

Conservation evaluation for birds of *Brachylaena* woodland and mixed dry forest in north-east Tanzania

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Summary

Three forest and woodland sites were surveyed in the lowlands of the East Usambara mountains, Tanzania, from August to October, 1996. Bombo East I and II Proposed Forest Reserves (PFR) and Bombo West FR were previously unknown biologically. Our fieldwork revealed several records of conservation interest. Four species of global conservation concern (Amani Sunbird *Anthreptes pallidigaster*, Southern Banded Snake Eagle *Circaetus fasciolatus*, Fischer's Turaco *Tauraco fischeri* and Plain-backed Sunbird *Anthreptes reichenowi*) were recorded, with a further seven species of regional concern. These sites were not as rich in bird species as other East Usambara lowland forests. Bombo East I PFR had the highest richness, which included the presence of three montane species that were most likely cold-season visitors. The Endangered Sokoke Scops Owl *Otus irenae*, otherwise known from similar woodland habitat in Kenya as well as lowland forest in the East Usambaras, was apparently absent at these sites. It is also clear from our survey that at least four threatened mammals and one possibly endemic snake inhabit the *Brachylaena* woodlands and mixed dry forest. Thus, our results indicate that the previously unexplored *Brachylaena* woodlands and mixed dry forest in north-east Tanzania are an additional habitat to some fauna of threatened status and do, therefore, merit conservation attention. The *Brachylaena* tree is highly favoured for charcoal production and the enormous demand for this product is increasing the degradation of these woodland patches. Larger tracts of unprotected *Brachylaena* woodland should receive immediate conservation attention.

Introduction

The East Usambara mountains are of great conservation significance since they comprise both Eastern Arc and lowland "Coastal" forest types (Burgess *et al.* 1998, Burgess in press). The Eastern Arc forests occur above 800 m and are moist, montane ecosystems whereas the lowland coastal forests which occur below this altitude are more seasonally influenced. Both forest types are biologically rich and together house many globally threatened and endemic animal and plant species (e.g. Lovett and Wasser 1993, Stattersfield *et al.* 1998, Burgess *et al.* 1998). With respect to birds, more attention has focused on the submontane elements (e.g. Sclater and Moreau 1932–1933, Stuart 1983, 1989) and only recently has there been greater coverage of the lowland avifauna (Evans and Anderson 1993, Evans *et al.* 1994, CTRP 1994, Evans 1997a). These latter studies added three globally threatened species not previously known from the Usambaras (Sokoke Scops

Owl *Otus ireneae*, East Coast Akalat *Sheppardia gunningi*, Swynnerton's Robin *Swynnertonia swynnertoni*), as well as several new vertebrate and invertebrate taxa.

Even though new populations of several threatened mammal, bird and herpetile species have been discovered in these lowland forests (see Burgess *et al.* 1998, Burgess *et al.* in press, Mlingwa *et al.* in press, Broadley and Howell in press), many vestigial forest patches remain unexplored and are currently unprotected (Sheil 1992, Burgess *et al.* 1993, Burgess in press). Additionally, prior to our investigations, the adjacent *Brachylaena*-dominated habitat had not received any biological or significant conservation attention despite its potential as an important refuge for endemic Eastern Arc and Coastal Forest biota. Habitat degradation continues to threaten the vestigial forest patches and, especially, the *Brachylaena* woodland, which is cleared for subsistence farming and charcoal burning by an expanding human population.

Although our focus was primarily on birds and the threats to their habitats in three unexplored and very recently mapped lowland forest and *Brachylaena*-dominated woodland patches, other biota and aspects of human utilization also received attention (N.J.C., M.G., unpubl.). Since a short summary article was written on the most important avifaunal results from this work (Cordeiro and Githiru 1998), here we will focus more on: (1) describing the assemblages of these sites and compare them with adjacent lowland forests; (2) providing annotated accounts on species of conservation concern at the global and regional levels; and (3) discussing the conservation priorities of the areas visited and the *Brachylaena* woodland habitat in north-east Tanzania. A fourth forest reserve visited during this period, Mgambo Proposed Forest Reserve (PFR), largely comprises different habitat types in comparison with the other three discussed here. Due to these habitat differences, discussion of the avifauna of Mgambo PFR would fall beyond the scope of this paper and therefore reported elsewhere (Cordeiro and Githiru in press).

Physical geography

Forest cover, which comprises a total of about 25,000 ha in the highlands and lowlands of the East Usambaras (Hamilton and Bensted-Smith 1989, CTRP 1994), has been fragmented into a network of patches due to human activities over the past few thousands of years (Schmidt 1989, Newmark 1993), especially so since the late 1800s due to the establishment of colonial estates, followed by sisal and tea plantation and shifting cultivation (M.I.L. Katigula and S. Johansson *in litt.* 1997, see also Hamilton and Bensted-Smith 1989). More details on the vegetation, climate and physical and social geography of the East Usambaras can be found elsewhere (Moreau 1935, Hamilton and Bensted-Smith 1989, AFIMP 1987, Lovett and Pócs 1993).

Sites that were surveyed are briefly described below (see Figure 1) with details of the general relief, dominant vegetation, canopy height and surrounding villages. The soil at all sites and in much of the lowlands is a red-brown sandy-clay type, classified as rhodic ferrasol (Hamilton and Bensted-Smith 1989). To determine the common plants at each site, specimens were processed and sub-

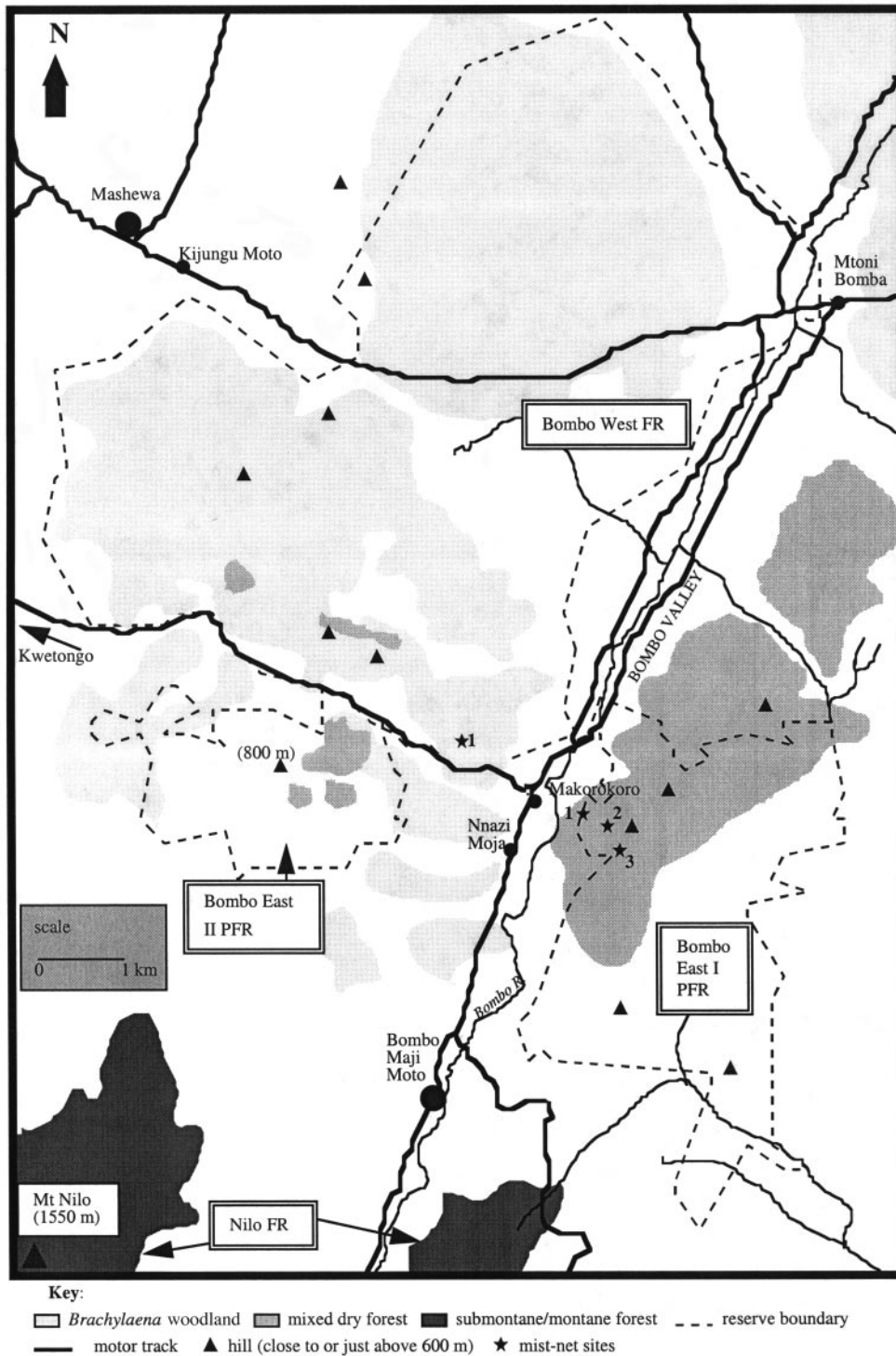


Figure 1. Map showing mist-net sites and locations of Bombo East I and II Proposed Forest Reserves, Bombo West Forest Reserve and adjacent Nilo Forest Reserve. Three different habitat types are shown; *Acacia* woodland, wooded grassland and cultivation occur in the surrounding areas. The extent of the *Brachylaena* woodland and mixed dry forest shown on this map is based on our observations and the main reference map (SMD 1991). Aerial photographs would have made this map more accurate.

sequently identified at the East African Herbarium, Nairobi. Although most plants were identified some could only be placed to genus.

Mean minimum and maximum temperatures for this study period ranged from 17.9 to 27.9 °C (data from Kilangangua Forest Station, at head of Bombo Valley). Rainfall is estimated at about 750 mm per year for this area (Lovett and Pócs 1993). Although we did not obtain data on rainfall, we made note of small light showers which fell in late September and became more frequent and lasted longer by October. It appeared that more rain fell in the Bombo East I PFR hills, than on much of the valley floor. Mist persisted for short periods on the uppermost parts of these forested hills during fairly cool mornings and evenings.

Description of Bombo East I and II Proposed Forest Reserves

Both these hill-top forests lie in the Bombo Valley; Bombo East I PFR (04°49'S, 38°42'E) which rises from about 250–600 m, is almost equally split between Muheza and Korogwe Districts, Tanga Region. Bombo East II PFR (04°49'S, 38°40'E) which has an elevational range from c. 450 to 850 m, is located in Korogwe District (Figure 1). Bombo East I PFR, the larger of two, has an area of 1,120 ha. Bombo East II PFR is on a hill called Mlima Mwarabu and comprises an area of 470 ha (Johansson and Sandy 1996). Following the mapping surveys of 1996 by the East Usambara Catchment Forest Project (hereafter EUCFP, R. Sandy verbally 1996), demarcation of the boundaries took place at the time of this study. The vegetation of Bombo East I PFR includes a mosaic of *Brachylaena* woodland, mixed *Brachylaena* and lowland forest species, and dry *Acacia* woodland bordering the main forest blocks. The semi-deciduous mixed *Brachylaena* woodland and lowland forest habitat, being unique in the East Usambaras, is here termed mixed dry forest after Clarke *et al.* (in press). This habitat, which persists on the hills of both PFRs as well as two small hills in the southern extreme of Bombo West FR, probably survives as such by drawing more moisture from the wetter and adjacent East Usambara mountains. Average canopy height varies from 10 to 25 m with emergents up to 40 m. These characteristics along with a more distinctive stratification, differentiated this habitat from the more open, shorter canopy and less diverse *Brachylaena* vegetational community.

Several tree species, with a canopy height of about 10–25 m, dominate the mixed dry forest on the hill making it diverse in terms of species composition and vegetation structure. Trees and shrubs include *Combretum* spp., *Brachylaena huillensis*, *Scorodophloeus fischeri*, *Strychnos henningsi* and up to 40-m-tall *Sterculia appendiculata* on the large valley slopes. *Combretum holstii*, *Croton dichogamus*, *Cordia* spp., *Uvaria acuminata* and saplings of some of the above species occurred less commonly within this community. Average canopy tree dbh in the *Brachylaena*-dominated area was 19.1 cm (range = 6–30.9 cm, $n = 12$) and mean canopy tree dbh in the mixed dry forest was 15.2 (range = 10.2–34.1 cm, $n = 16$). *Acacia* wooded-grassland and cultivation surrounded this vegetation type.

Bombo East II PFR was dominated by a forest mosaic similar to Bombo East I PFR and was surrounded either by cultivation, *Brachylaena* woodland or *Acacia* wooded-grassland. Apart from the rice-cultivated Bombo River at the foot of the Bombo East I hill, there was little evidence of streams in either of the reserves despite indications on the reference map (SMD 1991). Of the villages that sur-

round these reserves (Figure 1), Nnazi Moja, Makorokoro and Bombo Maji Moto appear to benefit the most through the use of a variety of resources. General interviews with residents from each village, village chairpeople, forestry personnel and personal observations indicate that dry wood is collected for firewood and *Brachylaena* trees are quite often sought by charcoal makers and wood carvers. Grazing in the grassy woodlands also occurs.

Description of Bombo West Forest Reserve

This reserve (04°47'S, 38°40'E) located in the Bombo Valley, Korogwe District, comprises 3,564 ha (Johansson and Sandy 1996) and has an elevational range from about 400 to 700 m (Figure 1). Bombo West FR is largely dominated by *Brachylaena huillensis* (mean dbh = 27.9 cm, range = 16.3–50.5 cm, $n = 24$) woodland (Figure 1, Lovett and Pócs 1993), although several other trees and shrubs occur commonly such as *Scorodophloeus fischeri*, *Uvaria* spp., *Combretum* sp., *Croton* spp., *Cynometra* spp., *Grewia* spp., *Euphorbia* spp., *Adenium obesum*, *Teclea trichocarpa*, *Strychnos usambarensis* and *S. henningsi*. This woodland type is now known as *Brachylaena huillensis* dry forest (Clarke *et al.* in press), but we choose to refer to it here as woodland habitat to distinguish it from mixed dry forest that envelopes the hills in these reserves. Patches of *Acacia–Commiphora–Sterculia* woodland occur within and adjacent to the *Brachylaena* habitat where cultivation is not present. Two grasses, *Sporobolus* and *Digitaria* spp., inhabit both woodland types. The canopy height ranges from 6 to 15 m with a few emergents reaching about 20 m. The boundaries were marked again recently and a small portion on the southern side is now connected with the newly established Bombo East II PFR (Figure 1). Based on general interviews with residents and leaders of most of the surrounding villages, and personal observations, Nnazi Moja, Makorokoro, Kwetongo, Mashewa and Kijungu Moto (Figure 1) may have a fairly large investment in Bombo West FR. All the uses mentioned above for Bombo East I PFR are in common with Bombo West FR; however, the western and southern parts of this reserve are closest to these thriving villages and therefore are more devoid of dry wood. Many villagers were observed collecting and transporting fuelwood to these villages, particularly to Mashewa and Kijungu Moto.

Brachylaena uses

Brachylaena huillensis is an evergreen tree that grows extremely slowly, usually attaining heights of 6–18 m. It occurs in upland semi-deciduous forests where it is often common, and is also abundant in dry lowland habitats. Past and present uses of this tree species include timber production, wood carving and fuelwood for both charcoal burning and firewood (Beentje 1994). It has medicinal value in that the root has been used in the treatment of schistosomiasis (Ruffo *et al.* 1989). The tree is in great demand because it gives very long-burning, smokeless fuelwood and its wood is highly favoured for carving. Principally due to its importance in wood carving, but more so for the charcoal industry, it has been excessively harvested from almost pure stands in unprotected tracts north of the East Usambara mountains (see Cordeiro and Githiru 1998). Furthermore, the tree has been selectively removed from natural mixed forests in coastal kayas of

Table 1. Mist-net effort, altitude and habitats of each mist-net site in Bombo East I Proposed Forest Reserve (PFR) and Bombo West FR. Mist-net effort is indicated in net-metre-hours (product of total net transect multiplied by time nets were operated)

	Bombo East I PFR			Bombo West FR
	1a, 1b	2a,b	3a,b	1a,b
Sites	1a, 1b	2a,b	3a,b	1a,b
Habitats	MFe	MFv	MF	B
Altitude (m)	400	500	400	500
Diurnal total	3696	3024	3640	7090
<i>Total diurnal effort</i>		10360		7090
Nocturnal total	5376	2688	4032	9600
<i>Total nocturnal effort</i>		12096		9600

Habitat abbreviations: MF, mixed dry forest; Mfe, edge of mixed dry forest dominated by *Brachylaena*; Mfv, valley slope with mixed dry forest; B, *Brachylaena* woodland.

Kenya (Robertson 1987) and from Mt Kasigau in Kenya (M.G. pers. obs. 1998). In the Arabuko Sokoke Forest, the *Cynometra–Manilkara–Brachylaena* woodland has been severely modified by removal of *Brachylaena*, to the extent that it is now usually referred to as *Cynometra* woodland (Virani 1994).

Methods

Methods were designed to locate as many species as possible in the time available, especially targeting those species of conservation concern (see Cordeiro 1998). Audio-visual observations, serving the purpose of locating as many species as possible in a variety of habitats and elevations, were conducted daily. As well as using pre-recorded calls and playback to attract birds, dawn choruses were recorded at each site to document species that may have gone unnoticed through the other techniques (Svendsen *et al.* 1995).

Mist-netting of birds in a variety of habitats (see Table 1) during the day and night was also employed to capture the more elusive understorey birds. Birds were ringed with East African Ringing Scheme rings and standard biometric measurements, moult and brood patch scores were recorded. Diurnal mist-netting efforts amounted to 17,450 net-metre-hours (hereafter nmh) and nocturnal, 21,696 nmh totals for all sites combined (Table 1). Greater netting effort was focused on Bombo East I PFR due to the unique vegetation types. Netting was not conducted in Bombo East II PFR. The use of mist-nets is a good technique to locate elusive understorey dwellers that may otherwise be unnoticed (e.g. Karr 1981), but is biased to an extent that makes it of poor value for documenting community parameters (e.g. Remsen and Good 1996). Bombo East I PFR and Bombo West FR/Bombo East II PFR were surveyed from 10–30 September and 30 September to 10 October, respectively. Nomenclature and systematics follow Zimmerman *et al.* (1996).

Results

Mist-netting

Twenty-eight species (147 individuals) were captured in the two forest reserves. Twenty-five (121 individuals) and 14 (26 individuals) species were captured at

Table 2. Number of species and individuals captured in mist-nets in each habitat (see Table 1 for key to abbreviations) from the two forest reserves. Recapture data are not included

Species	Bombo East			Bombo West	Total
	MFe	MFv	MF	B	
African Goshawk <i>Accipiter tachiro</i>	—	1	1	—	2
Tambourine Dove <i>Turtur tympanistria</i>	—	—	1	—	1
Emerald-spotted Wood Dove <i>T. chalcospilos</i>	—	—	—	1	1
Yellowbill <i>Ceuthmochares aereus</i>	—	—	2	—	2
Narina Trogon <i>Apaloderma narina</i>	—	1	—	1	2
Fischer's Greenbul <i>Phyllastrephus fischeri</i>	2	8	9	1	20
Northern Brownbul <i>P. strepitans</i>	2	—	—	—	2
Terrestrial Brownbul <i>P. terrestris</i>	1	3	3	—	7
Tiny Greenbul <i>P. debilis</i>	1	2	4	—	7
Yellow-bellied Greenbul <i>Chlorocichla flaviventris</i>	4	—	1	5	10
Eastern Nicator <i>Nicator gularis</i>	4	—	1	3	8
White-starred Forest Robin <i>Pogonocichla stellata</i>	—	—	1	—	1
Red-capped Robin-chat <i>Cossypha natalensis</i>	11	1	4	—	16
White-chested Alethe <i>Alethe fuelleborni</i>	1	—	—	—	1
Red-tailed Ant Thrush <i>Neocossyphus rufus</i>	1	—	—	—	1
Eastern Bearded Scrub Robin <i>Cercotrichas quadrivirgata</i>	6	1	2	5	14
Grey-backed Camaroptera <i>Camaroptera brachyura</i>	4	—	5	2	11
Yellow-breasted Apalis <i>Apalis flavida</i>	—	—	2	1	3
Blue-mantled Crested Flycatcher <i>Trochocercus cyanomelas</i>	2	1	1	—	4
African Paradise Flycatcher <i>Terpsiphone viridis</i>	2	1	2	1	6
Forest Batis <i>Batis mixta</i>	—	2	7	—	9
Retz's Helmet-shrike <i>Prionops retzii</i>	—	—	—	1	1
Grey-headed Bush-shrike <i>Malaconotus blanchoti</i>	—	—	—	1	1
Tropical Boubou <i>Laniarius aethiopicus</i>	1	—	1	2	4
Black-backed Puffback <i>Dryoscopus cubla</i>	1	—	—	1	2
Plain-backed Sunbird <i>Anthreptes reichenowi</i>	—	1	1	1	3
Collared Sunbird <i>A. collaris</i>	—	—	1	—	1
Peter's Twinspot <i>Hypargos niveoguttatus</i>	2	—	5	—	7
<i>Totals for each reserve</i>			121	26	

Bombo East I PFR and Bombo West FR, respectively (Table 2). The most abundant species in the netted sample included Fischer's *Phyllastrephus fischeri* and Yellow-bellied Greenbuls *Chlorocichla flaviventris*, Red-capped Robin-chat *Cossypha natalensis*, Eastern Bearded Scrub Robin *Cercotrichas quadrivirgata*, Grey-backed Camaroptera *Camaroptera brachyura* and Forest Batis *Batis mixta* (Table 2). Although several bats were caught, no nocturnal birds were captured.

Species check-list

Data on the number of species at Bombo East I PFR and Bombo West FR are presented in Table 3. All species recorded in Bombo East II PFR were also noted in Bombo West FR and, since the two are connected by a narrow corridor, it would seem that they share a similar avifauna. The mixed dry forest in Bombo East II PFR was not sufficiently surveyed as more effort was concentrated in the *Brachylaena* woodland. One hundred and eighty four taxa from all sites were recorded, but only those from the forest and *Brachylaena* woodland are listed in

Table 3. Bombo East I PFR had the highest species richness with 143 species (65 mixed dry forest and *Brachylaena* species, 78 *Acacia* woodland and cultivation species) whereas 122 species (54 mixed dry forest and *Brachylaena* species, 69 *Acacia* woodland and cultivation species) were recorded in Bombo West FR (Table 3; N.J.C. and M.G., unpubl.). For further details on several other species see Cordeiro and Githiru (in press).

Species of conservation concern

Collar *et al.* (1994) identify all globally threatened and near-threatened birds, using the most recent IUCN categories of threat (Mace and Stuart 1994). Categories of threat used within this text follow the global directory of Collar *et al.* (1994) and the regional directory of Bennun and Njoroge (1996). We also discuss restricted-range taxa to highlight other species of potential conservation concern in these habitats. Restricted-range species have a global range of 50,000 km² or less (Stattersfield *et al.* 1998). We distinguish globally and regionally threatened species below.

Banded Snake Eagle *Circaetus cinerascens* Regionally Vulnerable

Zimmerman *et al.* (1996) state that this raptor is rare in northern Tanzania. We observed both Banded *Circaetus cinerascens* and Southern Banded Snake Eagle *C. fasciolatus* in the same habitat just outside Bombo East I PFR, the former flying above the latter's nest on 13 September. This is highly unusual as the two closely related species are considered allopatric through much of their range (Britton 1980). Additionally, this record is the first of this localized species from the East African coastal region (Britton 1980, Zimmerman *et al.* 1996). We do not know whether this eagle is resident in mixed dry forest or *Brachylaena* woodland.

Southern Banded Snake Eagle *Circaetus fasciolatus* Globally Near-Threatened

The Southern Banded Snake Eagle has a localized distribution in coastal forest from Somalia to South Africa (Collar *et al.* 1994), with inland populations occurring in the semi-evergreen forests of the Kilombero/Kibashira swamps, and several Eastern Arc mountains, Tanzania. It is commonly recorded in the East Usambaras (Moreau 1935, Collar and Stuart 1985, Tye 1993, CTRP 1994).

Only one old nest, possibly of this raptor, was located in the fork of a *Sterculia appendiculata* tree. The breeding pair of eagles we observed had a nest in a c. 18 m high *Combretum* tree about 20 m outside Bombo East I PFR, at 400 m asl. Repetitive calling from this pair in the early morning and evening hours led us to locate this nest. The nest was about 40–50 cm in diameter and constructed at c. 14 m above the ground in the fork of the tree where the branches spread outward with much green foliage. The sex of the sitting individual was not determined. We did not observe a change in incubating individuals but periodically noted one individual flying over the nest. It appeared that young were present on 11 October. The breeding record in the mixed dry forest, together with records of its occurrence in other inland semi-evergreen forests, is of considerable conservation interest as it appears that the breeding range of this near-threatened raptor may not be strictly confined to coastal forest.

Table 3. List of all species recorded in or near each study site in *Brachylaena* woodland or mixed dry forest. Birds recorded from the mixed dry forest and present in several lowland forests in the East Usambaras, but not recorded from *Brachylaena* woodland in Bombo West FR, are denoted with a †. Species that are chiefly montane dwellers are marked with a *. An x indicates that the taxon may forage in, but not necessarily reside in this habitat. Some species (denoted by §) that were mainly recorded in *Brachylaena* woodland or mixed dry forest may also occur in the adjacent *Acacia* woodlands. Altitudes for certain birds are given as appropriate

Species	Habitat	Bombo East	Bombo West
Bat Hawk <i>Macheiramphus alcinus</i>	†		x
Southern Banded Snake Eagle <i>Circaetus fasciolatus</i>		x	(x)
African Harrier Hawk <i>Polyboroides typus</i>	§	x	x
African Goshawk <i>Accipiter tachiro</i>		x	x
Little Sparrowhawk <i>A. minullus</i>	§	x	x
Wahlberg's Eagle <i>Aquila wahlbergi</i>	§	x	x
African Crowned Eagle <i>Stephanoaetus coronatus</i>		x	x
Martial Eagle <i>Polemaetus bellicosus</i>	§	x	x
Sooty Falcon <i>Falco concolor</i>	§		x
Crested Francolin <i>Francolinus sephaena</i>	†	x	x
Crested Guinea fowl <i>Guttera pucherani</i>		x	x
Tambourine Dove <i>Turtur tympanistria</i>	†	x	x
Emerald-spotted Wood Dove <i>T. chalcospilos</i>		x	x
Red-eyed Dove <i>Streptopelia semitorquata</i>	§	x	x
Fischer's Turaco <i>Tauraco fischeri</i>	†	x	x
Yellowbill <i>Ceuthmochares aereus</i>		x	x
African Barred Owlet <i>Glaucidium capense</i>		x (below 600 m)	x (below 600 m)
African Wood Owl <i>Strix woodfordii</i>		x	x
Mottled Swift <i>Apus aequatorialis</i>	§	x	(x)
Narina Trogon <i>Apaloderma narina</i>		x	x
Green Wood-Hoopoe <i>Phoeniculus purpureus</i>	§	x	x
Crowned Hornbill <i>Tockus alboterminatus</i>	§	x	x
Trumpeter Hornbill <i>Bycanistes bucinator</i>		x	x
Scaly-throated Honeyguide <i>Indicator variegatus</i>		x	x
Mombasa Woodpecker <i>Campethera mombassica</i>		x	x
Cardinal Woodpecker <i>Dendropicos fuscescens</i>	§	x	x
African Broadbill <i>Smithornis capensis</i>	†	x (400–600 m)	
Black Rough-wing <i>Psalidoprocne pristoptera</i>	†,*	x	
Fischer's Greenbul <i>Phyllastrephus fischeri</i>		x	x
Northern Brownbul <i>P. strepitans</i>		x	x
Terrestrial Brownbul <i>P. terrestris</i>		x	x
Tiny Greenbul <i>P. debilis</i> ^a	†	x	
Yellow-bellied Greenbul <i>Chlorocichla flaviventris</i>	§	x	x
White-starred Forest Robin <i>Pogonocichla stellata</i>	†,*	x	
Red-capped Robin-chat <i>Cossypha natalensis</i>		x	x
Eastern Nicator <i>Nicator gularis</i>		x	x
White-chested Alethe <i>Alethe fuelleborni</i> ^b	†,*	x (400 m)	
Red-tailed Ant Thrush <i>Neocossyphus rufus</i>		x	x
Eastern Bearded Scrub Robin <i>Cercotrichas quadrivirgata</i>		x	x
Ashy Flycatcher <i>Muscicapa caerulescens</i>	†	x	x
Grey-backed Camaroptera <i>Camaroptera brachyura</i>		x	x
Yellow-breasted Apalis <i>Apalis flavida</i>	§	x	x
Black-headed Apalis <i>A. melanocephala</i>		†	x
Little Yellow Flycatcher <i>Erythrocerus holochlorus</i>		x	x
Blue-mantled Crested Flycatcher <i>Trochocercus cyanomelas</i>		x	
African Paradise Flycatcher <i>Terpsiphone viridis</i>		x	x
Forest Batis <i>Batis mixta</i> ^c	†	x	
Pale Batis <i>B. soror</i>			x

Table 3 cont.

Species	Habitat	Bombo East	Bombo West
Black-and-White Flycatcher <i>Bias musicus</i> ^d		x	
Retz's Helmet-shrike <i>Prionops retzii</i>	§	x	x
Chestnut-fronted Helmet-shrike <i>P. scopifrons</i>	x	x	
Brown-crowned Tchagra <i>Tchagra australis</i>		x	x
Black-crowned Tchagra <i>T. senegala</i>		x	x
Black-fronted Bush-shrike <i>Malaconotus multicolor</i>	†,*	x (400–500 m)	
Four-coloured Bush-shrike <i>M. quadricolor</i>		x	x
Grey-headed Bushshrike <i>M. blanchoti</i>		x	x
Tropical Boubou <i>Laniarius aethiopicus</i>		x	x
Black-backed Puffback <i>Dryoscopus cubla</i>	§	x	x
Black-headed Oriole <i>Oriolus larvatus</i>	§	x	x
Eurasian Golden Oriole <i>O. oriolus</i>	§	x	x
Waller's Starling <i>Onychognathus walleri</i>	†,*	x (500 m)	
Black-bellied Starling <i>Lamprotornis corruscus</i>		x	(x)
Collared Sunbird <i>Anthreptes collaris</i>	§	x	x
Amani Sunbird <i>A. pallidigaster</i>	†	x (400 m)	
Plain-backed Sunbird <i>A. reichenowi</i>		x (below 600 m)	x (below 600 m)
Olive Sunbird <i>Nectarinia olivacea</i>	†	x	
Dark-backed Weaver <i>Ploceus bicolor</i>	†	x	
Peter's Twinspot <i>Hypargos niveoguttatus</i>		x	x

^a ssp. *rabai*; ^b ssp. *usambarae*; ^c ssp. *ultima*; ^d outside the PFR (see text).

Fischer's Turaco *Tauraco fischeri*

Globally Near-Threatened

Although quite common in the East Usambaras (Moreau 1935, Collar and Stuart 1985, Stuart 1989, Tye 1993), including the lowlands (Evans 1997a), audio-visual observations at all our study sites suggest that Fischer's Turaco occurred at lower densities than elsewhere in this range. It appears to require dense and tall woodland or forest, and was therefore only encountered in such habitat at all sites. The low densities may be apparent throughout the year or, possibly attributed to seasonal fluctuations due to availability of fruiting trees.

Mombasa Woodpecker *Campethera mombassica*

Restricted Range

This woodpecker is well known from the East Usambara submontane and lowland (e.g. Evans 1997a) forests. We recorded it at all three sites in fair numbers, where both *Brachylaena* woodland and mixed dry forest were favourite habitats. Numbers appeared greater in the mixed dry forests at all three Bombo Valley sites and the species was also regularly encountered in dense *Brachylaena* woodland in Bombo West FR. Of interest, however, is the lack of records from the adjacent *Acacia* woodlands although individuals were occasionally observed at the margins of these habitats.

White-chested Alethe *Alethe fuelleborni*

Globally Restricted Range

Well known in the East Usambara submontane and lowland forests (Moreau 1935, Stuart 1989, Tye 1993, Evans 1997a), this thrush was netted once in the transition area between *Brachylaena* stands and mixed dry forest in Bombo East I PFR.

Little Yellow Flycatcher *Erythrocercus holochlorus* Regionally Vulnerable

This flycatcher is another species known from a select few sites in East Africa, including the East Usambara lowlands (e.g. Stuart 1989, Evans 1997a). It was a regular member of mixed species flocks and commonly recorded in Bombo East I PFR, especially in the mixed dry forest, but was less common in the *Brachylaena* woodland in Bombo West FR.

Amani Sunbird *Anthreptes pallidigaster* Globally Vulnerable

In the East Usambaras, this low-density bird is known from only a few scattered records, ranging from low-altitude to submontane forest (e.g. Moreau 1935, Stuart 1989, Tye 1993, Evans 1997a, Cordeiro 1998, Seddon *et al.* 1999). A male was recorded only once in Bombo East I PFR in the rather dense mixed dry forest and it must therefore be scarce or overlooked here. Whether this record represents a resident or wanderer remains to be seen.

Plain-backed Sunbird *Anthreptes reichenowi* Globally Near-Threatened

Frequently recorded at all three sites, having been known in the East Usambaras mainly from the lowland forests (Evans 1997a), this species regularly joined mixed-species flocks and was also observed feeding alone or in pairs. Given its presence at these sites, the population of this sunbird would therefore appear reasonably secure.

Other widespread species of conservation concern

Another six species of conservation concern at the regional level (Regionally Near-Threatened, RNt; Regionally Vulnerable, RV; Regional Responsibility, RR) were found at these sites: Bat Hawk *Macheiramphus alcinus* (RNt), African Crowned Eagle *Stephanoaetus coronatus* (RV), Martial Eagle *Polemaetus bellicosus* (RV), Fischer's Greenbul *Phyllastrephus fischeri* (RR), Chestnut-fronted Helmet-shrike *Prionops scopifrons* (RNt) and Four-coloured Bush-shrike *Malaconotus* (RNt). The first four are generally widespread in the region whereas the last two are most restricted in range, both generally confined to the coastal area (Britton 1980, Zimmerman *et al.* 1996). Chestnut-fronted Helmet-shrike is well known from the East Usambara lowlands (e.g. Stuart 1989, Evans 1997a). We observed three to four different flocks of this species in the *Brachylaena* woodland of Bombo West FR; however, only one flock was encountered in Bombo East I PFR. Although known from some inland forests such as the North Pare Mountains and Chyulu Hills (Britton 1980, Cordeiro and Kiure 1995, Zimmerman *et al.* 1996), Four-coloured Bush-shrike is primarily a coastal forest dweller. We recorded it in mixed dry forest and *Brachylaena* woodland at all three sites where it was not uncommon.

Montane elements

Several montane birds are believed to move to lower altitudes during the cold season and have thus been reported from the East Usambara lowlands during

this season (e.g. Stuart 1989, CTRP 1994, Evans 1997a). Five montane elements, Black Rough-wing *Psalidoprocne pristoptera*, White-starred Forest Robin *Pogonochla stellata*, Black-fronted Bush-shrike *Malaconotus multicolor*, Waller's Starling *Onychognathus walleri* and White-chested Alethe were noted from the mixed dry forest in Bombo East I PFR (Table 3). If these species are not residents or wanderers, then they are most likely montane visitors in the lowlands during the cold season as has been observed elsewhere in the Eastern Arc mountain range (e.g. Burgess and Mlingwa in press). The behavioural and evolutionary significance of this downward movement in East Africa requires further study as conservation strategies may need to focus on the entire elevational expanse of forests in the Eastern Arc and not just the submontane and montane forests.

Dry country elements

Several typical arid habitat taxa that occur in the Mkomazi–Tsavo area (e.g. Lack 1994) were recorded in the Bombo Valley sites we surveyed. Dry country species included Pygmy Batis *Batis perkeo*, Hunter's Sunbird *Nectarinia hunteri*, Red-headed Weaver *Anaplectes rubriceps*, Yellow-spotted Petronia *Petronia pyrgita*, Abyssinian White-eye *Zosterops abyssinicus*, African Penduline Tit *Anthoscopus caroli* and White-crested Helmet-shrike *Prionops plumatus* (Cordeiro and Githiru in press). Presence of these arid habitat elements in the Bombo Valley can be attributed to *Acacia* wooded grasslands which form a link with the Mkomazi–Tsavo vegetational belt. Our records of these species were mainly from *Acacia* woodlands or in the ecotone between this habitat and the *Brachylaena* woodland.

Globally threatened and near-threatened species not recorded in this survey

Some globally threatened (T), near-threatened (NT) (Collar *et al.* 1994) and restricted-range (R-R) (Stattersfield *et al.* 1998) species known from other lowland forest patches in the East Usambaras (Stuart 1989, CTRP 1994, Anderson *et al.* 1997, Evans 1997a,b) went unrecorded at all three sites: Sokoke Scops Owl *Otus ireneae* (T), East Coast Akalat *Sheppardia gunningi* (T), Swynnerton's Robin *Swynnertonia swynnertoni* (T) and Kenrick's Starling *Poeoptera kenricki* (R-R). The apparent absence of the akalat (habitat of Swynnerton's Forest Robin not present in study sites) and starling may be real as an intense effort was made to locate these species through mist-netting and audio-visual observations, including playback. However, the possibility that they may have been overlooked cannot be ruled out, especially in the case of the elusive akalat. The owl was recently discovered in the East Usambara lowland forests (CTRP 1994, Evans 1997a,b) and due to its presence in the *Brachylaena*–*Cynometra* woodland in nearby Arabuko-Sokoke Forest, Kenya (Virani 1994, 1996), it may have been expected to occur in the Bombo Valley. All the methods employed to locate the akalat and starling were also used to search for this owl, but to no avail. As it has only been found below 400 m in the Usambaras and since most parts of the reserves were at or above 400 m, it is possible that the conditions for this species were not ideal. Another plausible theory for the lack of any records is that it may occur at very low densities, compared with other sites in the Usambara lowlands (Evans 1997b) and thus could have been overlooked.

Discussion

Habitat degradation and conservation in the East Usambaras

Prior to the 1990s, forest cover was being rapidly lost to several damaging human-related activities (see Hamilton and Bensted-Smith 1989). However, since 1993, EUCFP has made great strides to afford protection to the forests in this range. Current forest area under the jurisdiction of EUCFP is 45,137.7 ha, a figure that includes proposed forest reserves and some woodland areas (Johansson and Sandy 1996). This is more than twice the amount (i.e. 21,900 ha) in 1993 (Hyytiäinen 1995) and mainly results from EUCFP's efforts to enlarge existing forest reserves, incorporate unprotected forests into their programme and link fragmented forests by establishing forest corridors. Johansson and Sandy (1996) state that 75% of the total forest area is in, or will receive, forest reserve status in the very near future whereas about 95% of the well-stocked forests are already in forest reserves. With regard to lowland forests which amount to 29,497 ha, about 81% have, or will receive in the near future, forest reserve status, and about 98% of the more intact forest is already in forest reserves (Johansson and Sandy 1996). Bombo East PFRs are two examples of EUCFP's recent incorporation of a fairly large area of *Brachylaena* woodland and several small lowland forest patches into their forest reserve network.

The achievement of the EUCFP is remarkable and exemplifies an outstanding model for other forestry bodies to follow. However, although many human-related conflicts were sufficiently managed through the planning stages of the proposed reserves, the degradation of surrounding habitats not included in the reserve boundaries is a major concern. Regulating the use of buffer zones, planting woodlots for fuelwood supplementation, restricting and controlling grazing, enforcing proper fire control measures (e.g. by establishing fire strips around farms) and especially enhancing overall awareness of the local people will go a long way in ensuring that these habitats are well managed and conserved.

Comparison between study areas and East Usambara lowland forest avifauna

Not including possible altitude migrants from montane areas and some Afrotropical migrants, at least 15 species that are known to occur at several forested sites in the East Usambara lowlands (Stuart 1989, CTRP 1994, Evans 1997a) went unrecorded during this investigation. These include: Eastern Bronze-naped Pigeon *Columba delegorguei*, Sokoke Scops Owl, Usambara Eagle-Owl *Bubo vosseleri*, Eastern Green Tinkerbird *Pogoniulus simplex*, Green Barbet *Stactolaema olivacea*, Little Greenbul *Andropadus virens*, Yellow-streaked Greenbul *Phyllastrephus flavostriatus*, Pale-breasted Illadopsis *Illadopsis rufipennis*, Swynnerton's Robin, East Coast Akalat, Kretschmer's Longbill *Macrosphenus kretschmeri*, Southern Hyliota *Hyliota australis*, Square-tailed Drongo *Dicrurus ludwigii*, Green-headed Oriole *Oriolus chlorocephalus*, Uluguru Violet-backed Sunbird *Anthreptes neglectus*. For many, the possibility that they were overlooked cannot be ruled out as several of them occur at low densities (e.g. Sokoke Scops Owl) or are very elusive (e.g. Southern Hyliota *Hyliota australis*). Furthermore, for some species (e.g. Swynnerton's Robin), unsuitable habitat may explain their absence. However, for the more conspicuous and vocal species like the Green Barbet, Yellow-streaked Greenbul,

Square-tailed Drongo and Green-headed Oriole, the apparent absences are difficult to understand, especially in the mixed dry forest in Bombo East I PFR. It is possible that the small sizes of mixed dry forest patches, together with the lack of large, mature trees, which are characteristic of lowland forests where these species are known to occur, may explain their absence in our study sites. However, the scant ecological information available on these birds makes any observed patterns difficult to interpret with confidence.

With regard to differences in the avifauna between the mixed dry forest (Bombo East I PFR) and the *Brachylaena* woodland, although several species overlap (see Table 3), the absence of some more typical forest species in the latter habitat is of interest. Forest birds such as the Black-headed Apalis *Apalis melanocephala*, Tiny Greenbul *Phyllastrephus debilis*, Forest Batis *Batis mixta*, Olive Sunbird *Nectarinia olivacea* and Dark-backed Weaver *Ploceus bicolor*, which were not recorded in the drier *Brachylaena* woodland, indicate the overall impoverishment of this habitat compared with the mixed dry forest. It therefore appears that although these woodlands harbour some important bird species, their overall conservation status for the protection of birds, as currently understood, is not as high as that for Bombo East I PFR. Bombo East I PFR, with at least 65 species somewhat dependent on the mixed dry forest (Table 3) and a further 78 that inhabit the *Acacia* woodland, thickets and cultivation (N.J.C. and M.G. unpubl.), clearly maintains a high diversity of species. Nevertheless, in comparison with other lowland forests in the East Usambaras, where up to six globally threatened, three near-threatened and three restricted-range bird species occur, all three sites do not rank very high. Of importance, however, is the presence of some bird species of conservation concern together with the possibility that at least one site (Bombo East I PFR) serves as a cold season refuge for montane elements.

The landscape mosaic of all three reserves is made up of several types of contiguous habitats: mixed dry forest, *Brachylaena* woodland, *Acacia* wooded grassland. This mosaic was more prevalent in Bombo East I PFR than in the other two sites, and together with a larger area of mixed dry forest, could account for the higher bird diversity (in species richness and abundance, see results section). Bombo West FR was dominated by *Brachylaena* and only very small mixed dry forest patches were located on three hills. This woodland habitat was more uniform than the more stratified mixed dry forest which may be another reason that explains the reduced bird diversity in this reserve.

Animals other than birds

Although our coverage of mammals and other animal groups was not thorough, we obtained several records of conservation interest. The presence of the Tree Hyrax *Dendrohyrax vallidus*, Zanzibar Dwarf Galago *Galagoides zanzibaricus*, Zanzibar Elephant Shrew *Rhynchocyon petersi*, Lesser Pouched Rat *Beamys hindei* and a possible endemic snake (*Prosymna* sp. cf. Broadley 1995) raises the overall conservation value of the mixed dry forest and *Brachylaena* woodlands in this area.

Recommendations for further fieldwork

Given that a number species of birds and mammals of conservation concern, and one possible endemic reptile, were found in these study areas, the poten-

tial for further discoveries is high. The following recommendations are therefore presented (see also CTRP 1994) to highlight these study sites and the *Brachylaena* woodland as important areas for future conservation and research efforts:

1. The avifauna of the mixed dry forest and *Brachylaena* woodland should be studied during all seasons to facilitate a more rounded view of the dynamics of this community. In addition, determining whether or not Bombo East I PFR and other sites could serve as cold season refugia for montane elements is of great concern given the overall evolutionary and conservation significance of this phenomenon. Furthermore, as two globally threatened birds (Sokoke Scops Owl, Sokoke Pipit *Anthus sokokensis*) inhabit comparable *Cynometra-Brachylaena* woodland in Kenya, their presence in the study areas is still very likely if they occur at very low densities. Due to this, we feel that the priority of surveying the *Brachylaena* woodlands north of the Bombo Valley, many patches of which are being degraded at high rates by wood-carving and charcoal industries, is very high. Further populations of this owl and other threatened bird and mammal species could be discovered. With regard to mammals, the occurrence of Ader's Duiker *Cephalophus adersi*, Golden-rumped Elephant Shrew *Rhynchocyon chrysopygus* and Sokoke Dog Mongoose *Bdeogale omnivora* in some of the woodland patches near the Kenya-Tanzania border is highly probable given their habitat requirements and proximity to the Kenyan coastal forests.
2. Ecological studies of key bird and mammal species, such as those of conservation importance, are of great necessity if we plan to create efficient conservation strategies for the species' future survival. What habitats they use, for what needs and at what times are also important ecological questions that can be addressed for model species or species of conservation concern in this system.

The accelerating destruction of the *Brachylaena* woodlands by the charcoal industry could be curbed by modelling schemes after EUCFP's programme in the Usambaras. These woodland tracts have no formal protection and therefore the overall conservation importance of this unique vegetation type merits immediate conservation attention. This could be done peacefully in the same manner as those forest reserves that were recently established in the northern extreme of the East Usambaras. Furthermore, setting aside key tracts, controlling the charcoal trade in the more damaged sites, and setting up wood-lots, may help ameliorate the current situation without causing grave harm to the livelihood of the people involved. However, because the demand for charcoal comes from nearby coastal towns, and Pemba and Zanzibar islands (from where it is also believed to be exported to parts of the Middle East), other alternatives need to be sought. Perhaps the study on the charcoal market by EUCFP (S. Johansson verbally 1998) will provide solutions to this problem. In particular, controlling the market and instituting the use of alternative energy sources (e.g. solar-powered cookers) could potentially reverse current trends. An alternative to charcoal, compressed sawdust from mills, is currently being explored by a Japanese Aid organization in Kilimanjaro Region (N.J.C. pers. obs.): if the quality is high and cost is relatively low, then it could become an important alternative to charcoal in urban areas.

Given the serious threats to the poorly explored *Brachylaena* woodland patches north of the East Usambaras and their potential to house several endangered animals and plants, it is critical that further research and conservation strategies be focused on this habitat. Indeed, controlling the charcoal industry in the area will help decrease the advent of habitat degradation, which appeared to be quite high and a potential danger to local communities, the environment and the fauna and flora.

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