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IMPORTANCE OF THE EASTERN ARC MOUNTAINS FOR VASCULAR PLANTS

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ABSTRACT

The term 'Eastern Arc' was introduced in 1985 to describe an exceptionally rich area of restricted range plant species on the crystalline mountains of eastern Tanzania and south-east Kenya. About a third of the Eastern Arc flora is composed of restricted-range species. Qualitative and quantitative data are used to demonstrate that the endemics are spread throughout the elevation and moisture gradients of the Eastern Arc. Because of the high number of endemic plant species, all of the Eastern Arc forests are of importance to conservation. However, ridge-tops, heaths, limestone forests and dry forest types are vegetation formations occupying a small area and so are conservation priorities.

INTRODUCTION

The words 'Eastern Arc' first appeared in print in 1985, together with a map of the mountains (Lovett, 1985). The term Eastern Arc was also used at the 1985 Association for the Taxonomic Study of the Flora of Tropical Africa (AETFAT) congress in St Louis (Lovett, 1988). The term was coined to describe an area of high endemism on the crystalline mountains of tropical eastern Africa in a presentation that discussed the distribution of montane forest plants in Tanzania and suggested that as much as a third of the eastern Tanzanian forest flora was endemic mainly in the Flora of Tropical East Africa floristic regions K7, T3, T6 and T7 (see Lovett, 1988). These flora areas include the Taita Hills, Pare, Usambara, Nguru, Uluguru, Usagara, Ukaguru, Udzungwa and Mahenge Mountains, many of which are well known for their remarkable flora (Polhill, 1968). The term was later clarified at the 1988 AETFAT Hamburg congress (Lovett, 1990; figure 1), defining the Eastern Arc as the ancient crystalline mountains of eastern Tanzania and south-east Kenya under the direct climatic influence of the Indian Ocean.

The southern limit of the Eastern Arc are the forests on the Mufindi escarpment. Further south, beyond the Makambako Gap where the TAZARA railway crosses the Southern Highlands, the forests are under the climatic influence of Lake Nyasa. The northern limits are the forests on the Taita and Shimba Hills.

There are two important considerations in the Eastern Arc definition that link botany with management. Firstly, it was the extraordinary patterns of botanical endemism that drew attention to the Eastern Arc as a biogeographical area and resulted in the Eastern Arc being included in the Tanzania Forestry Action Plan as the key ecosystem conservation project (Bensted-Smith & Msangi, 1989). Secondly, the patterns of endemism correlate with geological and climatological parameters. The implication is that the long history of geological and climatic stability is responsible for the high degree of endemism, a hypothesis elaborated at the 1994 AETFAT Wageningen congress (Lovett & Friis, 1996). Having evolved through millions of years of environmental stability the Eastern Arc plants are not adapted to large-scale disturbance. This makes endemic-rich Eastern Arc vegetation types fragile in the sense that management interventions that involve perturbations beyond the scale to which the Eastern Arc endemics are adapted to withstand, result in a loss of the restricted-range plants and a lowering of diversity.

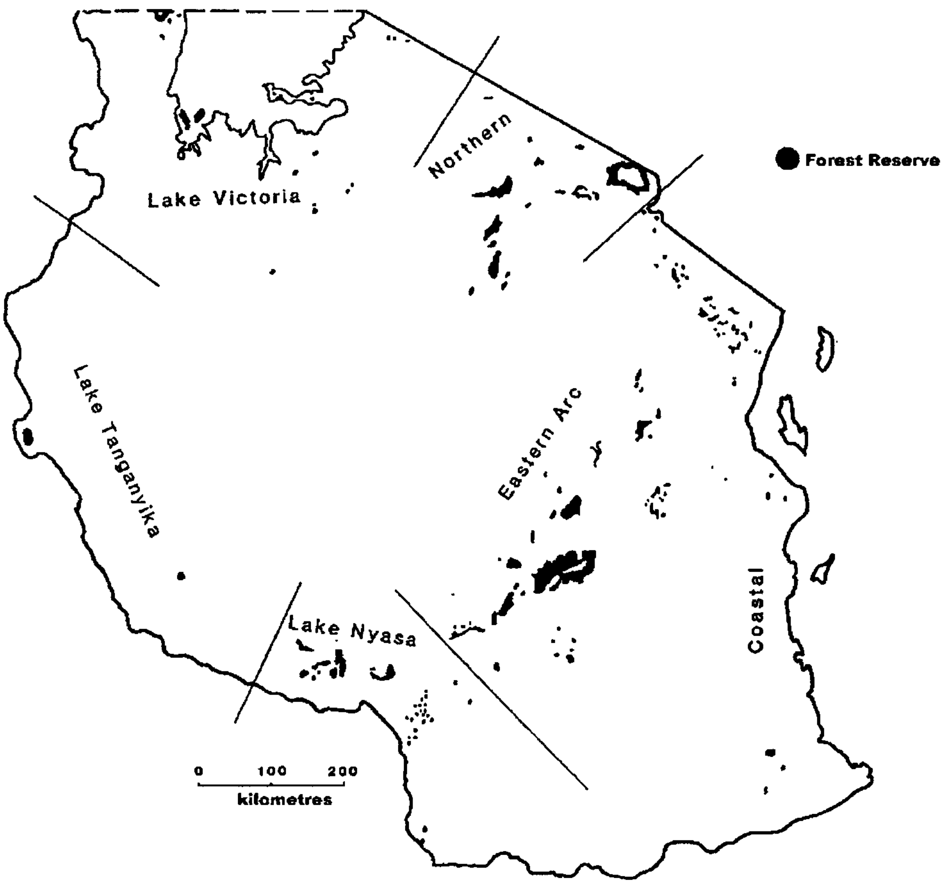


Figure 1. Division of Tanzanian forests on the basis of geology and climate (from Lovett, 1990). Forest distribution is based on forest reserves containing closed forest formations. Coastal, Eastern Arc and Northern forests are under the direct climatic influence of the Indian Ocean, but Coastal forests are predominantly on sedimentary rocks, the Eastern Arc are on igneous and metamorphic rocks, and Northern forests are predominantly on volcanic areas (with the exception of the Mbulu highlands). Forests associated with the great lakes of Victoria, Tanganyika and Nyasa are subject to environmental fluctuations associated with variation in the local climates associated with these lakes.

Using qualitative and quantitative data on large trees, this paper will demonstrate that Eastern Arc endemic plants occur throughout the elevational, latitudinal and moisture range of the forests. The results are discussed in the context of management for conservation. It is concluded that the entire Eastern Arc is important for restricted range plants, though areas that have been subject to disturbance have lost their endemic flora. Attention is drawn to some vegetation formations that occupy particularly small areas, and which are vulnerable to change.

METHODS

Forests throughout the Eastern Arc were visited during the period 1979–1994, described botanically and ecological observations made (Høst *et al.*, 1995; Lovett, 1989, 1991a, 1991b, 1991c, 1991d, 1991e, 1991f, 1993c, 1993b, 1994a, 1994b, 1994c; Lovett *et al.*, 1988, Lovett *et al.*, 1997; Lovett & Congdon, 1989a, 1989b, 1989c, 1989d, 1989e, 1990a, 1990b, 1993; Lovett & Gereau, 1990; Lovett & Minja, 1990, 1992; Lovett & Moyer, 1992; Lovett & Norton, 1989; Lovett & Pócs, 1993; Lovett & Stuart, in press; Lovett & Thomas, 1986, 1988; Moyer, 1992; Moyer & Lovett, in press; Moyer *et al.*, 1990). Taxonomic and distributional data were obtained from the Flora of Tropical East Africa (Polhill *et al.*, 1952), supplemented by later taxonomic revisions. Additional information was obtained from published vegetation descriptions of Eastern Arc forests (Beentje, 1988; Iversen, 1991; Pócs, 1976; Pócs *et al.*, 1990; Rodgers *et al.*, 1983).

A list of all tree taxa (those as described as a tree by collectors) endemic or near-endemic to the Eastern Arc was compiled and divided by distribution, height, taxonomic rank and elevational distribution. Larger endemic trees (> 20 cm diameter at breast height) were divided into their distribution within the Eastern Arc and by forest type.

Quantitative data on large trees using the twenty-tree variable area plot method was obtained from the Usambara, Nguru, Malundwe and Udzungwa Mountains (Hall, 1991; Hamilton, 1989; Lovett, 1993a, 1996, 1998; Lovett *et al.*, 1997; Lovett & Norton, 1989; Lovett & Stuart, in press). In the twenty-tree variable plot method the twenty trees ≥ 20 cm diameter at breast height nearest to an objectively chosen point are measured for girth and identified.

RESULTS

A total of 223 endemic or near-endemic tree taxa were identified (Lovett *et al.*, in press). Of these, a remarkably high proportion (58 %) are currently only known from a few sites in Tanzania. A much smaller proportion also occur in the Coastal Forests (14 %), the Northern Forests (4 %) or Lake Nyasa Forests (4.5 %). Most of the trees are relatively small with 50 % being less than 10 m tall, but 22 % are higher than 20 m. The majority of the trees are endemic or near-endemic at the species level (69 %) with 7 % at the generic level. The endemics occur throughout the elevational range of the forests, from the lower slopes where they abut the coastal plain at around 200–400 m, to the tree line at 2,000–2,400 m (Lovett *et al.*, in press).

Of the 223 endemic or near-endemic trees there are 66 trees of more than 20 cm dbh which are found only in the Eastern Arc (table 1; appendix). Of these, 29 only occur in one of the three areas of the Eastern Arc (northern, central and southern), 14 occur in two areas and 23 in all three areas. The northern area is the richest in endemic large trees with 80 % of the total. Submontane forest is the richest forest type for endemic large trees (56 % of the total), followed by montane forest (33 %) and lowland forest (29 %). Dry lowland, dry montane and upper montane forests contain relative few endemic large trees.

Table 1. Numbers of large moist forest trees endemic to the Eastern Arc (with some lowland taxa also occurring in coastal forest) in different parts of the Eastern Arc and different forest types. A total of 66 trees are included (listed in appendix). 29 trees occur in one area, 14 in two areas and 23 in all three areas. A large tree is defined as being >20 cm diameter at breast height. No=northern Eastern Arc (Usambara, Taita, Pare); Ce=central Eastern Arc (Nguru, Uluguru, Ukaguru, Rubeho); So=southern Eastern Arc (Udzungwa, Mahenge); DL=dry lowland forest; LF=lowland forest; SM=submontane forest; MF=montane forest; DM=dry montane forest; UM=upper montane forest. Forest types follow Lovett (1993b).

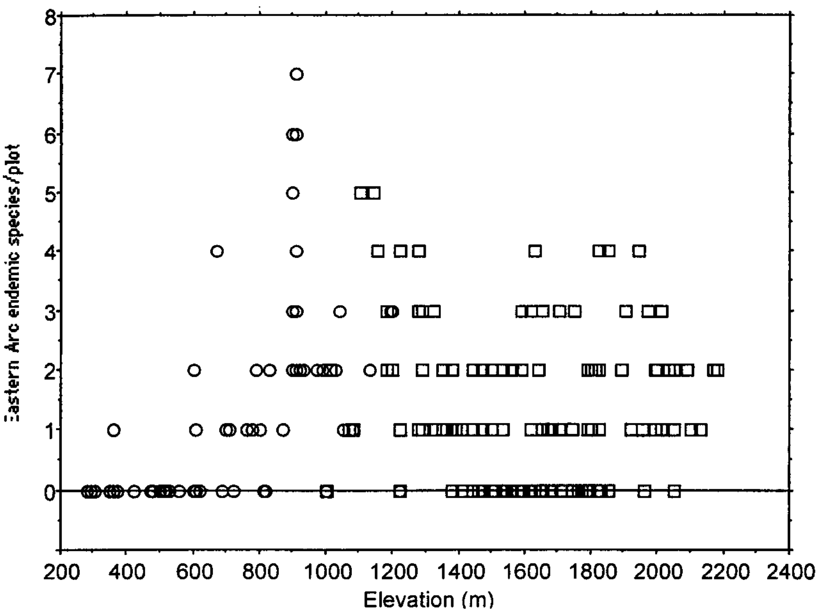
	Forest Type						
Area	DL	LF	SM	MF	DM	UM	Totals
No	5	17	29	17	3	3	53
Ce	4	14	22	14	0	4	37
So	4	14	23	14	0	1	36
Totals	5	19	37	22	3	5	66

The large tree plots demonstrate that moist forest communities change continuously with elevation (Lovett, 1996, 1998), but the driest montane forest type, at Shume in the West Usambara, is markedly different in structure and floristics from the moist forest (Lovett, 1996; Lovett & Stuart, in press). Moist forest tree plot diversity remains high throughout the latitudinal and elevational range of the Eastern Arc (Lovett, 1996; Lovett *et al.*, 1997), but is lower in the driest montane forest type at Shume (Lovett, 1996). In the plots assessed in the Usambara Mountains the numbers of endemic species and endemic trees is high throughout the elevation range (figure 2), but the numbers of endemic species is highest in submontane forest, whereas some plots in montane forest contain the highest numbers of endemic trees.

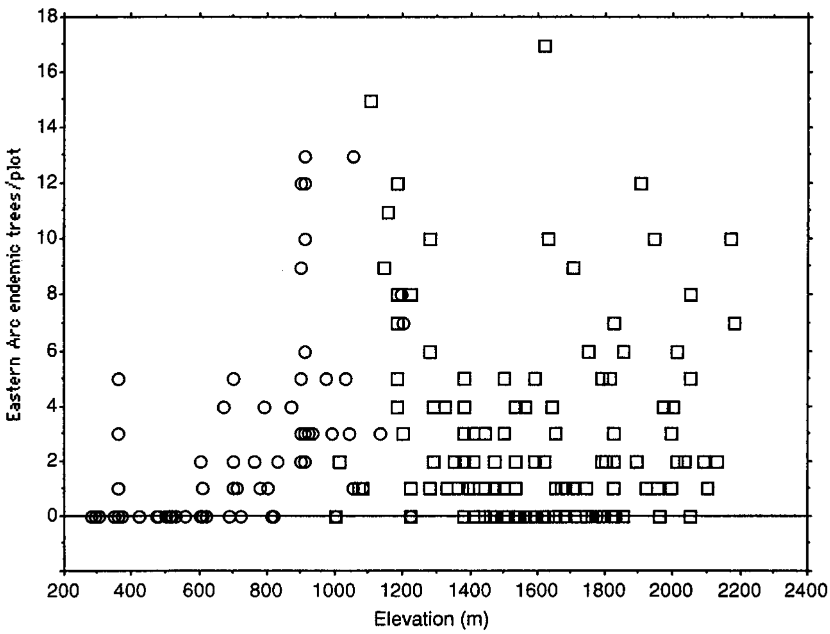
Disturbance has a major impact on forest composition. Two large tree plots at Ambangulu in the West Usambara mountains from an elevation of 1,200–1,300 m show floristic similarities to plots from elevations above 1,700 m (figure 3). The similarities are caused by a tree typical of montane and upper montane forest, *Ocotea usambarensis*, growing at mid-elevations on a site that may have been disturbed in the past (Lovett, 1996). In the southern Udzungwa mountains, endemic-rich diverse forest occurs adjacent to low diversity forest composed of widespread species at both low and high elevations (Lovett, 1994b; Lovett *et al.*, 1997; Lovett & Congdon, 1989c, d). Similarly, low diversity forest composed of widespread trees is found in the Rubeho Mountains over old cultivation (Lovett & Minja, 1990) in contrast to the nearby Mangalisa Mountain forests, which contain Eastern Arc endemics (Lovett & Congdon, 1989a).

DISCUSSION

Eastern Arc endemic trees occur throughout the elevational and moisture range in which the Eastern Arc forests occur and can comprise a substantial proportion of the individual trees in the forests (figure 2). Not all the forest types occupy a similar area or contain similar numbers of endemic species. Each forest type is discussed in turn below.



A



B

Figure 2. Elevational distribution of Eastern Arc endemic trees in the Usambara Mountains. Each point represents a plot containing 20 trees of more than 20 cm diameter at breast height. A. Numbers of Eastern Arc endemic species in each plot. B. Numbers of Eastern Arc endemic trees in each plot. Total number of plots=231. Squares are plots from the West Usambara Mountains. Circles are plots from the East Usambara Mountains. (Data from Lovett, 1996; Hamilton et al. *1989; Hall, 1991).*

The driest forest type is represented by the distinct Shume-*Juniperus* forest of the West Usambara Mountains, which formerly was quite extensive but is now only a few hectares in extent following the excision of an area of Government Forest Reserve for cultivation (Lovett & Stuart, in press). The forest contains the narrow-range endemic tree *Calodendrum eickii*, and may contain the monotypic endemic genus *Platypterocarpus*, though this may now be extinct following loss of the transition forest between dry and moist forest types. Dry montane forests elsewhere in the Eastern Arc, such as the *Hagenia* forests of the Udzungwa Mountains, are not rich in restricted-range trees (table 1). It may be that they have been subject to either natural or anthropic disturbance in the past, or else the climatic conditions that support the Shume-*Juniperus* forest are not present on the other mountains.

High-elevation cloud forests naturally occupy a small area, being found on wetter ridge-tops where cloud is frequent. These forests are distinct physiognomically, with a relatively low canopy and large quantities of epiphytes, herbs, mosses and ferns. Considering their small area, these forests are remarkably rich in restricted-range trees. For example, 16 % of the 223 Eastern Arc restricted-range trees are found in the elevational band 2,000–2,400 m. The most endemic-rich upper montane forests are found in the northern and central Eastern Arc on the Taita, West Usambara, Southern Nguru, Ukaguru and Uluguru Mountains. There are two possible reasons for the comparative poverty of the southern Eastern Arc upper montane forests. Firstly, the high elevation forests of the Uhehe Plateau and outlying mountains are composed of relatively widespread species (Lovett & Congdon, 1989c, 1990a; Lovett & Gereau, 1990; Moyer, 1992), being floristically rather similar to montane forests in Malawi (Dowsett-Lemaire, 1989). This may be due to a similar climate and environmental history, or they may have been subject to anthropic disturbance in the past. Secondly, the upper montane forests of the Luhomero Massif in the north-eastern part of the Udzungwa Mountains are not well known and may be found to be rich in restricted-range plant taxa. Endemic-rich moist upper montane forest is fairly fragile. Patches cleared on the northern Uluguru and southern Nguru mountain ridges for direction finding markers have not regenerated well, and historical anthropic disturbance appears to result in species-rich forest being replaced by bamboo or other low diversity vegetation types. The climate above 2,000 m is harsh. Frost is frequent during July and August, and ultra-violet insulation is high during cloud free periods (Flenley, 1992). It may be that once the micro-climate developed by species rich forest over millennia is lost, then regeneration is slow.

Although it is not a forest formation, heath is another Eastern Arc high-elevation vegetation type containing endemic plant species. For example, the straggling monotypic orchid *Neobenthamia gracilis* and the monotypic herb *Urogentias ulugurica* grow with *Xerophyta spekei* on exposed rock faces on Kanga Mountain and the Uluguru. The large-flowered endemic herb *Streptocarpus hirsutissimus* also grows on exposed rocks on the same mountains (Lovett & Thomas, 1988). These endemic-rich non-forest formations should not be confused with heaths growing on the leached, podzolised soils that result from removal of forest. The derived heaths do not contain plants of restricted distribution.

At elevations below 1,800 m, when rainfall exceeds a reliable 1,500 mm/year and in the absence of disturbance, the Eastern Arc forests can be exceptionally well developed with emergent trees regularly exceeding 60 m in height. Moist montane forest occurs throughout the Eastern Arc, though it has been lost from the slopes of the Taita Hills. The numbers of endemic large trees are similar in northern, central and southern parts of the Eastern Arc, with new species of tree, such as the monotypic *Neohemsleya usambarensis* being described relatively recently from the West Usambara Mountains (Pennington, 1991), *Zenkerella perplexa* from the Uluguru Mountains and Malundwe Hill (Temu, 1990; Lovett 1993d) and a possible new genus of Annonaceae (herbarium collection reference = Ede 65) still remaining undescribed in the Udzungwa Mountains (Lovett *et al.*, 1988; Lovett & Congdon, 1989d; Verdcourt, 1971).

Although the numbers of endemic trees in montane forests can be locally very high (figure 3B), submontane forests appear to be the richest in endemic large tree species (table 1, figure 3A). Submontane forests of the Usambara Mountains in the northern part of the Eastern Arc contain the most endemic large tree species (table 1), but some new species, such as *Omphalocarpum strombocarpum* and *Placodiscus pedicellatus*, have recently been described from the Udzungwa Mountains and further new species may be found as botanical exploration proceeds. Endemic submontane trees can occur at very low densities (Harvey & Lovett, 1999) and new species, such as *Uvariodendron oligocarpum*, have even been discovered comparatively recently in the relatively well-collected Usambara Mountains (Verdcourt, 1986). The formerly extensive submontane forests in the Usambara Mountains have been largely replaced by plantations or disturbed by logging. Those of the Uluguru Mountains have been mostly lost to cultivation. Submontane forests still occur in a band on the steep eastern slopes of the northern and southern Nguru, the Udzungwa and Mahenge Mountains.

In contrast to montane and submontane forests, which occur on the slopes or hilly plateau of the Eastern Arc on well drained soils derived from crystalline gneissic rocks, lowland forests occur on a variety of soil types. The crystalline rocks of the Mozambique belt, of which the Eastern Arc are formed, abut against mid-Jurassic sediments on their eastern side where the mountains meet the coastal plain, forming metamorphic limestones (Griffiths, 1993; Hawthorne, 1993). Forests on these limestones can be exceptionally rich in endemic species, such as the small forest patch at Kimboza east of the Uluguru Mountains and lowland forests on the Mahenge Mountains. Because they are not on the mountain slopes proper, these forests can be regarded as Coastal Forests (Burgess *et al.*, 1998), though administratively they are regarded as Catchment Forest Reserves along with the other Eastern Arc forests (Lovett & Pócs, 1993). Lowland forests closer to the Eastern Arc foothills can be seasonally inundated by groundwater, and although they can contain some very large trees, they are not known to be rich in species of restricted distribution. The lowland groundwater forests have also been extensively disturbed by logging as they are rich in commercially valuable species such as mvule (*Milicia excelsa*) and mkangazi (*Khaya anthotheca*). Lowland forests on the slopes and valleys of the Eastern Arc mountains proper are rich in species of restricted distribution, though in many places these forests have been replaced by cultivation or are heavily disturbed by timber extraction and pole cutting.

In summary, I will try to identify key areas for plant conservation in the Eastern Arc. Firstly though, I must emphasise the botanical importance of the Eastern Arc as a whole. Together with the Coastal Forests, they form a centre of botanical endemism that contains many more restricted-range plant species than any other forest areas in eastern tropical Africa. The forests are highly fragmented, both naturally due to variation in landscape and rainfall, and as a result of human disturbance. Even relatively small patches of forest can contain many narrow-range endemics, such as the small forest patch at Lulanda in the southern Udzungwa (Lovett & Congdon, 1990b). The endemic plant species occur throughout the elevational, latitudinal and moisture gradients in which the Eastern Arc forests occur, but are lost when the forests are heavily disturbed. Wetter forest types contain more endemic plant species than drier forests, but each forest type has a different species composition and the endemic plants have narrow ecological ranges, so the dry forest endemics do not occur in wet forest and *vice versa*. Non-forest formations such as heaths or

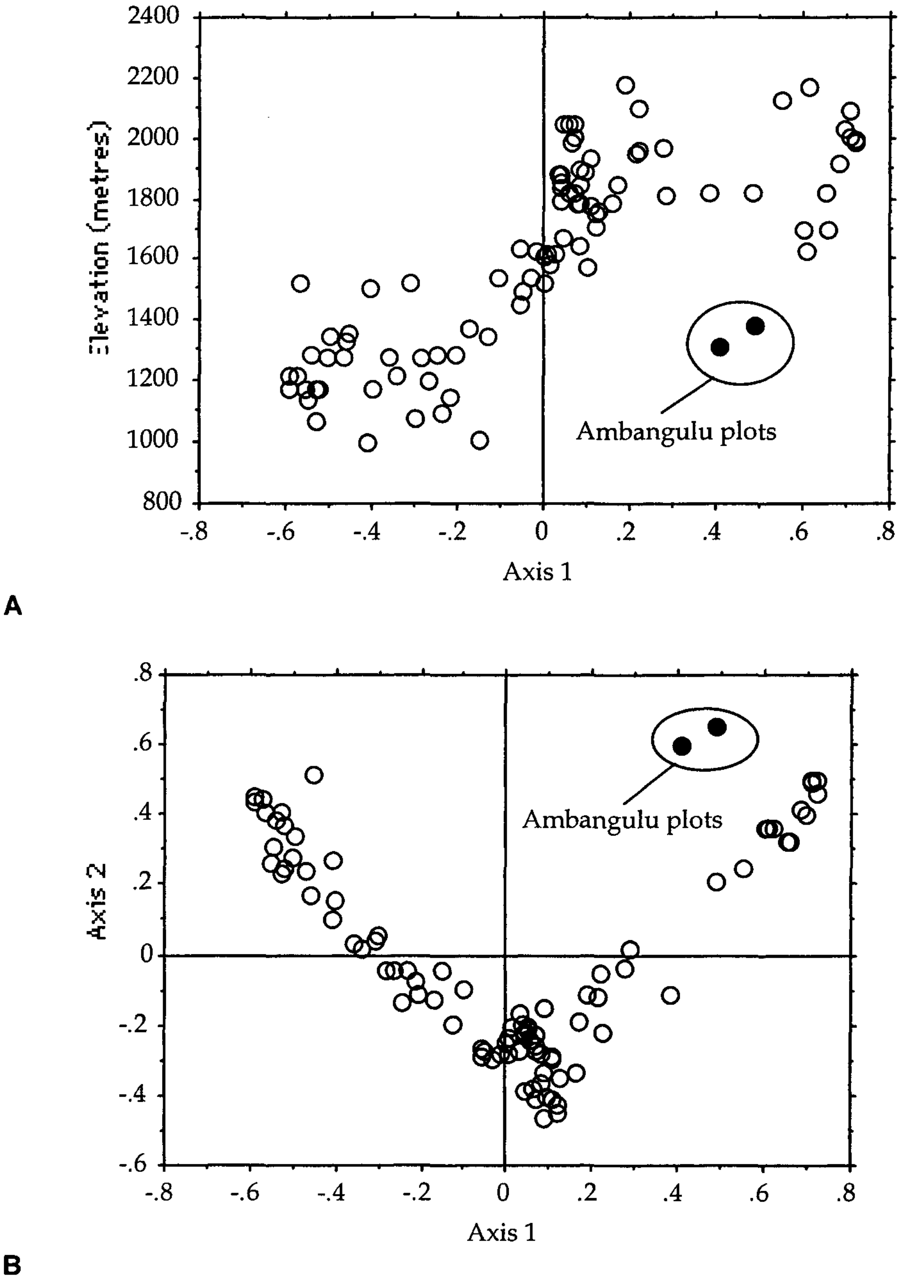


Figure 3. Ordination of large tree plots from the West Usambara Mountains showing a montane tree, Ocotea usambarensis, *descending in elevation in response to environmental change (from Lovett, 1996). Each point represents a sample of twenty trees > 20 cm diameter. The ordination is weighted by basal area contribution of each species. A. Axis one of the ordination is positively correlated with elevation. B. Two plots from Ambangulu contain some large* Ocotea *trees that are occurring below their normal elevation range, possibly following disturbance in the forest.*

lithophytic communities can also contain endemics. In deciding which are the key areas for plant conservation in the Eastern Arc the following principles can be used to prioritise sites:

1. A full elevational, latitudinal and moisture range of forests should be conserved.
2. Areas under threat, such as small forest patches, should be protected.
3. Forest types that are fragile and undergo major floristic change following disturbance should be protected.

Because heavy disturbance eliminates restricted-range plant species, if the management goal is to retain the Eastern Arc endemic plants, then the management prescription needs to minimise perturbations such as logging, pole collecting or other extractive techniques. Five localities of botanical interest in Tanzania are given as examples in table 2, and the Uluguru Mountains have been ranked as the most important catchment forest nationally (Lovett & Pócs, 1993). A full list of sites of botanical importance would be very long. There are about 150 forest reserves or forest patches in Nature Reserves and National Parks in the Eastern Arc Mountains of Tanzania (Lovett & Norton, 1989; Lovett & Pócs, 1993; Lovett & Moyer, 1992; Moyer, 1992; Iversen, 1991), with further forests on the Taita Hills (Beentje, 1988) and Shimba Hills of Kenya. Relatively few forest areas are outside forest reserves, but these can also be rich in endemic species such as forests on the Ambangulu tea estate (Lovett, 1991e). As botanical exploration proceeds, previously unknown forests can reveal great interest. For example, the Njerera Forest Reserve in the southern Udzungwa Mountains, which was overlooked in the surveys by Lovett & Pócs (1993) and Moyer (1992), has been found to contain many restricted range plant species (Lovett *et al.*, 1997) and several narrow-range endemics including two new species of saprophytic herbs in the family Triuridaceae in a presently undescribed genus (M. Cheek, pers. comm.). By far the best approach to plant conservation in the Eastern Arc is to recognise the importance of the area as a whole as defined climatologically and geologically (Lovett, 1990) and gear management to protecting the whole area rather than focusing on individual patches or mountain ranges.

Table 2. Five locations of botanical interest as examples of conservation priorities in Tanzania selected for either a) threat due to small size or b) a vegetation formation of small size and low resilience to disturbance.

Forest location	Importance	Reason for conservation
Shume-*Juniperus* Forest	Driest Eastern Arc montane forest type	Last remaining patch of formerly extensive forest
Northern Uluguru cloud forests	Wettest upper montane forest type	Occupies a small area and is not resilient to disturbance
Nguru and Uluguru *Xerophyta* heaths and lithophytic formations	Unusual vegetation type with several monotypic genera	Occupies a small area and is not resilient to disturbance
Lulanda Forest, southern Udzungwa	Montane forest rich in endemic plants	Small forest patch of formerly extensive forest
Kimboza Forest, Uluguru foothills	Lowland forest on limestone rich in endemic plants	Small forest patch under pressure for pole cutting.

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APPENDIX

Large moist forest trees endemic to the Eastern Arc (with some lowland taxa also occurring in coastal forest). A large tree is defined as being > 20 cm diameter at breast height. No=northern Eastern Arc (Usambara, Taita, Pare); Ce=central Eastern Arc (Nguru, Uluguru, Ukaguru, Rubeho); So=southern Eastern Arc (Udzungwa, Mahenge); DL=dry lowland forest; LF=lowland forest; SM=submontane forest; MF= montane forest; DM = dry montane forest; UM = upper montane forest. Forest types follow Lovett (1993b).

	No	Ce	So	DL	LF	SM	MF	DM	UM	Coastal
Anisophyllaceae										
Anisophyllea obtusifolia Engl. & Brehm.	1	1	1			1				
Annonaceae										
Annonaceae gen. nov. = Ede 65			1				1			
Anonidium usambarense R.E. Fries	1					1				
Enantia kummeriae Engl. & Diels	1	1	1		1	1				
Greenwaydendron suaveolens (Engl. & Diels) Verdc. subsp. *usambaricum* Verdc.	1					1				
Isolona heinsenii Engl. & Diels	1		1		1	1				
Lettowianthus stellatus Diels	1	1	1	1	1					Also coastal
Polyceratocarpus scheffleri Engl. & Diels	1	1	1			1	1			
Uvariodendron gorgonis Verdc.	1	1	1		1					Also coastal
Uvariodendron oligocarpum Verdc.	1					1				
Uvariodendron pycnophyllum (Diels) R.E. Fries	1					1				
Uvariodendron usambarense R.E. Fries	1	1				1				
Araliaceae										
Polyscias stuhlmannii Harms	1	1							1	
Schefflera lukwangulensis (Tennant) Bernardi	1	1							1	
Celastraceae										
Platypterocarpus tanganyikensis Dunkley & Brenan	1							1		
Chrysobalanaceae										
Hirtella megacarpa R. Grah.	1	1	1				1			
Clusiaceae										
Allanblackia stuhlmannii (Engl.) Engl.	1	1	1			1	1			
Allanblackia ulugurensis Engl.		1	1				1		1	
Garcinia semseii Verdc.		1	1		1	1				
Mammea usambarensis Verdc.	1						1			
Ebenaceae										
Diospyros kabuyeana F. White	1	1	1	1						Also coastal
Diospyros occulta F. White	1		1	1	1					Also coastal

	No	Ce	So	DL	LF	SM	MF	DM	UM	Coastal
Diospyros sp. aff. *amaniensis* Guerke		1	1			1	1			
Euphorbiaceae										
Croton dictyophlebodes A.R.-Sm.	1						1	1		
Drypetes usambarica (Pax) Hutch.	1	1	1		1	1	1			Also coastal
Macaranga conglomerata Brenan	1						1			
Sibangea pleioneura A.R.-Sm.			1			1				
Fabaceae										
Angylocalyx braunii Harms	1	1	1	1	1					Also coastal
Cynometra brachyrrachis Harms	1				1					
Cynometra engleri Harms	1				1					
Cynometra longipedicellata Harms	1					1				
Cynometra sp. A	1	1	1			1				
Cynometra sp. B	1					1				
Cynometra ulugurensis Harms		1			1					
Englerodendron usambarense Harms	1					1				
Isoberlinia scheffleri (Harms) Greenway	1	1	1		1	1	1			
Millettia elongatistyla Gillett	1	1	1		1					
Newtonia paucijuga (Harms) Brenan	1	1	1		1					
Pterocarpus mildbraedii Harms subsp. *usambarensis* (Verdc.) Polhill	1		1		1					
Scorodophloeos fischeri (Taub.) J. Léon.	1	1		1	1					Also coastal
Zenkerella capparidacea (Taub.) J. Léon.	1	1				1	1			
Zenkerella egregia J. Léon.	1	1			1					
Zenkerella perplexa Temu		1				1	1			
Flacourtiaceae										
Casearia engleri Gilg	1						1		1	
Lauraceae										
Beilschmidia kweo (Mildbr.) Robyns & Wilczek	1	1	1			1	1			
Melastomataceae										
Lijndenia brenanii (A. & R. Fernandes) Jacq. Fél.	1					1				
Lijndenia greenwayii (Brenan) Borhidi	1					1				
Memecylon sp. A			1				1			
Memecylon teitense Wickens	1						1			
Myristicaceae										
Cephalosphaera usambarensis (Warb.) Warb.	1	1	1			1				
Myrtaceae										
Syzygium sclerophyllum Brenan	1	1	1			1	1			
Ochnaceae										
Ouratea scheffleri Engl. & Gilg	1					1				

	No	Ce	So	DL	LF	SM	MF	DM	UM	Coastal
Ouratea schusteri Gilg ex Engl.	1	1	1				1			
Octoknemataceae										
Octoknema orientalis Mildbr.		1	1			1				
Pittosporaceae										
Pittosporum goetzei Engl.		1							1	
Rutaceae										
Calodendrum eickii Engl.	1							1		
Sapindaceae										
Allophylus melliodorus Radlk.	1	1	1			1	1			
Placodiscus amaniensis Radlk.	1					1				
Placodiscus pedicellatus F.G. Davies			1			1				
Sapotaceae										
Neohemsleya usambarensis Pennington	1						1			
Omphalocarpum strombocarpum Y.B. Harv. & J.C. Lovett			1			1				
Pouteria pseudoracemosa (J.H. Hemsl.) L. Gautier	1	1	1		1	1				
Simaroubaceae										
Odyendea zimmermannii Engl.	1	1	1		1	1				Also coastal
Sterculiaceae										
Cola scheffleri K. Schum.	1	1	1			1				
Tiliaceae										
Grewia goetzeana K. Schum.		1	1			1				
Verbenaceae										
Vitex amaniensis Pieper	1	1	1			1	1			
Totals	53	37	36	5	19	37	22	3	5	