forests is presented, followed by a discussion of the issues which are involved, and some ways in which they might be tackled.



Figure 5 Isolated baobabs *Adansonia digitata* and the forest dependent *Sterculia appendiculata* remaining in cultivated land near Kitomanga, Lindi Region, Tanzania. These species are usually left following forest clearance, due to their soft, spongy wood which does not burn, and also due to the traditional protection usually accorded to them. Baobabs may also have been planted as a traditional crop as they were formerly important for clothing fibres and perhaps also as a staple food source. (Photo: G.P. Clarke)

5.1 History of anthropic disturbance

G.P. Clarke and N.J. Karoma

Introduction

Coastal Forests are widely recognised to have been formerly much more extensive (Elton, 1874; Swynnerton, 1917; Troup, 1923; Gray, 1952; Moll and White, 1978; Hall, 1984; Sheil, 1992; Hawthorne, 1993; Chami, 1994). Although global climatic changes (especially the drier periods during the Pleistocene climatic fluctuations) are recognised to have both fragmented and reduced the extent of tropical forest in Africa (e.g. Hamilton, 1989), the severity of these climatic desiccations are not thought to have been sufficient in the eastern African coastal zone to fully account for the amount of Coastal Forest that must have been lost (Chapter 2.3; cf. Dale, 1954), and are even thought to have been greatly exaggerated in tropical lowlands in general (White, 1993). We believe that it is the combination of gradual climatic desiccation together with increasing human activity that accounts for much of the loss of Coastal Forest during recent geological time.¹

Modern humans (*Homo sapiens*) originated in eastern Africa some 300,000 years ago (although the hominid lineage stretches back at least five million years). At first their limited technological capability and low population had little impact on the Coastal Forests, and the early hunter-gatherers in general had a much lower effect on the presence and condition of the forests than that caused by natural factors such as elephants and climate. Subsequent developments of fire, tools (and more recently of machines) have given humanity an ever greater destructive capability on the forests, which together with advances in crops and medicines have led to an increased population to carry out that destruction. This chapter charts the history of the anthropic disturbance to the Coastal Forests, in chronological order of the main events and discoveries that we believe have brought about the gradual destruction of these forests.

The discovery of fire-making

The creation and use of fire was a major discovery for humanity, and the first tool that could be used to dominate the landscape (Hall, 1984). However, wildfires predate the human genesis as they can be started naturally by lightning, falling stones, volcanic activity etc. (Phillips, 1965; Granger, 1984). There is considerable evidence of natural fires throughout the geological record, with charcoal layers being a common palaeobotanical feature of many strata. There are records of bush fires in eastern Africa from the Plio-Pleistocene (2–5 million years ago) in Ethiopia, which are contemporary with (although not caused by) the earliest hominids (Deschamps, 1984). Hominids learnt to make fire about 1.5 million years ago in the Rift Valley area (Clark and Harris, 1985; Brian, 1993), but are not thought to have used it to create artificial bushfires until 180,000–150,000 years ago (Kielland-Lund, 1988; Hall, 1984). These fires are thought to have been set to drive game animals out of areas of dense vegetation to where they could be more easily hunted.

The use of fire by hunters may have had a great influence on Coastal Forests (cf. Hall, 1984; Hawthorne, 1993). Fires are known to occur (albeit occasionally) in dry forests² which may then recover if further fires are excluded (Menaut *et al.*, 1995; Swaine, 1992), but forest will eventually be

¹ Swynnerton (1917) concludes that most of the forest between the Chimanimani Mountains and the sea (i.e. in the lowlands of southern Mozambique) was removed 'especially by, and for long only by, fire'. From his observations of the rate of forest loss due to fire at Chirinda, he calculates from a slightly increased rate of forest loss that the duration of this forest destruction had taken place over 105,000 years, which is in the same order of magnitude as the earliest evidence for bush firing by humans (180,000–150,000 years ago).

² Moomaw (1960) notes that 'even the humid rain forest community' of the Kenya coast will burn during the dry season, but comments that the Kenyan Coastal Forests nonetheless do not burn readily.

converted to woodland or grassland if it is repeatedly burnt³; conversely many woodlands will revert to forest if fire is excluded (Menaut *et al.*, 1995; Trapnell, 1959; Swaine *et al.*, 1992⁴). We believe that natural bushfires would have originally occurred at a sufficiently low frequency⁵ to have enabled Coastal Forest to regenerate once it had been burnt, and that the deliberate creation of additional bushfires by prehistoric hunters tipped the ecological balance such that fire, encroaching into the forest margins, was able over thousands of years to convert large areas of these forests to woodland. Once converted, the woodlands were maintained by the continued regime of regular burning. Coastal Forests have certainly been more widespread in areas that are now woodland, as borne out by discoveries of fossilised Gum Copal (a product of the Coastal Forest tree *Hymenaea verrucosa*⁶) in areas that are now fire-climax woodland (Elton, 1874; Kerner von Marilaun and Hansen, 1916).

Circumstantial evidence for the past role of fire as a cause of forest loss has been unearthed in recent archaeological excavations at Mpara Hill on the Tanzanian coast. Here small pieces of charcoal have been found throughout the later Pleistocene (pre 10,000 BC) artefact bearing deposit (Karoma, 1993a), in an area where fossilised Gum Copal is also found, demonstrating that ancient fires have swept through an area that has also been covered with Gum Copal forest⁷. The base of the

³ Moomaw (1960) considers the *Manilkara-Diospyros* Lowland Dry Forests of the northern Kenya coast to have largely been destroyed by fire, cultivation and grazing, and that the remaining forest at Boni is particularly at risk from fires set by hunters and honey gatherers. The 'Moist Lowland Savanna' (classified as woodland in White, 1983) of coastal Kenya is considered by Moomaw to be secondary fire-destroyed forest.

The elders of Gendagenda village in northern Tanzania describe a forest fire on the northern of the Gendagenda peaks during the last century (Clarke and Stubblefield, 1995). The forest has since been replaced by elephant grass (*Pennisetum purpureum*) which burns on the peak with spectacular ferocity every year (Clarke, pers. obs.). Coastal Forest still exists on the southern peak but in places appears to be in retreat from the annual fires at its edge (Clarke, pers. obs.). Comparable observations of the destruction by fire of large patches of forest, and of the erosion of their boundaries, are recorded by Swynnerton (1917) from Chirinda Forest, Zimbabwe.

Clarke has also observed stages in the conversion of Coastal Forest to woodland/grassland by fire, but this process is believed to be very slow and does not become complete until forest canopy trees that are not affected by fire die a natural death of old age. A good example of this process is taking place at Tongwe Forest where there is a moribund stand of 25–30m high individuals of *Antiaris toxicaria* emerging from a grassland that is regularly burnt (Clarke and Stubblefield, 1995). No regeneration is taking place and no other forest species exist here except further up the slope where the forest edge is in retreat from fire.

⁴ The references cited are for fire-exclusion experiments in Zambia and Ghana. To our knowledge no such experiments have been completed in the Coastal Forest belt, although fire plots were constructed in the *Brachystegia* woodlands of the Simbo Forest Reserve, Bagamoyo District, Tanzania (Forest Department, 1948). However a number of examples can be cited of forests that have regenerated following a known history of complete clearance and even cultivation or urbanisation (e.g. around Tongwe Fort, over the graves and house on Kilulu Hill, over the abandoned city of Gede in coastal Kenya (Figure 5.1.3(a) and (b)) and over former villages in the Matumbi Hills that were abandoned after the Ujamaa villagisation programme. Most of these sites are areas where the forest has regenerated under the protection from fire by existing forest, although over the ruins of the former German military HQ on Chole Island (off Mafia Island) dense forest has now developed where there was no forest at the beginning of this century. Bush fires are unknown on Chole Island which is densely cultivated.

Further examples of forest regenerating where fire is excluded can be found throughout coastal Tanzania, where ancient mango trees in small villages (e.g. Nambunjo in Rufiji District) sometimes develop a forest understorey where they are undisturbed from grazing or cultivation, and where the surrounding areas of local cultivation provide the necessary buffer against bush fires.

⁵ The great majority of the bushfires observed today in Africa (perhaps 99%) are thought to be started by humans (Granger, 1984; Swynnerton, 1917).

⁶ *Hymenaea verrucosa* is limited to the Coastal Forests on the African mainland, but occurs elsewhere on Madagascar and the Mascarene Islands. It grows to a very large, distinctive and commercially important tree, and is very infrequently, if ever, found in fire climax woodland. The species appears therefore to depend on forest conditions to survive (where fire is absent).

⁷ Gum Copal trees were noted to be scattered in the Uzaramo area of Tanzania at the end of the last century 'representing what at one time must have been a dense copal forest' (Gray, 1952) but where 'the extent of these ancient forests can now only be estimated by the area of the [digging for semi-fossilised Gum Copal] and by the position of the existing [Gum Copal trees]' (Elton, 1874). The Gum Copal trees had become so rare that the majority of the copal trade at that time was supplied by digging (up to 4ft deep) for the semi-fossilised resin from those ancient forests (Elton, 1874; Gray, 1952 citing notes by Sir John Kirk).

deposit, which is part of a raised beach 100ft above the current sea level, is dated to the last interglacial (about 100,000 BC).

Patterns of floristic endemism in the Coastal Forest belt also suggest that the Coastal Forests are older than the surrounding woodland areas, based on the evidence of endemic plant genera which are thought to represent ancient phylogenetic lineages. Most (91%) of the genera which are restricted to the eastern African coastal zone are found in forest and other fire-excluded habitats (such as thickets and bushland clumps), compared to just 14% that are recorded in the fire climax woodlands and grasslands, even though the fire-excluded habitats account for less than 2% of this area (Chapter 4.1). The comparatively higher proportion (50%) of endemic species occurring in the fire-climax habitats nonetheless suggests that a mosaic of fire climax rangeland and forest must have been present for a long time (i.e. long before the earliest records of forest clearance for agriculture), to enable the necessary speciation to have occurred in the habitats modified by fire (cf. Moreau, 1933; Granger, 1984; Chapter 4.1 for more detailed discussion).

The introduction of crops and cultivation

The earliest humans were nomadic hunter-gatherers who took what they needed from the environment. Just before the end of the last Ice-Age (approx. 10,000 BC) humans discovered that the environment could be altered to support an increased proportion of useful foodplants, or crops (i.e. through the practice of cultivation), thereby enabling an area to support a larger and settled population.

Coastal eastern Africa is known to have been settled continuously since late Pleistocene times, as indicated by recent archaeological finds at the Abu Bakar Hill and Mpirani sites near Mombasa (Kato 1988a, 1988b; Yasukawa 1988) and at several locations in the Kilwa coast area, including Kilwa Kisiwani (Chittick, 1974), Kilwa Masoko (Harding, 1961), Mgongo, Kiuleule, Mpara and Singino Hills (Karoma, 1982 and 1993a). In the Kilwa coast area there are remains of large Stone Age hunter-forager-fishing communities, which have been found on raised former beaches at between 60 and 100ft above the present sea level, suggesting a late Pleistocene date when the sea level was higher (Birch, 1963; Cooke, 1970 and 1974; Alexander, 1969). It was possibly these people who first utilised the abundant Baobab trees along the coast as a food and raw material source, and these may have been intentionally planted to increase their number, thereby possibly becoming the first food crop in eastern Africa (Karoma, 1993b).

The practice of cereal cultivation came later, probably reaching eastern Africa via two routes, from the north or the east via the coast, and later from the interlacustrine region between Lake Victoria and the Western Rift. The arrival of cereal cultivation coincides with a population explosion in areas inland of the coast, where the population had remained sparse until the Early Iron Age (500 BC). The population increase is attributed by some historians to the expansion of the Bantu people from central Africa, based on the evidence of a shared Bantu language that is now adopted throughout eastern and southern Africa. Other historians consider this dispersal to have been limited to language, cereal cultivation and the knowledge of iron-working (Gramly, 1978; Schepatz, 1988), which would have enabled the existing population to expand (see following section). However, irrespective of which school of thought is followed, the start of this Bantu 'dispersal' to other parts of the continent is acknowledged to predate 2000 BC (Maggs in Moll and White, 1978), reaching the Indian Ocean at the Usambara Mountains about 2000 years ago (Schmidt, 1989). The Bantu migration/influence brought the practice of forest clearance and the cultivation of sorghum and millet (Sutton, 1990) to East Africa. There is archaeological evidence of forest clearance and settlement in the lowland forests of the Eastern Arc Mountains during this time (Schmidt, 1989).

A further cereal type (Asian rice) was brought by settlers from Indonesia to coastal areas during the first millennium AD, and contributed to the clearance of forest on Zanzibar and Pemba Islands.

The effect of forest loss due to clearance for cultivation would have been intensified by bushfires, as these prevent cleared land at the edge of forests from regenerating back to forest (Swynnerton, 1917). Even a low population practising shifting cultivation would then have gradually reduced the extent of forest, if these farmers had chosen to clear more forest rather than woodland during their

successive cultivation cycles (Hall, 1984). Forest is often cleared in preference to woodland in coastal East Africa (Clarke, pers. obs.; Hall, 1984) as there is no herb layer to remove and forest soils initially tend to be more fertile as they contain a higher organic matter content (which is rapidly lost if the forest is removed) and have not lost nitrogen through volatilization by fire (Kiellund-Lund, 1988; Chapter 2.2). In addition, forest contains a greater quantity of woody matter than woodland, so more fertile ash is produced when this is burnt during clearing, thereby improving the yield from the resulting agricultural land for a few years (Hall, 1984; shifting cultivation practice described in Gillman, 1945).

The combined effects of shifting agricultural clearance and bushfires are considered by Hall (1984) to have been a major recent cause of forest loss in southern Africa, especially along the eastern coastal plains.

The development of iron tools

At the time that cereal cultivation was introduced to East Africa, the population density in the lowlands was so low that shifting cultivation cycles would have had a sufficient rotation interval to permit much of the forest (except for the edges of forest blocks exposed to bushfires) to regenerate. Pressure for agricultural land would have been so low that it is likely that some areas (particularly steeply sloping hillsides) would never have been cleared. Evidence from the montane areas of Kilimanjaro, the Pare and Usambara Mountains nonetheless demonstrate a history of intense human pressure, leading to severe soil degradation and loss of much of the lowland forest at the base of these mountains (Schmidt, 1989).

The severity of the deforestation in these areas may be partially attributed to the need for fuelwood for the iron smelting that was carried out here by Early Iron Age people (Schmidt, 1989). Agricultural communities with a knowledge of iron working similar to those of the Usambaras and Kagera have also been found at Mkiu and Limbo in Kisarawe District, 20km from the coast (Schmidt and Karoma, 1987) dating from the first millennium AD (Chami, 1992; Schmidt *et al.*, 1992; Karoma *et al.*, 1988). The large quantities of slag recovered from the 2nd and 3rd levels at Limbo (Chami, 1994) would seem to suggest that the need for fuelwood for iron smelting during the first century AD was already considerable. Iron smelting is also known from Nampula in Mozambique in the second century AD (Chami, 1992; Chami, 1994 citing Sinclair *et al.*, 1993).

A high demand for fuelwood could have had considerable impact on the Coastal Forests, just as it was responsible for the depletion of much of the indigenous tropical forest in Kagera Region during Early Iron Age times, i.e. from 500 BC (Schmidt and Childs, 1985). Early iron working on the coast may therefore have led to a reduction in area and subsequent fragmentation of the Coastal Forests, both from the need for fuelwood for smelting, and from the consequent production of better iron tools that made it easier to clear areas of forest.

Trade and urbanisation on the coast

The earliest writing to mention the East African coast dates back to the first century AD, in which the Greek author of the *Periplus of the Erythraen Sea* records a well established trading entrepot called Rhapta, now interpreted to be either near present day Lamu, or Chakechake on Pemba Island (Horton, 1990). Early Iron Age communities (with characteristic pottery) were already present on the coast by this time, and the eastern African coast (known then to the Greeks as Azania) traded with merchants from the Red Sea and the Roman Empire. Sutton (1990) considers these trade links to have declined after the first century AD until after the advent of Islam at about 800 AD (Dale, 1954), but new finds (Chami, 1993) demonstrate that between the 4th and 10th centuries AD the coast was occupied by a people who are associated with a Triangularly Incised Ware (TIW), and who worked a variety of metals including iron, copper and lead. They also engaged in international trade, expanded in population and occupied the Indian Ocean coastal islands. Later archaeological records, particularly at Kilwa Kisiwani (Chittick, 1974) demonstrate that a sophisticated civilisation developed along the coast in the following centuries (Freeman-Grenville, 1967), especially after the arrival of the Shirazi

Arabs in 900 AD (Moomaw, 1960). Large coastal towns developed (Figure 5.1.1), which together with a thriving local ship-building industry would have created a large demand for termite-resistant timber (which may also have been exported at this time (Moomaw, 1960)). Coastal Forests (and also the mangrove forests) near these settlements would have been exploited to satisfy this demand, and some have given their name to the preferred timber species, e.g. the etymology of 'Mbamba Kofi' (*Azelia quanzensis*) is derived from the Bamba forest near Kilife (Aldrick, 1990).

The thriving settlements on the coast are known to have traded with the hinterland (as shown by the distribution of finds of Triangularly Incised Ware dating from the 4–11th centuries AD) and were later responsible for organising trade caravans into the interior during the late eighteenth or early nineteenth century (Freeman-Grenville, 1967), coinciding with the beginning of the slave trade.

The arrival of the Portuguese

Vasco da Gama's arrival in eastern Africa in 1498 found a prosperous cosmopolitan community living along the coast north of Quelimane (Figure 5.1.1), who were accustomed to trading with merchants from Arabia and India (Strandes, 1899). Over the ensuing centuries, the Portuguese sought to monopolise this trade (Figure 5.1.2), which had the reverse consequence of causing it to collapse, and the coastal area of eastern Africa went into economic decline (see Strandes, 1899 for a full account). Some of the thriving coastal towns were destroyed by the combination of repeated sackings by the Portuguese and the marauding Zimba tribe during the sixteenth century (Strandes, 1899), which may have slowed down the subsequent rate of forest loss in these areas. The Portuguese also began to take slaves, and from the early nineteenth century were joined in this trade by the Arabs.

The direct consequence of the arrival of the Portuguese in eastern Africa was a disruption to a steadily increasing population, which may be expected to have reversed the decline in the extent of the forests (Figure 5.1.3a and b). However, there is evidence that even during the height of slaving activity in eastern Africa the population continued to increase, or was at least stagnant (Kjekshus, 1977). The reason for this is that the arrival of the Portuguese coincided with the discovery of the New World (1492), and of further Portuguese explorations in Asia. These voyages brought the Portuguese into contact with new foodcrops, which they then introduced into eastern Africa (cassava, maize, papaya, cashews and avocados from the Americas and mangoes from SE Asia). The new crops enabled the land to support many more people, in an area which had formerly been almost uninhabited inland of the coast (the stretch of land between the Rovuma River and Kilwa had almost no people when the Portuguese Gaspar Bocarro travelled from Tete to Kilwa in 1616 (Gray, 1948)).

There are no written records of the history of the coastal hinterland prior to the middle of the last century, although oral historical accounts of the various tribes currently settled in the Coastal Forest belt indicate that these arrived relatively recently, typically 200–500 years ago, during a period of extensive tribal

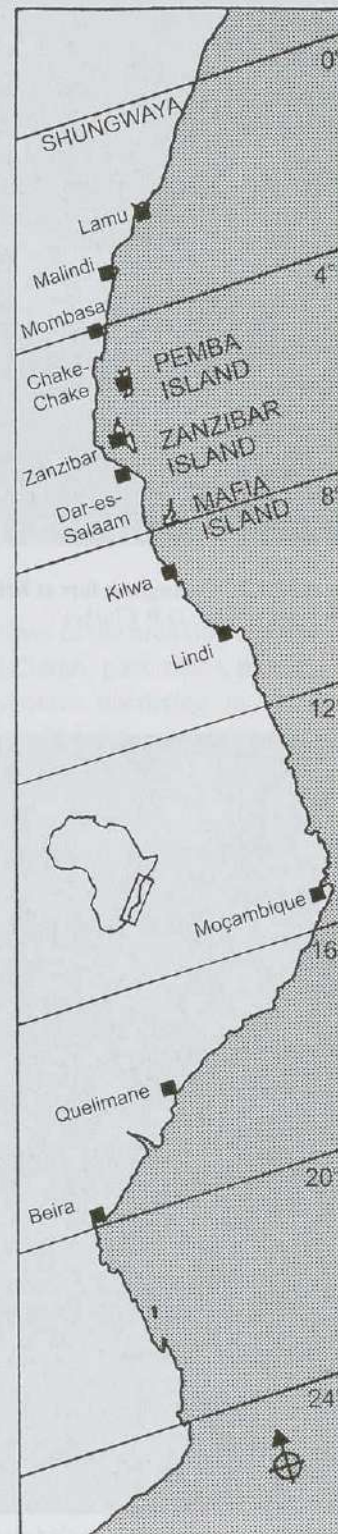


Figure 5.1.1 Main towns on the eastern African coast during the time of Vasco da Gama.



Figure 5.1.2 Portuguese fort at Kilwa Kisiwani, (Tanzania) used as a base to control trade along the eastern African coast. (Photo: G.P. Clarke)



Figure 5.1.3a Forest-covered Swahili ruins at Gede near Malindi (Kenya coast), abandoned at about the time of the arrival of the Portuguese. (a) Palace. (Photo: G.P. Clarke)



Figure 5.1.3b Forest-covered Swahili ruins at Gede near Malindi (Kenya coast), abandoned at about the time of the arrival of the Portuguese. (b) Mosque. (Photo: G.P. Clarke)

movements in eastern and southern Africa. The recent arrival of the tribes in the area may account for the poor knowledge that they have of their local forest plant species (Clarke, pers. obs.), particularly when compared to their excellent knowledge of the woodland species occurring in the areas surrounding the forests. This would indicate that these tribes have a much longer acquaintance with woodland rather than forest areas.

The settlement of the people of the coastal hinterland may be linked with the introduction of new foodcrops by the Portuguese, which would have allowed the population to expand and become settled, but this would have probably also meant an increase in the rate of forest loss in these areas.

Colonialism and plantations

Portuguese interests in eastern Africa were initially limited to the establishment of a number of forts and settlements, from which the coastal trade could be dominated and taxed. The introduction of a colonial-style economy can be ascribed to the Omani Arabs, who first wrested control of the Kenyan and Tanzanian coastal towns and trade from the Portuguese at the end of the seventeenth century, and later introduced cash crop plantations (cloves and cardamom) to Zanzibar and Pemba at the beginning of the nineteenth century. Large tracts of land were cleared for these plantations, such that Pemba Island, which was thickly forested before 1830, now has just a few km² of forest left. Coconut plantations were introduced to the mainland coastal areas from the middle of the nineteenth century, and Dar es Salaam, which was formerly covered with Gum Copal [*Hymenaea verrucosa*] forest, (see Figure 5.1.4) was cleared to create a coconut plantation for the Sultan of Zanzibar in the 1870s (Gray, 1952). These plantations were worked with slave labour, which probably caused a redistribution of the eastern African population from the hinterland to the coast and islands, rather than an overall population decline (Kjekshus, 1977).

The arrival of the European powers throughout eastern Africa at the end of the nineteenth century led to the spread of colonialism over the whole of eastern Africa. New cash crops were introduced to the coastal regions, particularly sisal and rubber. The plantations increased the demand for labour which was partially satisfied by the migration of people from inland areas (Kjekshus, 1977). Combined with better diets and healthcare these factors caused a substantial increase in the



Figure 5.1.4 Dar es Salaam from Oyster Bay in 1822, showing thick (?gum copal) forest on the Msasani Peninsula, as drawn by J.C. Galler, acting pursar on H.M.S. Barracouta (Captain A.E. Vidal). Pugu Hills to background left. Reproduced with permission of the UK Hydrographic Office.

population of coastal areas near the ports, with a corresponding increase in fuelwood, timber and cultivation pressures on the Coastal Forests (Chapter 5.3). Areas close to the large coastal cities have been most affected by the burgeoning human population, and some forests have completely disappeared during the last century, e.g. the Sachsenwald [Mogo] forest near Dar es Salaam and the Amboni forests near Tanga.

Imperial rule and forest management

In spite of the abolition of slavery, the advent of new medicines, plantation crops and industrialisation, the imposition of European imperial rule in eastern Africa, where traditional systems were disrupted and people were evicted from their land, actually caused the overall population to go into decline (Kjekshus, 1977). Colonial wars, as well as the First World War, caused a massive loss of life among the eastern African people, which added to that caused by the rinderpest epidemics and the arrival of jiggers and syphilis. The population decline that followed allowed areas that were formerly cultivated to revert to bush, such that game animals returned and with them the tsetse fly and sleeping sickness, thereby spiralling the population decline into a vicious circle and an eventual population collapse from the 1890s to the 1920s (particularly in the inland areas), which did not recover until the 1960s (Kjekshus, 1977).

This population collapse may have temporarily relieved the pressure on many of the Coastal Forests (except those near the large cities), i.e. through the cessation of salt and local iron production (Kjekshus, 1977), and by the abandonment of plantations on the coast that had formerly fed the slave industry (Moomaw, 1960). In addition, this period coincided with the advent of forest gazettment and management practices, so that for the first time the forests were considered to merit conservation⁸, albeit to monopolise timber production and to safeguard water catchments.

Most of the Coastal Forests are now contained within Forest Reserves or National Parks (Chapter 5.2; Burgess and Muir, 1994), so their history over the last 100 years is largely that of the development of the forestry service in eastern Africa. A detailed description of Forestry follows in the next Chapter, focusing on Tanzania.

Summary

The history of the interaction between humans and the Coastal Forests is one of ever increasing disturbance leading to the fragmentation of what must once have been a much more extensive forest along the eastern African seaboard.

The fragmentation process started with the introduction of increased burning, so that bushfires were increased in frequency far above the natural rate and would have gradually reduced the extent of forest over thousands of years. This process was then accelerated by the development of a large

⁸ The Mijikenda people of the Kenyan coast have protected many small patches of Coastal Forest as sacred, and similar local protection is also known to occur in Tanzania (Hawthorne, 1993). However, such local protection is usually only afforded very small areas and thus the gazettment of Forest Reserves at the beginning of the 20th century marks the first instances where larger tracts of forest were protected in their entirety.

population along the coast during the first millennium BC, and later in the foothills of the Eastern Arc Mountains where forest was first cleared for cultivation and to fuel iron smelting. Degradation of the forests near the coast would have continued with the development of the Swahili civilisation, but further inland the forests were probably little disturbed (except by fire) until new crops brought by the Portuguese led to an increasing population that was forced to seek more marginal land suitable for cultivation, starting about 500 years ago. The development of cash-crop plantations from the nineteenth century onwards further depleted the extent of the forests in areas with a higher rainfall, such as along the coast, on the islands and later (during European colonisation) at the base of the Eastern Arc mountains.

The Scramble for Africa at the end of the nineteenth century temporarily halted the process of forest loss (except in areas that were converted to plantations, or near the coastal ports), but by this time only tiny fragments of the extensive forests that were formerly present at the base of the Eastern Arc Mountains and along the coast were left for gazettment into Forest Reserves. The majority of the remaining patches of Coastal Forest have now been incorporated into protected areas, but all of the forests are still threatened with total elimination as a consequence of an ever increasing demand for farmland, fuel and timber (Chapters 5.2 and 5.3).

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5.2 Forestry

N.D. Burgess and S.B. Mbwana

Introduction

When the major colonial powers arrived in eastern Africa they initiated programmes to assess and then exploit the existing timber resources. Programmes of protection and management of the forests were also started, aiming to ensure a continuous supply of timber to the colony and to the colonial power, and to protect the forests to ensure an adequate water supply to key towns and agricultural areas (e.g. Troup, 1940; Hermansen *et al.*, 1985; Holmes, 1995).

Over the last 100 years the history of the Coastal Forests is closely tied to the development and changing fortunes of the Forestry Departments of eastern Africa. For further information see Lovett (1992). This chapter presents a case-history of the development of one of these Forestry Departments, in Tanzania, and its relationship to the protection, exploitation and conservation of the Tanzanian Coastal Forests. Although the political details have not been the same between Tanzania, Kenya, Zimbabwe and Malawi, we believe that the general situation in Tanzania illustrates patterns which will be mirrored elsewhere in eastern Africa (e.g. Wass, 1995). Political instability in Somalia and Mozambique has meant that the Forestry Services of those countries have not recently held full management control over their forests, although some Forest Reserves do exist.

Development of an eastern African Forestry Department – Tanzania

The development of the Forestry Department in Tanzania is divided by the major colonial and post colonial events.

German administration (Deutsch Ost-Afrika)(1891–1918)

The German Government took official control of the administration of German East Africa from the Karl Peters company in 1891 and maintained this control until the First World War (1918).

Control was established over valuable timber resources through a programme of exploration, survey and demarcation of forests as reserves under German administrative control (Anon, 1902; Stuhlmann, 1902; Graß, 1904; Anon, 1911; Troup, 1940; Anderson and Grove, 1988; Hamilton and Mwasha, 1989a; Schabel, 1990; Rodgers, 1993). The Germans concentrated initially on the mangrove forests of the Rufiji delta (gazettement started in 1898 – Graß, 1904) as these had supported a profitable trade in building poles, fire-wood and timber, which had been controlled by the Sultan of Zanzibar. Other forests were regarded as highly degraded through the actions of the local people. The forests around Dar es Salaam were described as 'very sad' and 'almost completely devastated' from burning, overgrazing and overcutting (quoted in Schabel, 1990). Moreover, forests of the East Usambaras were described as 'largely vanished' in 1898 (see Schabel, 1990)¹.

Gazettement and management programmes were pursued first in the montane forests of the West Usambaras (Wilhelmsthal), then the Coastal Forests of Tanga and Dar es Salaam Regions, followed by Bagamoyo and Morogoro Regions. The Lindi area was not tackled until c.1909, and not all the forests which were surveyed had been gazetted by the time that the First World War broke out. As well as gazetting areas, boundaries of reserves were cleared to prevent fire encroachment, and there

¹ The forestry situation at that time was perceived in a similar way in Kenya (Hutchins, 1907 and 1909; Logie 1962), possibly because dry forest may have been regarded as degraded forest by foresters expecting tropical forests similar to those of India or West Africa.

were experimental plantations of Coastal Forest species such as *Milicia excelsa*, *Azizelia quanzensis* and *Baphia kirkii* (Anon, 1911; Wood, 1966).

During the period of the First World War the lack of effective supervision resulted in considerable forest damage through encroachment by shifting cultivators (Troup, 1940).

British administration (1918–1961)

The British administered Tanganyika under a League of Nations mandate from the end of the First World War until independence in 1961.

A Department of Forestry headed by a Conservator of Forests was created on the 20th December 1920, the Conservator arrived in January 1921 and the other staff soon followed (Forest Department, 1921). The initial priority of the Department was to introduce a new Forest Ordinance (September, 1921) and to re-proclaim all the German gazetted reserves, which were principally in the coastal mangroves, the Coastal Forests and the Eastern Arc Mountains. The administration then started dealing with problems in reserves which had been reclaimed by local people, instigated protection against illegal cutting, clearing and grazing, and started programmes to resume timber extraction. Forest Reserves were also established in some of the former German estates, especially in the East Usambara Mountains following the seizure of these estates (Rodgers and Homewood, 1982; Hamilton and Mwasha, 1989b). This consolidation phase lasted up to the onset of the Second World War (Grant, 1924; Troup, 1936 and 1940; Parry, 1962; Sangster, 1962; Lundgren, 1975; Hamilton and Mwasha, 1989b; Rodgers, 1993).

The Tanganyikan forestry service was initially modelled on that of India, because Indian forestry had been established on a sound commercial basis during the latter half of the nineteenth century, raising revenue for the government whilst also being able to finance extensive programmes of reforestation (Troup, 1940). Indian-trained foresters were recruited into the African colonies in the hope that they would be able to achieve the same results. However, it became clear that the lower yield of merchantable timber in the Tanzanian (and Kenyan) forests made it very difficult, if not impossible, to generate sustained revenue surpluses (Troup, 1923; Nicholson, 1931; Brasnett, 1942; Ofcansky, 1984).

Between the First and Second World Wars colonial forest policy was derived from the Imperial Forestry Institute (now Oxford Forestry Institute), and could be summarised as 'the public good was best served through the protection of forests and water resources, even if this meant the displacement of local communities' (McCracken, 1988). Assessments were also made of the potential of indigenous trees and shrubs (e.g. Brenan and Greenway, 1949), and of the value of forests to safeguard water supplies (Hughes, 1949).

In Tanganyika² forest exploitation was stepped up during the Second World War to meet the demands of the war, and this intense exploitation continued until the early 1950s (see later). This policy caused considerable damage to the Coastal Forests, especially those of the Rondo Plateau and the Tanga area. However, in 1953 a new forest policy statement for the Forestry Department was issued (Box 5.2.1) which was more orientated towards conservation of forest resources, although not specifically their biodiversity values, and the involvement of local people in management was not sought.

This policy remained in force until early 1998, when it was replaced by one which was more open to involving local people in forest management (see Chapters 5.4 and 5.5).

Throughout the period of British colonial forestry in Tanganyika there was a degree of conflict with the local populations. The local people considered forest conservation which was deemed 'for the public good' to be a restriction of their private rights to gather forest products, cut trees and farm and graze animals in the forest area (Forest Department, 1921–1961).

² Also in Kenya (Gardner, 1942).

Box 5.2.1 Forest policy statement for the Tanganyikan Forest Department (Forest Department, 1953)

- (a) To demarcate and reserve in perpetuity, for the benefit of present and future inhabitants of the country, sufficient forested land or land capable of afforestation to preserve or improve local climates and water supplies, stabilise land which is liable to deterioration, and provide a sustained yield of forest produce of all kinds for internal use and export.
- (b) To manage forest estate and all forest growth on public land so as to obtain the best financial returns on capital value and cost of management in so far as such returns are consistent with the primary aims above.
- (c) To encourage and assist the practice of forestry by local Government bodies and by private enterprise.
- (d) To undertake and promote research and education in all branches of forestry and to build up by example and teaching a real understanding among the people of the country, of the value of forests and forestry to them and their descendants.

Post-colonial period (1961–present)

After independence the protection and exploitation functions of the Forestry Department continued much as before, except that the British officers gradually returned home as Tanzanian nationals were trained to take their places (Hamilton and Mwasha, 1989c; Forest Department, 1962–1970 and 1978; Somi and Nshubemuki, 1980; Holmes, 1995).

A major change in the management of forestry in Tanzania occurred between 1968 and 1972 when the government was decentralised. Following decentralisation, forestry management was undertaken by the Regional and District administrations. The Director of Forestry remained in control of the Forestry Department at central government level, but could only 'advise' on management issues relating to most Forest Reserves (including Coastal Forests). Regional and District Forestry Officers undertook the work in the forests, but were responsible to their local administrations and *not* to the Director of Forests. This change is regarded by senior foresters in Tanzania today as one of the major and continuing problems with the Tanzanian forestry service. Centralised functions, such as data-gathering and planned management declined from this time, and the situation worsened with increasing financial problems in the country, and frequent changes in the location of the Forestry and Beekeeping Division Headquarters in Dar es Salaam. This, however, was not the same in Kenya where the Division remained centralised, but the centralised functions declined nonetheless, due to a general lack of finance.

In 1988, Tanzania prepared a Tropical Forest Action Plan (TFAP) (Bensted-Smith and Msangi, 1989), which built on the existing Forestry Policy and was adopted by the Government of Tanzania in 1992. Its aim was to coordinate aid donor inputs to the forestry sector, but was also an acknowledgement that the major funding for forestry was being provided by foreign multilateral and bilateral aid donors of 'northern' countries (particularly Scandinavia).

The Tanzanian TFAP document generated considerable interest amongst the donor community, and the Coastal Forest options have been taken up by environmental non-governmental organisations (NGOs – including the World Wide Fund for Nature (WWF) and the Wildlife Conservation Society of Tanzania (WCST)), both using their own money and funds provided by other sources (see Chapter 5.4). The TFAP has probably assisted in channelling funds to the conservation and management of the Coastal Forests, but it is difficult to separate the effect of the TFAP from a surge of environmental awareness in donor countries during the late 1980s and early 1990s.

In the last few years there has been a considerable retrenchment of forestry staff, and a shift from the government/donors as paymaster to the current situation where the Forestry Department is permitted to keep 70% of the revenue it generates through licences, camping fees etc. It is likely that this trend towards self-accounting and self-financing will continue and it remains to be seen what effect this will have on the management of the Tanzanian forests, although in 1996 the Department only collected about 30% of the funds that it needed to finance its programmes. At the same time

donor support declined from \$22.5 million in 1990–91 to \$12.4 million in 1996, and the government's development contribution has fallen from TSh 98 million in 1992/93, to zero in 1995/96.

History of forest protection in Tanzania

Records of the Forestry Department in Tanzania (Forest Department, 1921–1970 and 1978), unpublished reports (Lovett and Pócs, 1993; Eriksen *et al.*, 1993; Clarke, 1995; Clarke and Dickinson, 1995; Clarke and Stubblefield, 1995), and the published documents referenced above have provided the data for this section.

Gazettement of Coastal Forests as Forest Reserves

Tanzanian Forestry Department records state that the majority of Coastal Forest reserves were gazetted during the British period. In fact, we believe that most reserves were originally designated by the Germans and then re-declared by the British (Table 5.2.1). Only a few Forest Reserves have been declared since independence, although renewed programmes of gazettement have been initiated in recent years through partnerships between Forestry Department and foreign aid donors, in some cases regazetting reserves which had been degazetted in the 1970s and 1980s, or where the gazettement process had never been completed.

Table 5.2.1 Gazettement of Forest Reserves containing Coastal Forest in Tanzania, 1891–1995, and in progress.

Period (mainly 10-year blocks)	Numbers of reserves per period	Mean number of reserves per year	Total reserved area (km ²)
1891–1920 (German) (30yrs)	26	0.86	895.74
1921–1930 (British)	1	0.1	910.14
1931–1940 (British)	1	0.1	959.14
1941–1950 (British)	1	0.1	1003.14
1951–1960 (British)	16	1.5	2647.64
1961–1970 (Independent)	3	0.3	2694.64
1971–1980 (Independent)	0	0	2694.64
1981–1990 (Independent)	1	0.1	2706.94
1991–1995 (Independent)	2	0.4	2764.94
In progress (Independent)	7	0	
Total	51, plus 7 in progress		2764.94

Source: From data in Forest Department 1921–1970, 1978; and G.P. Clarke's analysis of Forest Department records since that time.

Activities of forestry officers through time

The official duties of forestry officers in Tanzania have never significantly changed. These duties include survey and reserve gazettement, production of management plans/working plans, silviculture (controlled burning, natural regeneration, state plantation), and protection (annual boundary marking, protection from encroachment, apprehension of offenders, dealing with problems with animal and fungal pests).

What has changed is the level of finance available to the Forest Department to undertake these tasks. A decline in available funds started in the late 1960s, became serious in 1973 (coinciding with the first oil price shock), and continued to worsen throughout the 1980s and 1990s. This decline in finance is reflected in a reduction in activities and a major fall in written reporting by the Forest Department. Reduced reporting has resulted in increasingly scarce and unreliable statistics on all aspects of Forestry. Current retrenchment also means that there are few staff left in most offices.

A review of records in the Regional and District Forestry offices in Kilwa, Lindi and Tanga Regions show a marked decline in forestry activity after 1968. In some reserves, there have been no management activities for 30 years and the more remote reserves have been visited only rarely. Despite this great decline in forestry activity, Forest Reserve boundaries have generally remained well-respected by local people, sometimes due to the presence of a Forest Guard, but also because the positions of reserve boundaries were known and the local people respect government authority. Our experience, however, suggests that this respect started to break down in the late 1980s, and that this trend is continuing today (e.g. Chapter 5.4).

Wherever there is an externally financed project (see Chapter 5.4), capacity has been increased and in these areas forestry activities and staff morale have been greatly boosted. Also, the re-clearance and marking of the boundaries of a Forest Reserve demonstrate that the Forestry Department still has authority, and this benefit lasts for many years as the boundary remains clear and encroachment can be easily recognised.

Forest exploitation in Tanzania

Timber

There are several timber species in the Coastal Forests, which have long been valued by both indigenous peoples and Arab and European powers (Grant, 1934; Bryce, 1967) as they have the desirable traits of straightness, size, wood density and 'workability' (Table 5.2.2).

Table 5.2.2 Timber species in the Coastal Forests of eastern Africa.

Species	Distribution and habitat
1. Premium timbers suitable for high grade furniture and veneer	
<i>Milicia excelsa</i>	Widespread, f and w
<i>Khaya anthotheca</i>	Widespread, f
<i>Azelia quanzensis</i>	s-m z-i za, f and w
<i>Brachylaena huillensis</i>	z-i za, f and w
<i>Warburgia stuhlmanii</i>	z-i, f and w
2. Lesser timbers for construction, plywood, flooring, crates, railway sleepers, etc.	
<i>Antiaris toxicaria</i>	Widespread, f
<i>Baphia kirkii</i>	z-i, f
<i>Bombax rhodognaphalon</i>	z-i f and w
<i>Combretum schumannii</i>	z-i & za, f and w
<i>Cordia goetzei</i>	z-i, f
<i>Cordyla africana</i>	z-i za, f
<i>Diospyros mespiliformis</i>	Widespread, f
<i>Manilkara sansibarensis</i>	z-i, f and w
<i>Mimusops fruticosa</i>	z-i mad, f
<i>Newtonia paucijuga</i>	z-i, f
<i>Trichilia emetica</i>	Widespread, f and w
3. Specialist wood for carving	
<i>Dalbergia melanoxylon</i>	Widespread, w
<i>Brachylaena huillensis</i>	s-m z-i, f
<i>Combretum schumannii</i>	z-i za, f and w

Key:

Distribution: z-i = Zanzibar- Inhambane regional mosaic; za = Zambezian regional centre of endemism; mad = Madagascar; s-m = Somalia - Masai regional centre of endemism (after White, 1983).
Habitat: f - forest habitat (includes evergreen thicket); w - woodland habitat.

The relative accessibility of the Coastal Forests meant that they were one of the earliest sources of timber from East Africa. Since the development of Forest Reserves, their most valuable specialist timbers have been the heaviest exploited, and many forests have been exhausted of *Milicia*, *Khaya* and *Brachylaena*. Species of *Hymenaea*, *Baphia*, *Azelia* and *Manilkara* are still common canopy constituents of several Coastal Forests, and *Brachylaena* forms almost pure stands on drier sites

which are still inaccessible to logging. These species have been more recently exploited, or are starting to be used now as other species become unavailable.

Timber volumes

Data on annual exports of timber are available from the late 19th century through to 1970, as well as for 1977–1978 and 1986–1989. Within the Coastal Forests, it has only been possible to locate detailed logging data for the Rondo forest in Tanzania³. However, by selecting species which are found in the Coastal Forests (e.g. Mvule *Milicia excelsa*) an impression of the logging rates in the Coastal Forests can be obtained (Figure 5.2.1a–c). This shows, in particular, how the British colonial Forest Department exploited the high value *Milicia excelsa* and *Khaya anthotheca* timbers between the First and Second World Wars, and especially in the 1950s and early 1960s.

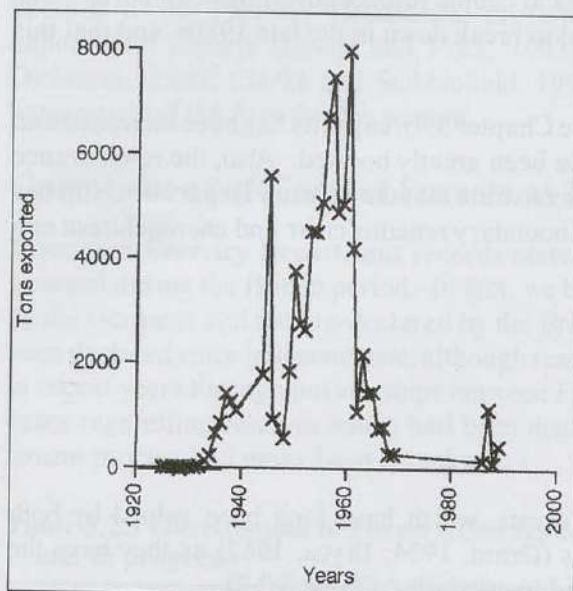


Figure 5.2.1(a) Timber exports: Mvule *Milicia excelsa* from Tanzania, 1925–1989 in tons dry wood (raw data from Forest Department, 1925–1978 and Forest Department, unpublished).

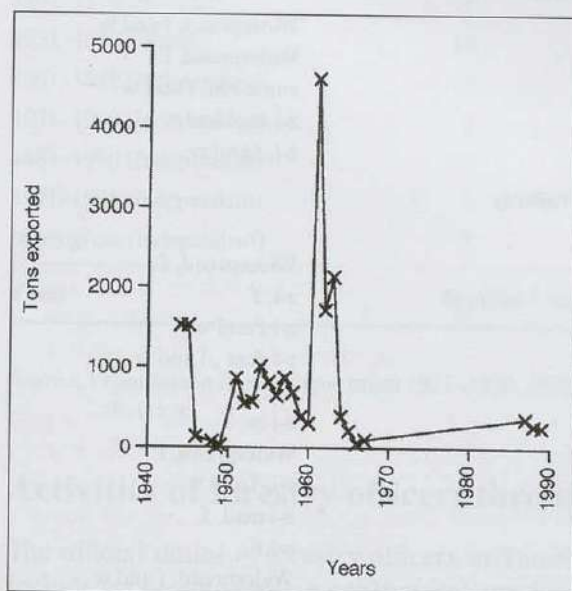


Figure 5.2.1(b) Timber exports: Mkangazi *Khaya anthotheca* 1943–1989 in tons dry wood (raw data from Forest Department, 1925–1978 and Forest Department, unpublished).

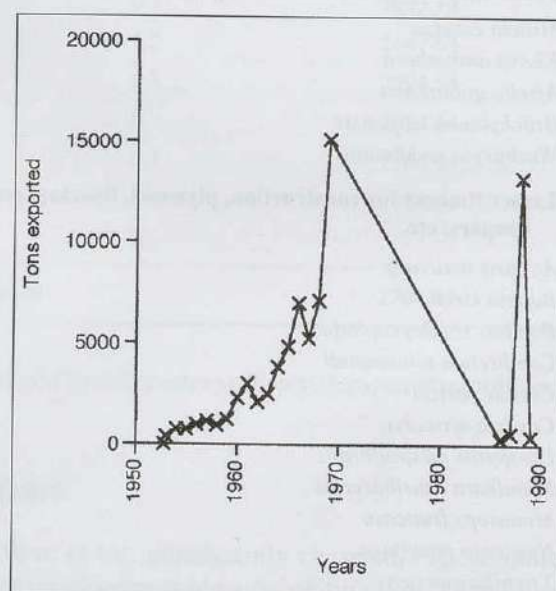


Figure 5.2.1(c) Timber exports: Mhuhu *Brachylaena huillensis* 1951–1989 in tons dry wood (raw data from Forest Department, 1925–1978 and Forest Department, unpublished).

³ Even the large scale and large budget KIFCON programme in Kenya was unable to compile these data for coastal Kenya (Wass, 1995).

The bulk of the *Milicia* exports during the late 1940s and 1950s came from the Rondo Plateau. The low volumes of both *Milicia* and *Khaya* harvested since Independence reflect the commercial scarcity of large trees, and more recently because timber trees have been extracted illegally by private operators (often using pit-sawing techniques). The majority of this timber has been used in Tanzania and is not thus recorded as an export. With the decline in availability of *Milicia* and *Khaya*, exploitation of *Brachylaena huillensis* became more important, with large volumes of this species being exported through the 1960s, 70s and 80s (although the data are sporadic in later years). Information from Kenya indicates that in recent years *Brachylaena* has become very scarce and exploitation is now focused on *Azela quanzensis*, *Brachystegia spiciformis* and *Manilkara sansibarensis* (Wass, 1995). This continues a trend over the past 50 years, where alternative timber species (of generally poorer quality) are substituted for preferred species as these become commercially extinct in the Coastal Forests (and elsewhere).

Data on the annual production of timber between 1951 and 1990, based on information recorded on exploitation licences, is also available in Tanzania (Figure 5.2.2). This data is useful for comparison with export figures (Figure 5.2.1) as the licences issued will be for both timber being exported and for timber used in the Tanzanian market, thus they may show a better picture of the exploitation of timber in the country's forests. Data presented (Figure 5.2.2) show the exploitation of different timber species over time. There is a decline in licence records from 1972, corresponding with the decentralisation of the government and a decline in reporting. There is also an apparent decline in the volume of timber harvested over time. This may be real, but it is difficult to determine because of (a) reduced centralised reporting following decentralisation, and (b) increased illegal pit-sawing as the management authority of the Forestry Department has declined.

During the colonial era, logging within Forest Reserves was carried out primarily by European- and Indian-owned companies that operated on long concessions using mechanised harvesting where possible (e.g. Steele Brothers in Rondo, Taj Mohammed in Morogoro, Sikh Sawmills in Tanga Region). At that time, pit-sawing was used strictly as a salvaging operation to remove what the concessionaires left behind. Quality hardwood timber from Tanzania was exported to markets in the UK, France, Germany, USA, with small quantities to a number of other countries and for use within

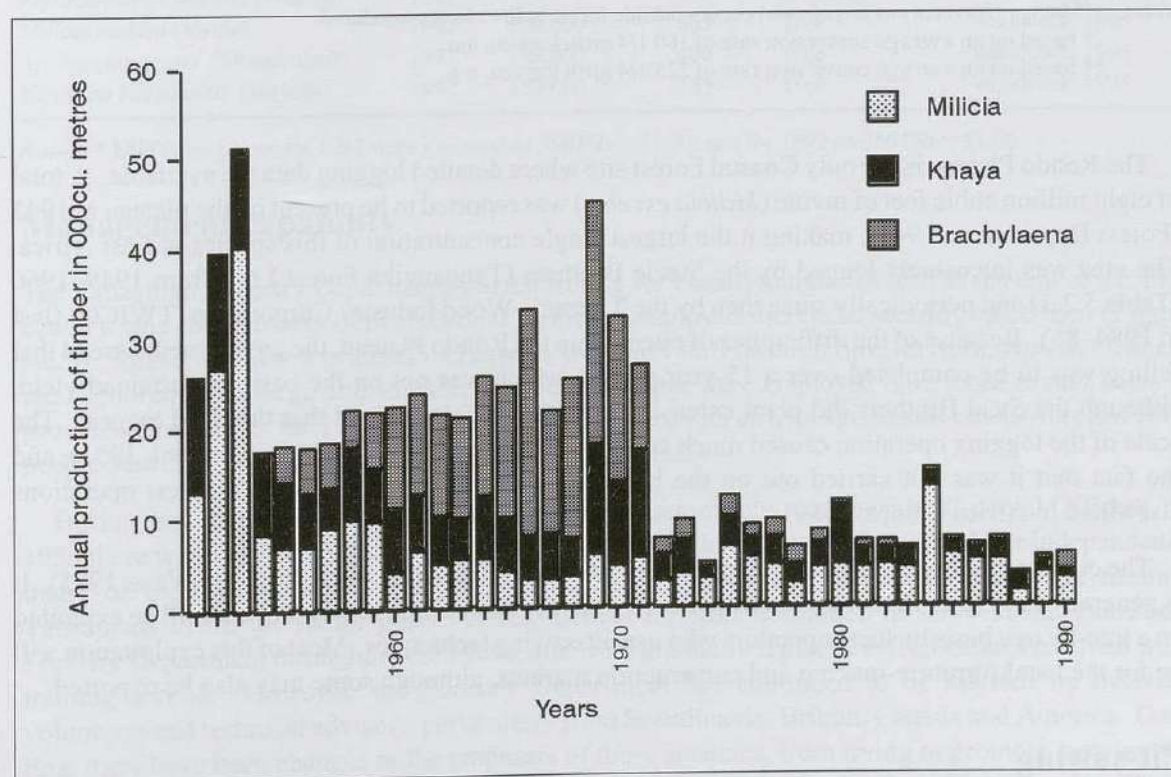


Figure 5.2.2 Annual production of timber in Tanzania 1951–1990, based on fee paying production, in 000cu. metres (from Bureau of Statistics, 1993).

Tanzania. The number of concessionaires has declined with time, and the last operating in the Coastal Forests were in Rondo (until 1984/85) and Sikh Sawmills in Kwamgumi and other lowland forests of the East Usambaras (until c. 1990). Timber exploitation from the Coastal Forests has increasingly been undertaken by small-scale operators using chain-saws or (much more commonly) pit-sawing teams, often operating illegally.

Table 5.2.3 Logging volumes and number of logs harvested from the Rondo Plateau, Tanzania, 1949–1960.

Year	Tree Species				Notes
	Mvule (<i>Milicia excelsa</i>)		Mninga (<i>Pterocarpus angolensis</i>) ^A		
	Cu. tons	No. logs ¼ girth	Cu. tons	No. logs ¼ girth	
1949–1951	3800	—	—	—	
1950	3545	—	—	—	1772 mvule trees
1951	—	—	—	—	sawn timber production started
1952	3600	—	—	—	average of 1.4 cubic tons/ tree and 4.5-6.0 cubic tons per acre
1953	4750	863,000	1000	228,000	
1954	4210	751,442	1070	237,442	
1955	4329*	779,350	817**	183,750	48,200 other logs, 7460 cu tons of all species
1956	3660*	658,750	992**	223,280	8060 cubic tons of all species
1957	5350*	963,000	1769**	398,080	9730 cubic tons of all species
1958	3910*	703,750	1697**	381,900	9990 cubic tons of all species
1959	4234*	762,064	2257**	507,936	8445 cubic tons of all species
1960	—	—	—	—	logging of mvule stopped
Total	41,388*	5,481,356	9602**	2,160,388	62,115 cubic tons (all species)

Notes: ^AMninga (*Pterocarpus angolensis*) occurs outside forest in fire climax woodland.

* based on an average conversion rate of 180 ¼ girth logs/cu. ton.

** based on an average conversion rate of 225 ¼ girth logs/cu. ton.

The Rondo Plateau is the only Coastal Forest site where detailed logging data are available. A total of eight million cubic feet of mvule (*Milicia excelsa*) was reported to be present on the plateau in 1945 (Forest Department, 1946), making it the largest single concentration of this species in East Africa. The area was intensively logged by the Steele Brothers (Tanganyika Forest Ltd.) from 1949–1960 (Table 5.2.3) and periodically since then by the Tanzania Wood Industry Corporation (TWICO) (last in 1984–85). Because of the difficulties of opening up the Rondo Plateau, the government agreed that felling was to be completed over a 15-year period, which was not on the basis of sustained yield, although the Steel Brothers did plant extensive areas of *Milicia* on land that they had logged. The scale of the logging operation caused much comment at the time (e.g. Forest Department, 1951), and the fact that it was not carried out on the basis of sustained yield is typical of forest operations elsewhere in Africa (Poore, 1989).

The current timber resource in the Coastal Forests is very small (e.g. for Kenya, see Wass, 1995). It is generally not viable for commercial operators with mechanical machinery, but can still be exploited on a tree-by tree basis by local operators who use pit-sawing techniques. Most of this exploitation will be for the local furniture-making and construction markets, although some may also be exported.

Pit-sawing

Pit-sawing is conducted by teams of 2–4 people who are able to reach most parts of a forest to exploit selected trees. Once they have cut the tree, it is lifted onto a platform (made from 3–4 smaller and

lower value trees), sawn into planks and carried out of the forest manually. Harvesting costs per plank are low, and for the best timbers represent less than 5% of the final market value. Until 1993 licences were available for pit-sawing in the Coastal Forests, but the prices were unrealistically low, and even then were often not obtained. In 1993 the Director of Forestry issued a decree to ban pit-sawing in Tanzanian Forest Reserves, to prevent the practice of further depleting stocks of timber trees. The rate of pit-sawing has certainly declined in some areas, e.g. the East Usambara lowland forests and Kilombero area, but there is no quantification of the reduction and pit-sawing continues in all areas (Cambridge-Tanzania Rain Forest Project, 1994; Woodcock, 1995; Fjelds , pers. comm.).

Typically, the main beneficiaries of pit-sawing are the businessmen who arrange the transportation (have their own lorries) as well as the final sale of the timber, often to Dar es Salaam in Tanzania, or Kenya. The highly skilled pit-sawing crews are often from outside the Coastal Forest belt (often from Iringa Region), and stay in the forest for the work period only. In this case little or no benefit accrues to the local communities, or the local forestry service. Our experience from the lowland East Usambaras is that pit-sawyers can be unpopular with the local people, although the main reasons are not clear – be they a sense of income lost, a distrust of outsiders, or perhaps the loss of hunting opportunities. However, this is not always the case as in the Pugu Hills near Dar es Salaam the pit-sawing teams are locally derived and the money they make from this activity goes directly back to the villages they come from.

Pit-sawn timber obtained from the Coastal Forests has a high value in local terms (Table 5.2.4), especially considering that the monthly salaries for forestry workers when these surveys were undertaken were \$30–50 per month.

Table 5.2.4 Example prices of timber trees and wood in 1991 and 1992.

Species	Year	Value		Units used	Data source
		TSh	USD (\$)		
<i>Milicia excelsa</i> (Mvule)	1991	–	425	m ³ timber	Clarke, unpublished
<i>Azelia quanzensis</i> (Mkomba)	1991	1,000	–	12'x1'x1" plank	Clarke, unpublished
<i>Pterocarpus angolensis</i> (Mninga)	1991	–	450	m ³ timber	Clarke, unpublished
<i>Milicia excelsa</i> (Mvule)	1992	300,000	665	Tree	Woodcock, 1995
<i>Azelia quanzensis</i> (Mbambakofi)	1992	180,000	400	Tree	Woodcock, 1995
<i>Newtonia buchananii</i> (Mnyasa)	1992	150,000	335	Tree	Woodcock, 1995

Note: * US Dollar prices for 1991 were assessed as 350TSh = \$1.00, and for 1992 as 450TSh = \$1.00.

Management capability

The Tanzanian Forestry Department started from a very small number of staff at the end of the 19th century, and the numbers of professional foresters employed increased steadily since then (Figure 5.2.3). There was also a gradual increase in 'support' staff through time (drivers, typists, cleaners etc.). Moreover, a large and variable number of people were employed on a more casual basis to provide labour. Over the 17 years from 1951–1968 there was an average casual labour-force of 1604 people/year. Prison labour was also used in several areas.

During the German and British administrations the senior jobs were held by Colonial Officers. In 1953 there were 58 British staff employed in the Tanganyikan Forestry Service. After independence many of these officers departed for Britain, and increased emphasis was placed on training Tanzanians to fill the senior posts. A few British foresters continued to serve in the Tanzanian Forestry Department throughout the 1960s, and were gradually replaced as Tanzanians returned from training abroad. However, the Forestry Department has continued to be assisted by overseas volunteers and technical advisors, particularly from Scandinavia, Britain, Canada and America. Over time there have been changes in the emphasis of these agencies, from trying to promote commercial production forestry along the models developed in their own countries (e.g. Finland – see P  ry, 1979; Moyo and Kowero, 1987), to the current emphasis on trying to ensure the involvement of local people in the management of the forests.

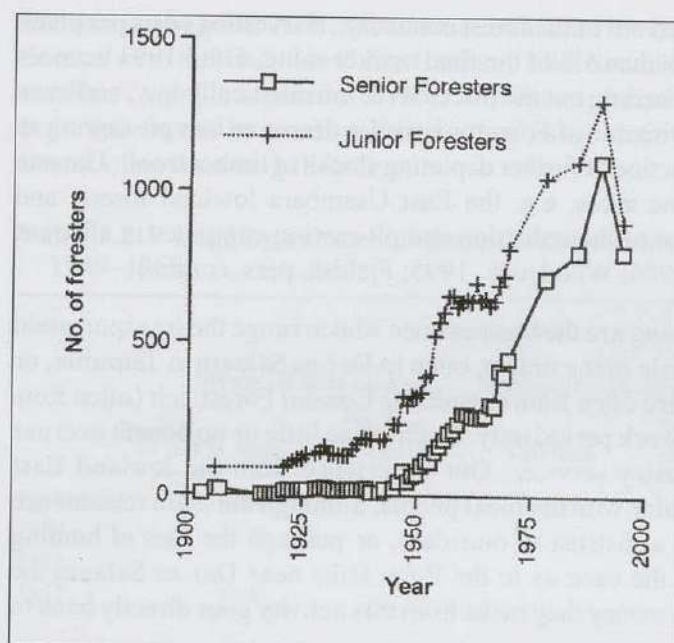


Figure 5.2.3 Numbers of senior foresters (Professional, Senior Technical and Junior Technical grades) and junior foresters (Forest Guards and Patrolmen grades) in the Tanzanian Forestry Department between 1903 and 1978 (from Colonial German records; Forest Department, 1920–1978), and estimated for 1985, 1990 and 1995.

We have not been able to locate detailed data on the numbers of forestry employees between 1978 and 1996. However, approximate numbers can be calculated from the known increase in the number of civil servants (e.g. Bureau of Statistics, 1993), assuming that forestry employee numbers increased in a similar way to other government sectors. Such an assessment indicates that the number of forestry employees probably doubled between 1978 and 1984 (to approx. 3400 staff), and probably doubled again by 1992 (to approx. 6800 staff). In 1992 the total number of government employees was around 500,000 (increased from 174,000 in 1980, 107,000 in 1976 and 105,062 in 1973). Since 1992, the number of government employees has been declining due to the conditions imposed by the World Bank/ IMF Structural Adjustment Programme. Between 1992 and 1994, 88,399 government staff were laid off and this process has continued. In the first phases of retrenchment only older

and support staff were affected, but the current phase (1996/7) is removing trained foresters, and leaving the District and Regional Offices with few people to do the necessary jobs. Assuming that Forestry has lost an average number of staff, the current total number of forestry personnel is probably in the region of 5000.

Finances

The income and expenditure of the Forestry Department between 1922 and 1978 can be compiled from Forestry Department annual reports (Figure 5.2.4; Figure 5.2.5). Due to changes in the location of the Tanzanian Forestry Department headquarters, records have become scattered and we have not been able to locate centrally compiled statistics for the late 1970s and 1980s, although information is available for the 1990s (Tables 5.2.5 and 5.2.6).

After the establishment of the British colonial forestry service in 1920, the first operational profit was made in 1928. Profitability was reversed in the 1930s as the world underwent a severe recession, leading to a fall in demand for wood products. From the end of the Second World War until 1952, the Forestry Department made considerable profits, reflecting intense (and unsustainable) forest exploitation by the British administration, partially in an attempt to repay war debts. If the official financial figures are taken at face value the Forestry Department has made a loss every year since 1953.

Table 5.2.5 1990/91–1995/96 annual recurrent budget for the Tanzanian Forestry Sector (data from Forestry Department, Dar es Salaam).

Financial year	Budget TSh x 1000	US dollar rate	US dollar total
1990/91	143,583.9	1\$ = TSh 180	797,688
1991/92	271,585.6	1\$ = TSh 230	1,180,806
1992/93	304,315.1	1\$ = TSh 350	869,471
1993/94	432,978.3	1\$ = TSh 480	902,038
1994/95	612,876.0	1\$ = TSh 520	1,180,530
1995/96	545,908.0	1\$ = TSh 550	992,560

Table 5.2.6 1991/92–1995/96 annual infrastructural development and investment budget of the Tanzanian Forestry Sector (in TSh x 1000) (data from Forestry Department, Dar es Salaam).

Year	Local TSh x 1000	Foreign TSh x 1000	Total TSh x 1000	US dollar rate	Local in US dollar total	Foreign in US dollar total
1991/92	98,340	915,100	1,013,440	\$1=TSh230	427,500	3,979,690
1992/93	161,289	2,617,935	2,779,224	\$1=TSh350	460,820	7,479,810
1993/94	91,600	1,291,022	1,382,622	\$1=TSh480	190,830	2,689,620
1994/95	45,700	2,441,554	2,487,254	\$1=TSh520	87,884	4,695,260
1995/96	51,485	2,039,871	2,091,356	\$1=TSh550	93,600	3,708,850

Note: 'Local' and 'foreign' denote the source of finance used for infrastructural development and investment.

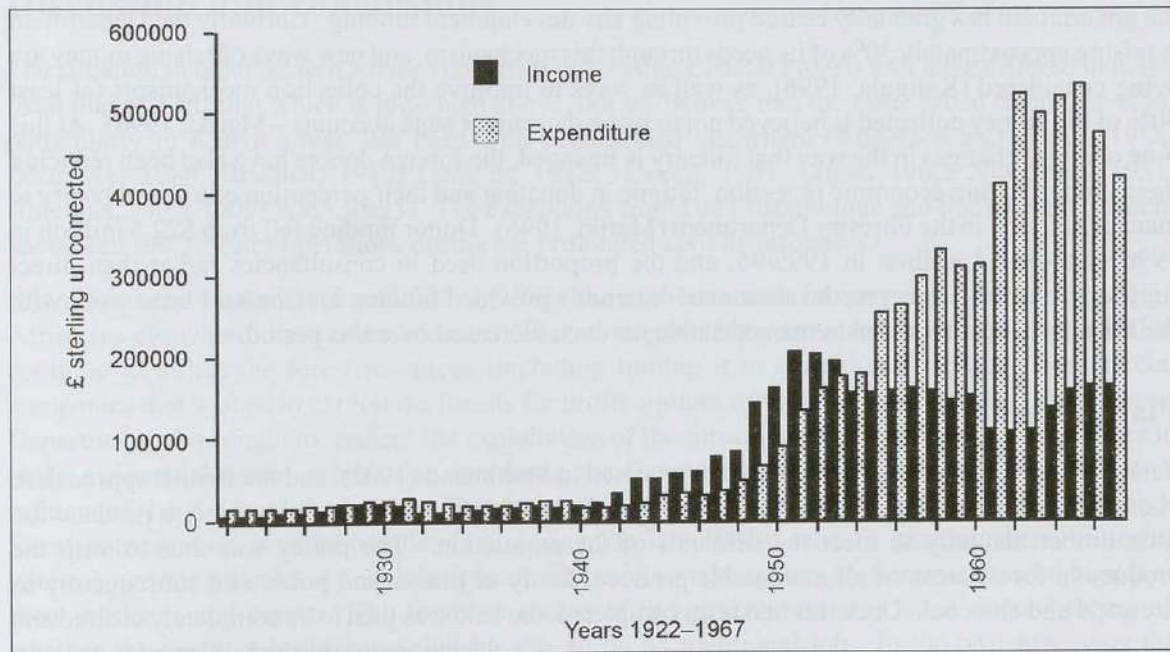


Figure 5.2.4 Income and expenditure of the Tanzanian Forest Department, 1922–1967 (as £ Sterling per year, uncorrected for inflation, devaluation etc.) (from Forest Department, 1922–1967).

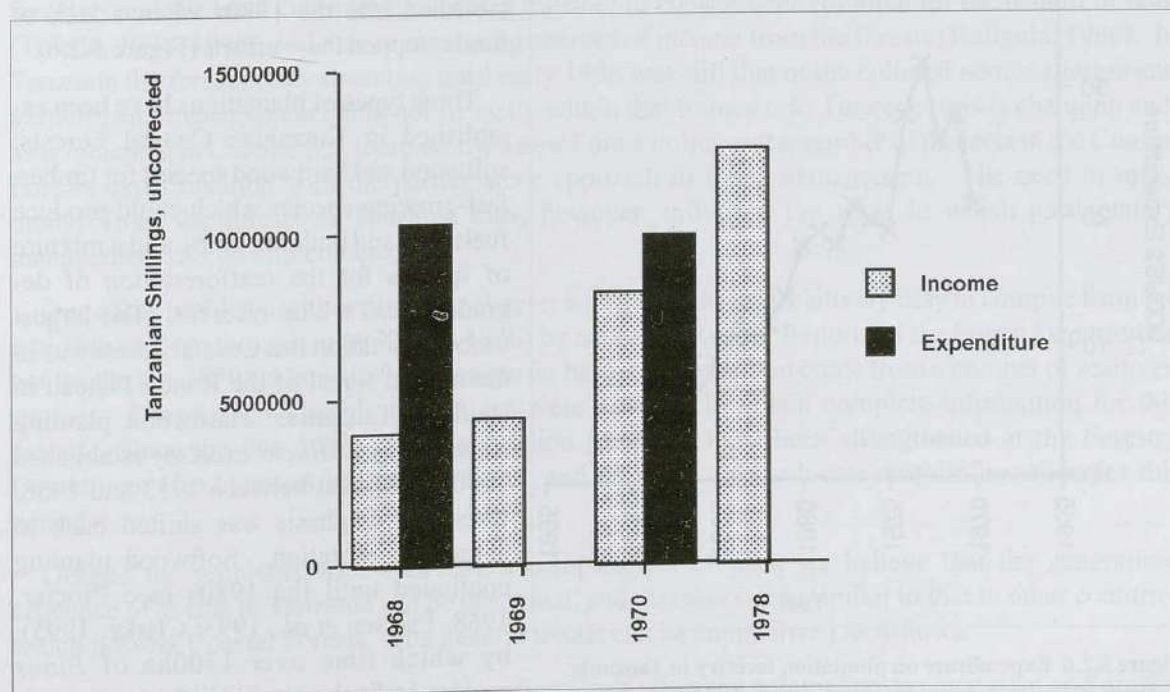


Figure 5.2.5 Income and expenditure of the Tanzanian Forest Department, 1968–1978 (in uncorrected Tanzanian Shillings) (from Forest Department, 1968–1978).

In recent years almost all of the annual recurrent budget has been used to pay staff salaries, with almost no money available for operational activities. Even the money available for salaries has been insufficient to provide a living wage. Assessments of the real value of the average monthly forester's wage showed that in 1986 this wage was worth less than 18% of its 1975 value, and that it covered about 25% of the required expenses of a typical household (World Bank, 1991). Wages have fallen further in real value terms since then, and civil servants are all obliged to have alternative means of earning money (Bagachwa *et al.*, 1994).

In the early 1990s funds from the Tanzanian government for capital investment in forestry were low, and most of this money came from foreign donors (Table 5.2.6). The quantity of externally supplied funds has, however, varied dramatically between years as projects have come and gone, and thus it is not easy to plan investment based on aid projects. Since 1994 the Forestry Department has been allowed to retain 70% of its recurrent revenue for running operational plans (Mariki, 1996), and the government has gradually ceased providing any development funding. Currently the Department is raising approximately 30% of its needs through this mechanism, and new ways of raising money are being considered (Katigula, 1996), as well as ways to improve the collection mechanisms (at least 50% of the money collected is believed not to reach the correct bank accounts – Mariki, 1996). At this time of major changes in the way that forestry is financed, the foreign donors have also been reducing their support, citing economic recession, fatigue in donating and their perception of a low capacity to manage 'affairs' in the Forestry Department (Mariki, 1996). Donor funding fell from \$22.5 million in 1990/91 to \$12.4 million in 1995/96, and the proportion used in consultancies rather than direct support increased. However, the amount of externally provided funding for Coastal Forest work with the Forestry Department has remained stable, or even increased over this period.

Plantations

Early German afforestation efforts are summarised in Stuhlmann (1902), and the British approach to plantation forestry is outlined in Honoré (1962). East African forests were assessed to produce too little timber annually to meet the demands of the population. The policy was thus to strip the productive forest areas of all marketable produce, firstly as timber and poles, and subsequently as firewood and charcoal. Once this had been completed, the land was then to be completely cleared and

plantations established. Plantation forestry in the Coastal Forests was continued after independence, with plantations being established into the 1980s when a lack of funds stopped these efforts (Figure 5.2.6).

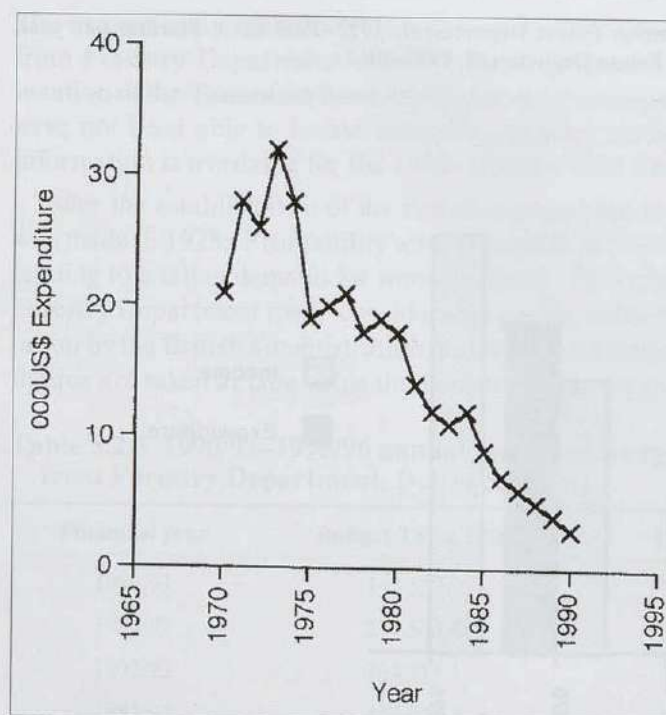


Figure 5.2.6 Expenditure on plantation forestry in Tanzania from 1970–1990 (from Bagachwa *et al.*, 1994).

Three types of plantations have been established in Tanzanian Coastal Forests; softwood and hardwood species for timber, fast-growing species which could produce fuelwood and building poles, and a mixture of species for the reafforestation of degraded areas within reserves. The largest timber plantation in a Coastal Forest was in the natural forest of the Rondo Plateau in southern Tanzania. Hardwood planting (especially of *Milicia excelsa*) established 1100ha of forest between 1953 and 1958, when the emphasis was shifted back to natural regeneration. Softwood planting continued until the 1980s (see Procter, 1968; Eriksen *et al.*, 1993; Clarke, 1995), by which time over 1700ha of *Pinus* species had been established. In the mid-1980s these efforts were abandoned as the

infrastructure of this remote area declined too much to continue the work. Other plantations of timber species have been established, for example, in the Arabuko-Sokoke forest in Kenya, the lowland East Usambaras, Pugu Hills, Ruvu North and Vikindu. Teak *Tectonia grandis*, *Eucalyptus* species, and other trees such as *Grevillea robusta* have all been used in these plantations.

Plantations of fuel-wood and pole-producing species (mainly *Senna siamea*) have also been established within areas of Coastal Forest near to major towns. For example, plantations were set up during the 1950s within Vikindu, Pugu and Kazimzumbwi Forest Reserves near Dar es Salaam, and Bassi, Kolekole and Steinbruch Forest Reserves near Tanga. Harvesting was originally undertaken by contractors to supply the urban market with cooking fuel, but the deteriorating economic situation led to the collapse of this system.

Discussion and conclusions

The situation in other eastern African countries possessing Coastal Forests will have differed in detail from that of Tanzania which is presented above, but we believe that the same broad trends are seen, particularly in Kenya which has been well-documented elsewhere (Anderson and Grove, 1988; Ofcansky, 1984; Brasnett, 1942; Gardner, 1942; Honoré, 1962; Logie, 1962; Nicholson, 1931; Hutchins, 1907; 1909; Wass, 1995). The exceptions would be Mozambique and Somalia where there have been few forestry operations during the prolonged civil disturbances.

As discussed in Anderson and Grove (1988) the problems with forestry management in eastern Africa (as elsewhere) have often been a conflict of interests between a) local people who wished to continue to utilise the forest resources (including turning it to agricultural land), b) commercial companies that wished to exploit the forests for profit without external interference, and c) the Forest Department who sought to 'police' the exploitation of the forest for the 'public good' and in order to make a financial return, whilst also sustaining the forest resource. Political considerations have influenced the ability of the Forestry Department to manage the resource. In general, periods when forest conservation is more popular (e.g. during the late 1980s) tend to increase their influence, whereas periods when local people's rights or financial considerations are paramount, tend to reduce their influence and power. The financial means of the government also has a major bearing on whether the Forestry Department will be able to do its traditional job. In the past few years the Forestry Departments of eastern Africa have been debating the role and approaches to management and there is considerable interest in more 'participatory' methods of forest management, with foresters and the local community working together to conserve the resource for the benefit of both (Toledo, 1994–1996), and also in increasing sources of income from the forests (Katigula, 1996). In Tanzania the forest policy operating until early 1998 was still that of the colonial administration and participatory management could not fit easily within that framework. However this is changing and, as is indicated in Chapter 5.5, there is now a new Forest Policy and a number of projects in the Coastal Forests experimenting with the participatory approach to forest management. The need to make money from the forests in Tanzania may, however, influence the ways in which participatory management can be implemented.

One of the problems with writing this chapter was that data were relatively easy to compile from the late 19th century through to 1970 (and 1978) by using the Annual Reports of the Forest Department, but for the late 1970s to late 1980s data were far harder to obtain and come from a number of scattered sources. Despite considerable efforts, we were not able to obtain complete information for this period. Since the late 1980s data compilation functions have been strengthened at the Forestry Department Headquarters in Dar es Salaam, and we were able to locate more information for this period.

Despite the problems with obtaining a complete set of data, we believe that the generalised sequence of events in Tanzania can be discerned, and that this seems similar to that in other countries which possess Coastal Forests. The general trends can be summarised as follows:

- An establishment and initial exploitation phase when the colonial governments set up Forestry Departments to locate areas of forests, map them, gazette them as Forest Reserves, enumerate