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The importance of the Nilo and Nguu North Forest Reserves for the conservation of montane forest birds in Tanzania

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Abstract

In July to October 1995 we conducted bird surveys in two forest reserves (FRs) in Tanzania: Nilo FR in the East Usambara Mountains and Nguu North FR in the Nguu Mountains. The survey results were used to assess the importance of the two FRs for the conservation of threatened, near-threatened and restricted range montane bird species, and threats to the forest in these areas were identified. The conservation importance of the East Usambaras and the Nguus relative to other forested mountain ranges in Tanzania was assessed. It was found that Nilo FR and the adjacent forested public land is an important site for the conservation of Usambara weaver and long-billed tailorbird, and Nguu North FR for east coast akalat. Both FRs harbour other forest-dependent species of conservation interest whose survival prospects would be enhanced by improved protection of the reserves. Both FRs are subject to degradation, predominantly through pit-sawing and cultivation. There is an urgent need for a long-term conservation programme in these FRs and we make practical recommendations for their future management. © 1998 Elsevier Science Ltd. All rights reserved.

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1. Introduction

The Eastern Arc Mountains, a chain of semi-isolated forest-capped mountain blocks extending from south-east Kenya to south Tanzania, harbour a unique flora and fauna (Wasser and Lovett, 1993). Long-term environmental stability has enabled the persistence of relictual taxa and has promoted radiation, leading to high levels of endemism (Fjeldså and Lovett, 1997). This is well demonstrated in birds; the Eastern Arc Mountains form part of the Tanzania–Malawi Endemic Bird Area (EBA) as defined by ICBP (1992). This EBA supports 37 restricted range bird species, including 31 endemic to the EBA and the endemic genera *Xenoperdix* and *Modulatrix* (Stattersfield et al., 1998). Of these species, 20 have been classified as globally threatened, and five as near-threatened (Collar et al., 1994). In addition

to their biological value, these mountains are extremely important water catchments and sources of timber and other forest products on which many depend (Rodgers, 1993). However, full protection of forest in Tanzania is limited to Udzungwa National Park (Fig. 1) (Rodgers, 1993). Other important areas of submontane and montane forest, such as the West Usambara and Uluguru Mountains, have Catchment Forest Reserve (FR) status. The gazettement of these reserves has made a significant contribution to forest conservation in Tanzania, but there is considerable evidence indicating that FR status does not completely protect forests from exploitation (Hamilton, 1989; Rodgers, 1993).

Working with the Wildlife Conservation Society of Tanzania and the East Usambara and Tanga Catchment Forest Projects, we surveyed the birds of two FRs in the East Usambara and Nguu Mountains in July to October 1995. Prior to this, no avifaunal information had been collected for the Nguu Mountains. Similarly, Nilo FR included the least-studied submontane forest in

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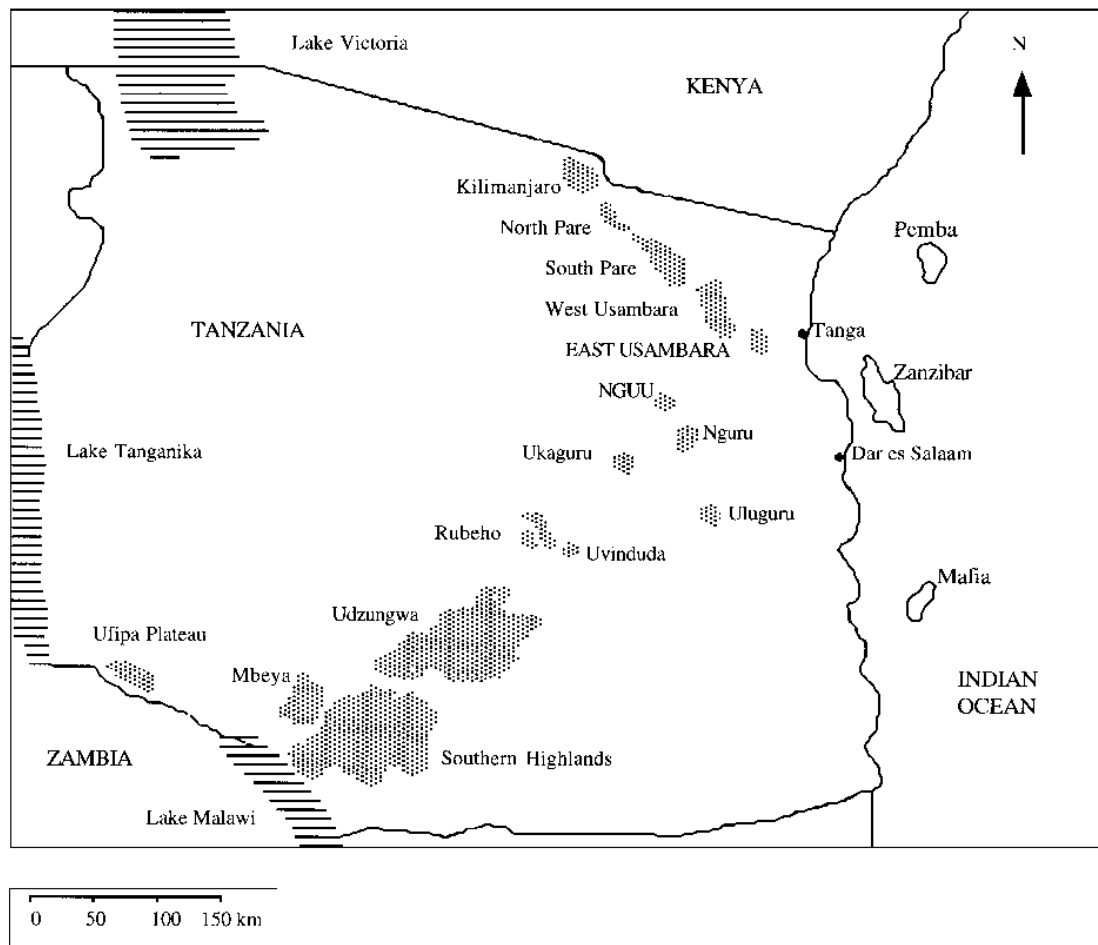


Fig. 1. Location of the East Usambaras and Ngus relative to other mountains supporting submontane forest in Eastern Tanzania.

the East Usambaras: Moreau visited the area briefly in 1931 (Sclater and Moreau, 1932, 1933), and Cordeiro (1998) conducted an eleven-day survey in 1994. The aims of our study were: (1) to survey birds in each FR and to assess the status and threats to the survival of threatened, near-threatened and restricted range species; (2) to use this information to assess the importance of each FR for the conservation of montane forest birds, and to compare the conservation importance of these areas relative to other FRs in the same mountain ranges and to other areas of montane forest in Tanzania; (3) to identify the key threats to the FRs; and (4) to make practical recommendations for the effective, long-term conservation of these areas.

2. Methods

Table 1 details the fieldwork effort at each site, dates of fieldwork, and the habitat and altitudes surveyed. The locations of these sites are given in Figs. 1–3.

2.1. Birds

A variety of methods was employed to produce ornithological inventories for each site. Diurnal field observations were carried out from semi-permanent transect routes of 2–4 km that passed through a cross-section of habitats. These routes often followed existing paths or stream beds, but new trails were also established. For each bird observation the species, number of individuals, age and sex where possible, flocking and foraging behaviour, altitude (to the nearest 50 m), location and habitat were recorded (see below). As fieldwork progressed we plotted species-discovery curves to provide an indication of the completeness of the avifaunal inventory at each site (Fig. 4). Nocturnal records were made between 2100 hours and 2400 hours on well-defined trails or stream beds using torches to detect eye-shine and illuminate birds for identification. To help locate elusive and nocturnal species ten 18 m mist nets were operated in a variety of habitats. Using a Marantz CP430 tape recorder and a Sennheiser ME66 directional

Table 1
Summary of fieldwork effort at study sites

FR	Site	Dates (1995)	Habitat ^a	Altitude (m)	Field-hours ^b		Mistnet hours ^c	
					Diurnal	Nocturnal	Diurnal	Nocturnal
Mount Nilo	Lutindi	4–19 July	1, 2 2, 3, 4	1200–1500 700–1200	329	11	440.5	26
	Kilanga	20–31 July	1, 2 2, 3	800–1030 700–800	268.5	12	202.5	12
Nguu North	Gombero	11–25 August	1, 2 3, 4	1000–1550 1000	369	22	443	12
	Luago	28 August–8 September	1, 2 2, 3	1140–1300 1000–1100	316.5	18	180	18

^a 1, submontane forest; 2, secondary forest; 3, forest edge; 4, cultivated land.

^b One field-hour is defined as 1 hour of field observations carried out by a single person or group of people working together.

^c One mist net hour is defined as the operation of a single 18m four-panel mist net for 1 hour.

microphone recordings were made of dawn choruses and the species recorded were documented. Recordings were used to locate shy species (pre-recorded tapes and field recordings).

Following an initial three-day period for familiarisation with the avifauna field records were used to calculate an encounter rate (number of birds recorded per 100 field hours, bhf) in order to make within-species comparisons of abundance between the different sites. These encounter rates have biases imposed by variation in habitat structure between sites and differences in species' detectability, and they are difficult to interpret. In this paper we have therefore scaled the encounter rates non-parametrically and described them in terms of subjective impressions of species abundance from the field as follows: abundant (≥ 20.0 bhf), common (10.0–19.9 bhf), fairly common (5.0–9.9 bhf), uncommon (1.0–4.9 bhf) and rare (< 1.0 bhf). Methods for calculating population densities (e.g. point census and line transect methods; Bibby et al., 1992) were not attempted because many of their underlying assumptions are violated on a short-term project in dense forest habitat and rugged terrain. Furthermore, an important component of our fieldwork, which is generally incompatible with more quantitative surveys, was to gather ecological information on rare or poorly known species (discussed in Seddon et al., in press).

The relative importance of these two protected areas for the conservation of montane forest birds in Tanzania was assessed on two scales. First, the avifaunal composition of Nilo FR was compared with that of other FRs, encompassing the main areas of submontane forest in the East Usambaras: Mount Mtai FR, Kwankoro FR, Amani-West FR and Amani-Sigi FR (using data from Johansson and Sandy, 1996). For the purpose of this analysis, ornithological data from the Kwankoro-Amani FRs was pooled, as they are contiguous. The avifaunal composition of the East

Usambaras and Nguus (assuming that the avifaunal composition of Nguu North FR is representative of the whole Nguu range) was then compared with that of other submontane forest blocks in Tanzania. Montane forest species were categorised (following Stuart et al., 1993) as those that apparently do not occur below 700m during the breeding season and appear to be dependent on forest for their survival (although there are limitations in such a definition, see Stuart, 1983). Avifaunal composition was analysed in terms of montane forest species, restricted range and globally near-threatened species, globally threatened montane forest species, and the number of birds endemic to a single mountain block. We justify assessing conservation priorities at the species level as this approach is widely used in current bird conservation literature (e.g. Collar et al., 1994; Stattersfield et al., 1997). For Nguu North FR and Nilo FR the data gathered in 1995 were used along with additional data for Nilo FR from Cordeiro (1998). For the other FRs in the East Usambaras and for the other forest blocks in our comparison, we used data from Stuart (1981, 1983), Stuart and Jensen (1985), Evans and Anderson (1993), Jensen and Brøgger-Jensen (1992), Dinesen et al. (1993), Stuart et al. (1993), Fjeldså and Rabøl (1995) and Stattersfield et al. (1998).

Nomenclature and taxonomy follow Britton (1980), and systematic order is taken from Dowsett and Dowsett-Lemaire (1993). Species of conservation interest are classified following Collar et al. (1994), Bennun and Njoroge (1996) and Stattersfield et al. (1998).

2.2. Forest descriptions

In order to assess habitat use, a general description of the forest in each FR was compiled. Using a 1:50000 topographic map (Directorate of Overseas Surveys for the United Republic of Tanzania, 1973), a compass and an altimeter, the forest, clearings, streams and areas

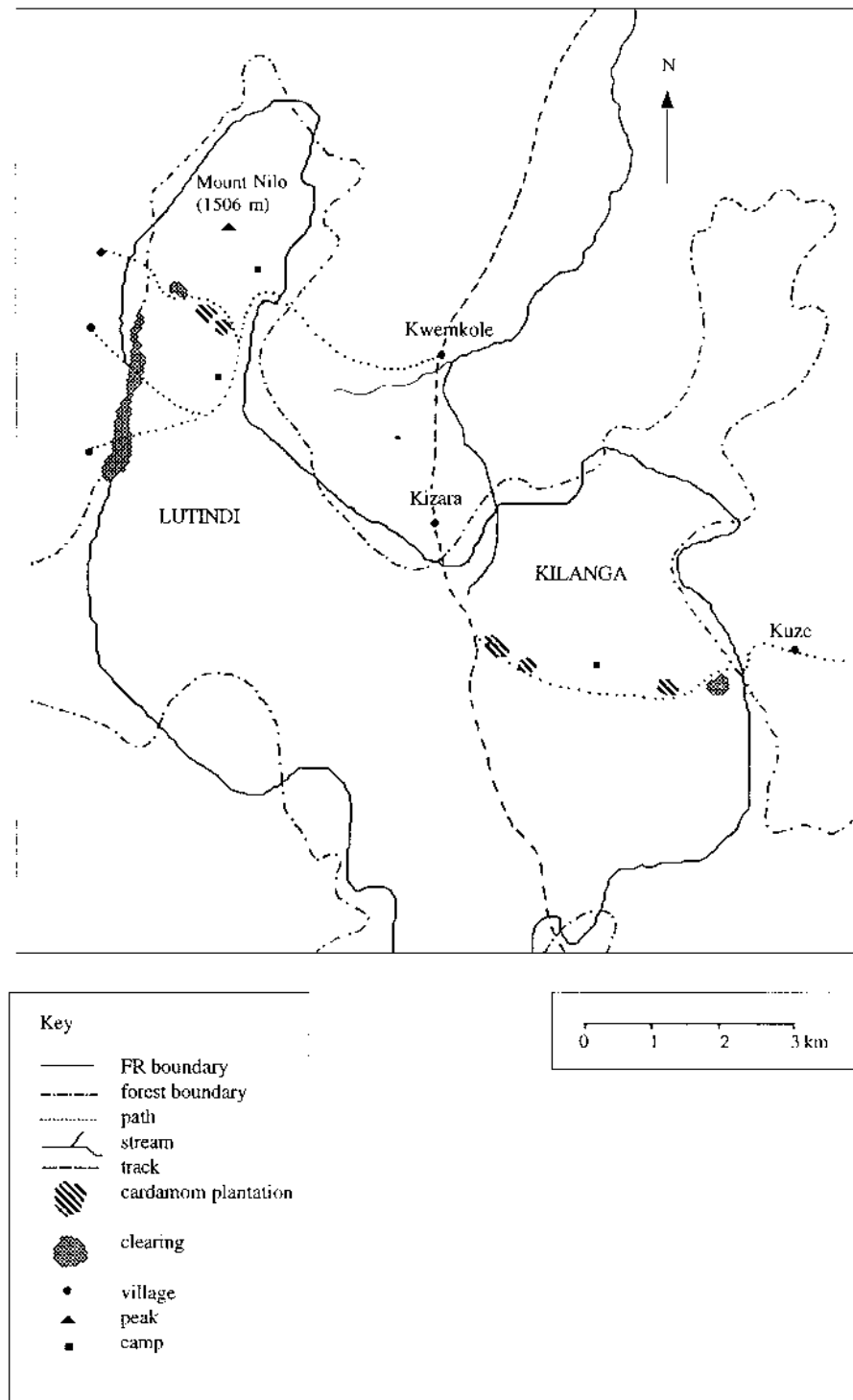


Fig. 2. Map showing the location of Lutindi and Kilanga in Nilo Forest Reserve.

(>0.5 ha) of cultivation (beans, maize, cardamom) were mapped. Following Lovett (1993), forest types were defined as lowland (<800 m), submontane (800–1400 m) and montane (1200–1800 m). Secondary forest was defined as habitat in which vegetation had regrown after heavy disturbance, and was characterised by a dense herbaceous cover and fast-growing, light-demanding

species such as *Macaranga capensis* and *Trema orientalis*. Survey points were established at ca. 300 m intervals along each transect and for each point altitude to the nearest 50 m was measured and slope angle estimated. Basic vegetation descriptions of the forest within 40 m of each point were compiled and the percentage cover for the canopy, subcanopy, mid-storey and field-layer

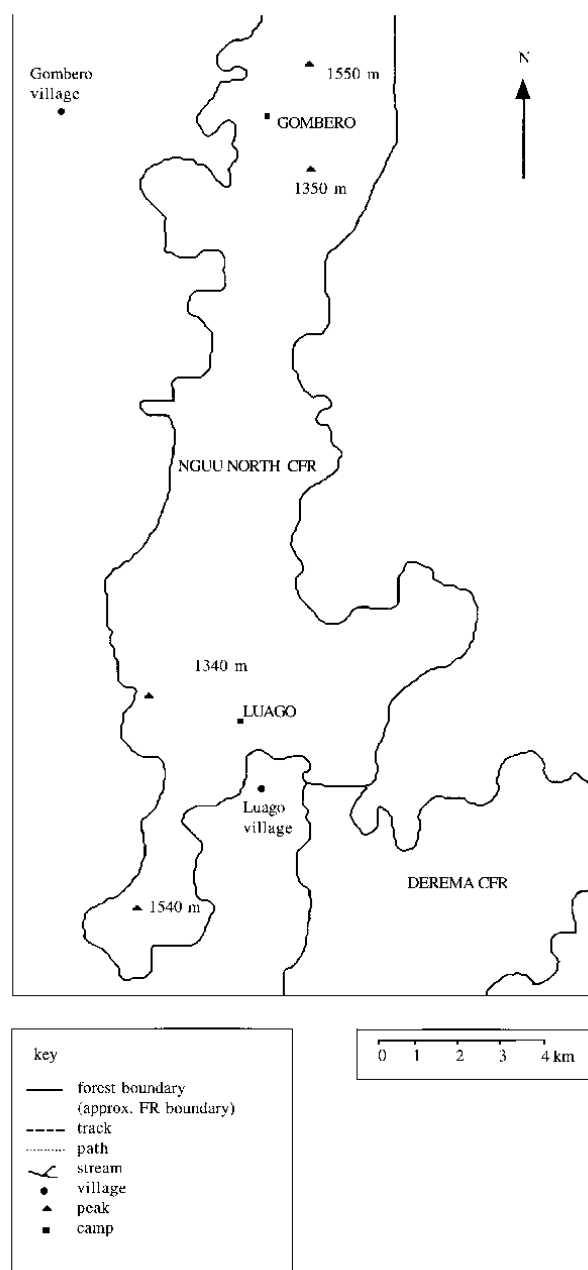


Fig. 3. Map showing the location of Gombero and Luago in Nguu North Forest Reserve.

was estimated. Canopy height was estimated by eye to the nearest 1 metre, modal and maximum tree diameter at breast height (dbh) to the nearest 10 cm for all trees over 5 cm in diameter. Samples and photographs were taken of unidentified tree species for subsequent identification by foresters at the regional forestry office in Tanga. At each survey point we estimated the percentage of trunks or stems (>5 cm) that particular plant taxa comprised in order to assess dominance by particular plants in the forest strata. In addition, all evidence of exploitation and disturbance within the FRs and

'public land' was documented. The latter was defined as unprotected, non-privately owned land adjacent to FRs where cultivation, grazing, mechanical logging, pit-sawing, collection of 'poles' (young trees with a dbh of 5–10 cm) and hunting are permitted.

3. Study sites

3.1. Nilo Catchment Forest Reserve, East Usambara Mountains

The East Usambara Mountains (Fig. 1.) form a steeply scarped, deeply dissected plateau between 900 and 1050 m, peaking at 1506 m (Mount Nilo). Nilo FR (38°39'–38°40'S, 4°52'–4°55'E) covers an area of 2720 ha and comprises three areas of submontane forest: Lutindi, Kilanga and Nkombola (classified as separate FRs until 1995). We surveyed forest at Lutindi and Kilanga. The main areas of forest occur on the ridges flanking the Bombo valley where the villages of Kwenkole and Kizara are located (Fig. 2).

3.1.1. Site 1: Lutindi (4°42'S, 38°39'E, access via Kwenkole village)

According to the foresters based in Kwenkole, most of the large trees were selectively logged ca. 20 years ago. However, near and on ridge-tops at ca. 1300 m patches of primary submontane forest remain (modal dbh: 30 cm, maximum dbh: 160 cm). Here the canopy provides 70% cover at 25–35 m with emergents to 40 m, and the forest is dominated by the two tree species, *Newtonia buchananii* and *Albizia gummifera*. In the sub-canopy, the dominant tree species were *Tabernaemontana* spp., *Allanblackia stuhlmanni*, *Rauwolfia caffra* and *Myrianthus holstii*, which accounted for >20% of the vegetation cover in this layer. Over 20% of the plant cover in the field layer comprised *Dracaena* sp., mainly in monospecific clumps. Along the numerous small streams, *Trichilia roka* and *Cryptomeria* sp. grow, and *Macaranga capensis* occurs in natural forest gaps. The slopes are 10–50° and the leaf litter is deep. In the public land bordering the reserve, cardamom, maize, beans, bananas and cassava are cultivated. It was estimated that ca. 20% of this land is still forested and that 1–5% of the canopy cover comprises the valuable timber species *Newtonia buchananii* and *Albizia gummifera*.

3.1.2. Site 2: Kilanga (4°55'S, 38°40'E, access via Kizara village)

The topography is similar to Lutindi with slopes of 10–50°. The canopy provides 50–60% cover at 30–40 m with emergents to 50 m. Modal dbh is 40 cm and maximum dbh is 150 cm. The main canopy tree species are *Ocotea usambarensis* and *Cephalosphaera usambarensis*, but no single tree species constitutes more than 20% of

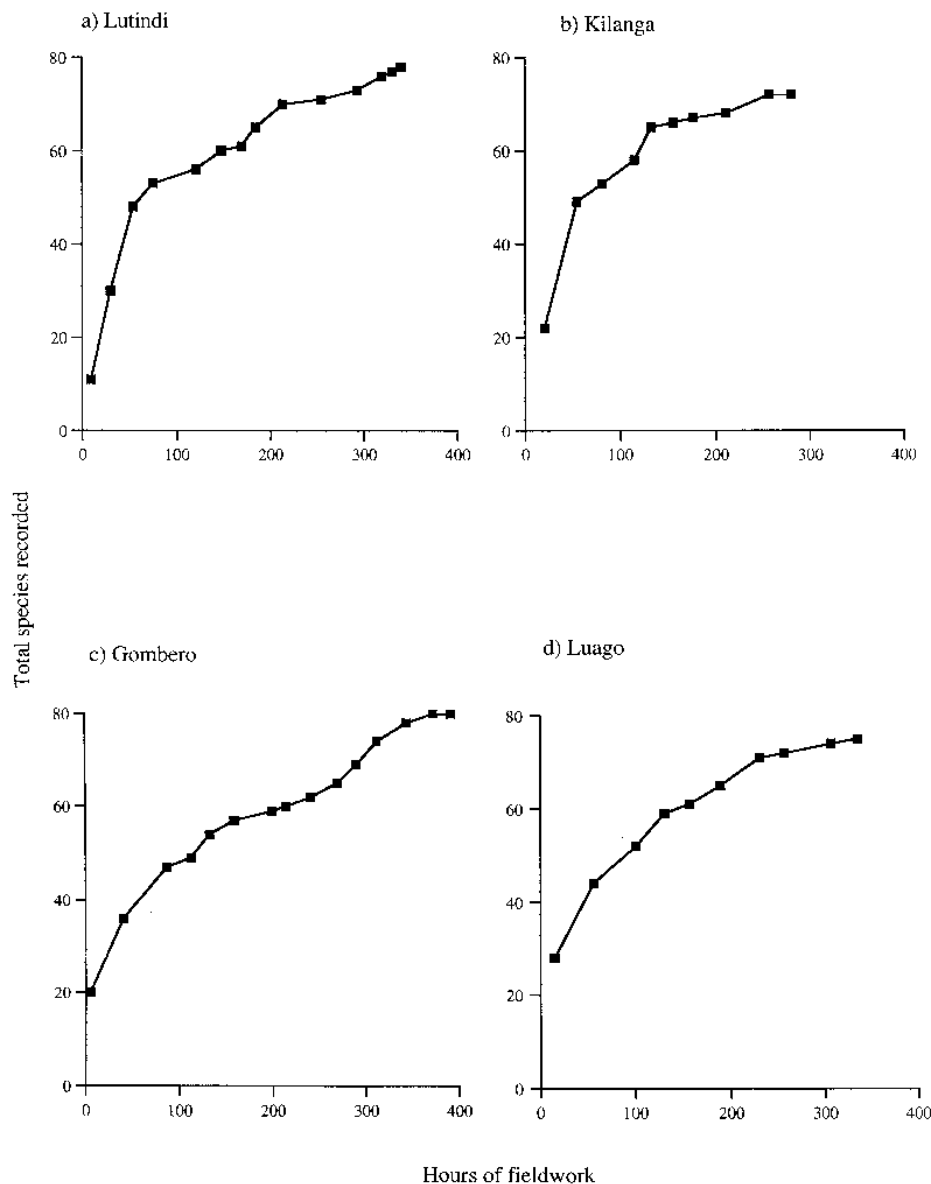


Fig. 4. Bird species-discovery curves for each study site.

the canopy cover. Tree ferns *Cyathea manniana* and figs *Ficus* spp. grow along the watercourses, *Macaranga capensis* and *Trema orientalis* occur in gaps, and lianas, pteridophytes and epiphytes grow on mature trees. *Croton* sp., *Rauvolfia* sp., *Albizia gummifera* and *Newtonia buchananii* account for 5–20% of all trees present. The forest floor has a deep leaf litter, dead wood and there are several small streams.

3.2. Nguru North Catchment Forest Reserve, Nguru Mountains

The Nguru mountains comprise several peaks and ridges running north–south on the eastern edge of the

Maasai steppe. Established in 1934 and covering an area of 14042 ha, Nguru North FR (5°27'–5°38'S, 37°36'–37°32'E) is the largest of the nine FRs in the Nguru Mountains (Lovett and Pócs, 1993). The forest is drier than in the East Usambaras, which perhaps results from the more inland location of these mountains and a rain shadow effect caused by the Nguru Mountains located ca. 50 km to the south-west. The area has a complicated topography, comprising many inter-digitating ridges at 860–1550 m with slopes of 10–40°. Between the ridges there are numerous streams, many of which have beds up to 20 m wide which fill during the wet season. Survey work was conducted in the northern (Gombero) and southern (Luago) regions of the reserve (Fig. 3).

3.2.1. Site 3: Gombero (5°29'S, 37°28'E, access via Gombero village)

Along the streams and on the slopes the canopy provides 60% cover at 25–30m with emergents to 40m. Modal dbh is 20cm and maximum dbh is 130cm. Approximately 5–20% of the tree species are figs *Ficus* spp., *Cylicomorpha parviflora* and *Macaranga capensis*, and 5–20% of the herbs consist of *Piper capensis* and *Cussonia* spp. On the slopes up to the ridge-tops at 1550m the main tree species are *Albizia gummifera*, *Olea* sp., *Teclea simplicifolia*, *Zenkerella* sp. and *Celtis zenkeri*. The forest floor has a dense leaf litter with much dead wood and lianas. An area of forest dominated by *Newtonia* spp. occurs on one side of a ridge at 1450m, where the canopy provides 70% cover at 30–40m with emergents up to 50m. Modal dbh is 30cm and maximum dbh is 160cm.

3.2.2. Site 4: Luago (5°36'S, 37°28'E, access via Luago village)

In the valleys the forest is dominated by the tree *Cylicomorpha parviflora* and the herb *Piper capensis*. On the slopes there are areas of intact forest where the canopy provides 65–70% cover at 30–40m with emergents to 45m and mainly comprises *Albizia gummifera*, *Newtonia buchananii*, *Vernonia cinerea* and *Antiaris usambarensis*. On the ridges *Diospyros abyssinica* is particularly common. The mid-storey and field-layer vegetation comprises 5–20% lianas, fungi and pteridophytes, and 1–5% figs *Ficus* spp., *Dracaena* sp., *Myrcianthus arboreus* and epiphytes. On the ridge forming the southernmost extension of the reserve the forest has a different structure: approximately 20% of the tree species are *Albizia gummifera*, there are several of the large, valuable timber trees *Khaya anthotheca*, the canopy provides 50–60% cover at 50m with emergents to 55m, modal dbh is 40cm and maximum dbh is 220cm.

4. Results and discussion

4.1. Species richness

We attempted to fit our species discovery data (Fig. 4) to the expression $S = k\sqrt{t}$; however, the fit was too poor to enable a meaningful asymptote to be estimated. Therefore, although the diurnal avifaunal inventory of each study site appeared reasonably complete, it was not possible to quantify the completeness of each survey. Taking Lutindi and Kilanga together, 91 bird species were recorded within and adjacent to Nilo FR, including 34 montane species. Nguu North FR had slightly more species (97) but only 21 of these were montane species. Of the 25 species caught in mist nets in Nilo FR, only two (pale-breasted illadopsis *Illadopsis rufipennis* and scaly-throated honeyguide *Indicator variegatus*) were not

recorded during transects. In Nguu North FR all 25 species caught were also sighted in the field. Mist-net and biometric data are presented in Seddon et al. (1995).

4.2. Species of conservation interest recorded

Table 2 gives the encounter rates of all species of conservation interest recorded during fieldwork, the altitudes at which they were recorded and their regional or global conservation status. The importance of the FRs for globally threatened species and species endemic to the Tanzania–Malawi Mountains and East African Coastal Forests EBA are discussed here. For observations on their ecology and conservation status, see Seddon et al. (in press), which also discusses the other species of conservation interest recorded.

4.2.1. Southern banded snake eagle *Circus fasciatus*

This species is resident in the coastal woodlands and forests of East Africa from south Somalia and the north Kenyan border south to KwaZulu-Natal, South Africa (Brown et al., 1982). Although seldom recorded more than 20km inland, it is common in the Korogwe area (N.J. Cordeiro, pers. comm.) and in the East Usambaras near Amani (Moreau, 1935; Collar and Stuart, 1985; Tye, 1993), and there are recent reports of breeding in the lowlands (Hipkiss et al., 1994).

This raptor was rare in both FRs. This scarcity of records is not surprising as this species occurs at low population densities throughout its range (N.J. Cordeiro, pers. comm.). Breeding records in lowland forest and coastal woodland in Kenya, Mozambique, Zimbabwe and Tanzania (Brown et al., 1982) indicate a preference for this type of habitat. However, in common with observations made at Amani (A. Tye, pers. comm.), we recorded this species in high altitude, intact submontane forest. Until more is ascertained about the habitat requirements of southern banded snake eagle it is difficult to assess the importance of either FR for its conservation.

4.2.2. Fischer's turaco *Tauraco fischeri*

This turaco is confined to forest from southern Somalia to northeastern Tanzania, ranging inland to the Shimba Hills, the East Usambara Mountains and Mafi Mountains, up to 1500m (Fry et al., 1988). It was fairly common within Nilo FR and the forested public land. The birds were mainly recorded in the canopy and sub-canopy of mature fruiting trees in intact submontane forest, suggesting some preference for this type of habitat (cf. Fry et al., 1988, who have noted that this species survives in thickets, wooded gardens and formerly forested areas which retain some large trees). Given the high levels of deforestation in the lowlands (Hamilton and Bensted-Smith, 1989), the forest in and around Nilo FR may represent an important site for the conservation of this species within the East Usambaras.

Table 2
Bird species of conservation interest recorded in two Forest Reserves

Species	Conservation status		Encounter rates (with altitudes of records in metres)			
	Global ^a	Regional ^b	Mount Nilo FR		Nguu North FR	
			Lutindi	Kilanga	Gombero	Luago
Southern banded snake eagle <i>Circaetus fasciolatus</i>	NT		0.3 (1100)		0.3 (1200)	0.6 (1360)
Lemon dove <i>Aplopelia larvata</i>		NT	0.3 (1200)	1.4 (1000)	2.2 (2.4) (1300–1500)	2.2 (15.8) (1300–1500)
Fischer's turaco <i>Tauraco fischeri</i>	NTRR [†]		5.2 (1200–1300)	4.5 (900–1030)		
Usambara eagle owl <i>Bubo vosseleri</i>	T(V)RR			^d (1000)		
Sharpe's akalat <i>Sheppardia sharpei</i>	RR		3.6 (1150–1250)	3.4 (850–1030)		
East coast akalat <i>Sheppardia gunningi</i>	T(V)				6.2 (1200–1500)	8.8 (1140–1200)
Evergreen forest warbler <i>Bradypterus barratti</i>		NT	5.5 (15.2) (1200–1500)	9.3 (48.8) (900–1030)	3.5 (26.3) (1100–1450)	19.0 ^e (1300–1450)
Southern hyliota <i>Hylia australis</i>		T(EN)	0.9 (1000–1200)	0.6 (1000)		
Long-billed tailorbird <i>Orthotomus moreaui</i>	T(C)RR		^c (1200–1250)			
Red-capped forest warbler <i>Orthotomus metopias</i>	RR		11.2 (1200–1250)	1.1 (900)		
Spot-throat <i>Modulatrix stictigula</i>	RR		12.5 ^e (1170–1230)	1.5 (40.2) (1030)		
Uluguru violet-backed sunbird <i>Anthreptes neglectus</i>		T(V)	1.5 (1000)	0.7 (900)	4.8 (1300–1350)	4.1 (1140)
Amani sunbird <i>Anthreptes pallidigaster</i>	T(V)RR [†]		6.0 (1200)	4.5 (1030)		
Banded green sunbird <i>Anthreptes rubritorques</i>	T(V)RR		2.7 (900)	1.9 (1030)	3.0 (1500)	4.1 (1280)
Moreau's sunbird <i>Nectarinia moreaui</i>	NTRR				1.1 (1360–1500)	
Kenrick's starling <i>Poeoptera kenricki</i>	RR		2.7 (900–1280)	1.9 (750)	4.9 (1500)	0.6 (1140)
Usambara weaver <i>Ploceus nicolli</i>	T(V)RR		3.3 (900–1200)	0.4 (1030)		

^a T=threatened; NT=near-threatened; (C)=critical; (EN)=endangered; (V)=vulnerable (Collar et al., 1994); RR=restricted range in the Tanzania–Malawi mountains EBA (C24); [†] also restricted range in the East African Coastal forests EBA (C23) (Stattersfield et al., 1998).

^b Status in East Africa (Bennun and Njoroge, 1996).

^c Aural records for highly vocal but elusive species.

^d Nocturnal aural records (encounter rate not appropriate).

^e Recorded by Cordeiro (1998).

4.2.3. Usambara eagle owl *Bubo vosseleri*

This elusive owl is only known from a few sites in the Usambara Mountains (Collar et al., 1994) and one site in the Ulugurus (Hunter et al., 1996). There were 19 records from submontane forest at 900–1300 m from 1962 to 1985, mostly from the Amani area of the East

Usambaras and Mazumbai in the West Usambaras (Collar and Stuart, 1985).

While not recorded at Lutindi during our fieldwork, there were four aural records in intact submontane forest at Kilanga. The population size has been estimated at 200–1000 individuals (Collar and Stuart, 1985), but

the discovery of this owl in three East Usambara lowland sites (Evans et al., 1994) and in the Ulugurus suggests that it is more widespread than previously thought. However, this lowland habitat is limited in extent and is under even greater pressure than montane forest (Collar et al., 1994). Our records in Kilanga, together with those of Cordeiro (1998) in Lutindi, indicate that Nilo FR and the adjacent forest may represent an important site for this species.

4.2.4. *Sharpe's akalat* *Sheppardia sharpei*

This species is a common resident in the undergrowth of highland forest at 900–2600m (Keith et al., 1992). The nominate race is found in northern Malawi, and *S. s. usambarae* is restricted to the Usambaras, Ngurus, Ulugurus, Udzungwas and Southern Highlands of Tanzania (Keith et al., 1992).

This species was common at Lutindi and Kilanga. All records were of birds in intact, relatively undisturbed forest with a dense understorey, indicating that this species may be susceptible to forest degradation. The high encounter rates in and adjacent to Nilo FR suggest that adequate protection of the forest here would increase the long-term survival prospects of the species.

4.2.5. *East coast akalat* *Sheppardia gunningi*

This thrush inhabits three separate areas: the nominate race is found in small, coastal, lowland forests around Beira in Mozambique, *S. g. bensoni* is found at 475–1750m in northern Malawi, and the race *S. g. sokokensis* is found in lowland forest up to 300m in Kenya and up to 800m in eastern Tanzania in the East Usambaras, Pugu Hills, Rondo Plateau, Dondwe forest and Zanzibar (Keith et al., 1992; Collar et al., 1994).

This species was fairly common in Gombero and Luago in intact submontane forest along streams and in areas of dense vegetation. Our records of this species represent a new locality and an upward altitudinal range extension of 700m in Tanzania. The biometrics of the 20 individuals mist-netted are closer to *S. g. bensoni*, which is slightly larger than either *S. g. gunningi* or *S. g. sokokensis*. Given that *S. g. bensoni* occurs 800km to the south in Malawi, an undescribed subspecies may be present in the Ngurus (Seddon et al., in press), but further work and molecular studies are needed to ascertain this. The east coast akalat has a wide range, but the pressures being placed upon its lowland coastal forest habitat in Tanzania and Kenya are especially severe, and in Malawi much suitable forest has already been cleared (Collar and Stuart, 1985). Recent work in the Arabuko-Sokoke Forest indicated that this area may possess the largest population of east coast akalat in Kenya (Nemeth, 1996). As the other sites in Tanzania are small or have tiny populations (T. Evans, pers. comm.), the Ngurus may hold the largest population, making Nguru North FR an important site for this species.

4.2.6. *Long-billed tailorbird* *Orthotomus moreaui*

This forest warbler is known from two disjunct populations representing two races: *O. m. moreaui* occurs in the Anani area of the East Usambaras at 900–1050m, and *O. m. sousae* occurs on the Njesi Plateau in northern Mozambique at 1650m. The latter region has not been visited for over 50 years so the status of this species here is unknown. It inhabits dense undergrowth in forest, at the forest edge and in clearings (Collar et al., 1994).

Two individuals of this species were observed just outside the Nilo FR in degraded public land at 1200–1250m by Cordeiro (1998). Prior to this, the tailorbird had not been recorded during other recent fieldwork in the Usambaras (e.g. Evans and Anderson, 1993) despite large areas of apparently suitable habitat, suggesting that the warbler is vulnerable to forest clearance (Collar and Stuart 1985). However, given this species habitat preferences, it seems unlikely that forest clearance alone is responsible for the decline in numbers of this species and further work is needed to ascertain its ecological requirements. If further searches for this species in and adjacent to Nilo FR are successful, then this area represents an extremely important site for the conservation of the long-billed tailorbird.

4.2.7. *Red-capped forest warbler* *Orthotomus metopias*

This poorly known warbler inhabits dense understorey within and at the edge of moist forest at 1000–2500m in the Usambaras, Ngurus, Ukagurus, Udzungwas and Southern Highlands of Tanzania (Britton, 1980; Zimmerman et al., 1996) and in northern Mozambique (Dowsett and Forbes-Watson, 1993). There are very few records from the East Usambaras (e.g. Newmark, 1991; Cordeiro, 1998), possibly because of the concentration of fieldwork in the Anani area, where habitat may be unsuitable.

This species was common at Lutindi in the field layer of intact submontane forest, forest-edge and adjacent forested public land. We recorded only one individual in degraded forest, which contrasts with Cordeiro (1998) who recorded at least 4–6 individuals in this habitat. This suggests a degree of tolerance to habitat disturbance, although we agree with Newmark (1991) that this forest warbler may be forest-dependent. The fact that this species had a high encounter rate at Lutindi yet it is scarce elsewhere in the East Usambaras suggests that Nilo FR represents an important site for it.

4.2.8. *Spot-throat* *Modulatrix stictigula*

The nominate race is found in the Ngurus, Ukagurus and Usambaras, while *M. s. pressa* is found in the Ulugurus, Songea, Njombe and Mount Rungwe (southern Tanzania) and the Misuku Hills, north Malawi, primarily above 1200m (Keith et al., 1992).

On the basis of aural records, this elusive species was classified as abundant at Lutindi and Kilanga. All our records, and those of Cordeiro (1998), were from the dense understorey of intact submontane forest, suggesting that it may be sensitive to habitat degradation (cf. Keith et al., 1992). The fact that spot-throat had a high encounter rate in Nilo FR but has been classified as rare elsewhere in the Usambaras (Zimmerman et al., 1996), suggests that this site may be important for the conservation of this species in these mountains.

4.2.9. *Anxani sunbird* *Anthreptes pallidigaster*

This species is confined to one site in Kenya (the Arabuko-Sokoke forest), and two in Tanzania: the Udzungwas at 1350–1550 m (Dinesen et al., 1993) and the East Usambaras, only up to 1100 m (Collar and Stuart, 1985; Hipkiss et al., 1994; A. Tye, pers. comm.).

This species was classed as fairly common in Nilo FR, but all records were from a single forest clearing and it is possible that they refer to repeated encounters with the same individuals. Together with those of Cordeiro (1998), our records represent an upward altitude extension of 150 m in the East Usambaras, indicating that the altitudinal range and hence the population of this sunbird is larger than previously thought. This species is apparently a canopy specialist preferring intact forest (Collar et al., 1994), so it is likely that its long-term survival is not assured unless areas of intact forest (such as those within and around Nilo FR) are protected.

4.2.10. *Banded green sunbird* *Anthreptes rubritorques*

This sunbird was previously only known from four forest areas: the Usambaras, Ngurus, Ulugurus and Udzungwas (Collar et al., 1994). It is common in the East Usambara submontane forests, with a small population in the lowlands (Hipkiss et al., 1994), and in the south-western region of the West Usambaras. It is generally considered to be scarce throughout the rest of its range (Collar et al., 1994).

This species was classified as uncommon at all sites in intact submontane forest, secondary forest clearings and, in Nguu North FR, in the ecotone between submontane and miombo woodland. Our records in the Nguus represent a new locality for this species. Most records were of birds in the subcanopy and canopy of mature trees either in forest clearings within the FR or at the forest edge. Although some of the Lutindi records were of individuals foraging in low scrub vegetation in the public land, these birds were always recorded in the vicinity of the few remaining mature trees. All of the Nguu North FR records were of individuals within or at the edge of intact submontane forest. Furthermore, at Lutindi and Luago we observed banded green sunbirds constructing nests in mature trees. Our observations suggest that this species may be tolerant of habitat disturbance, providing tall, mature forest trees remain.

Thus, better protection of forest comprising mature trees within and adjacent to Nilo and Nguu North FRs will improve the long-term survival prospects of this species.

4.2.11. *Moreau's sunbird* *Nectarinia moreaui*

This species was previously only known from moist forest above 1300 m in the Ngurus, Ukagurus, Udzungwas and Uvindudas (Britton, 1980).

This sunbird was uncommon at Gombero. It is likely to occur in other parts of the Nguus, which represent a new locality for it, and further work should be conducted in Derema and Kilindi FRs, where there appears to be much suitable habitat. Given the high levels of habitat destruction elsewhere in its range, Nguu North FR and potentially the entire Nguus may represent an important stronghold for this species.

4.2.12. *Kenrick's starling* *Poeoptera kenricki*

This arboreal starling is common in highland forest at 900–2500 m in central Kenya and eastern Tanzania (Britton, 1980). In the non-breeding season, it is known down to 450 m in Tanzania (Zimmerman et al., 1996).

This species was uncommon in intact and degraded forest-edge habitat, and it was observed predominantly in the canopy of mature trees at 20–40 m in both FRs, suggesting that it may be sensitive to logging. Improved protection of both FRs and of the intact forest adjacent to them is likely, in the long term, to enhance this species' chances of survival.

4.2.13. *Usambara weaver* *Ploceus nicolli*

This forest weaver mainly inhabits the canopy of evergreen montane forest, but has been noted on forest edge and in isolated trees in cultivated areas (Stuart and Hutton, 1978; van der Willigen and Lovett, 1981). The nominate race is endemic to the East and West Usambaras at 900–2200 m, while *P. n. anderseni* is known from the Ulugurus and Udzungwas (Britton, 1980).

This species was uncommon at both sites in Nilo FR in the canopy and subcanopy of mature trees (e.g. *Albizia* spp. and *Newtonia* spp.), in clearings within intact submontane forest and in cultivated public land with scattered mature trees. It was not recorded in the East Usambaras from 1932 until 1994, when it was observed just outside Nilo FR (Sclater and Moreau, 1932; Sclater and Moreau, 1933; Cordeiro, 1995). Nilo FR and the adjacent forested public land is likely to represent the last remaining stronghold in the East Usambaras for the nominate race and it is therefore a very important site for the conservation of this species.

4.3. *Species of conservation interest not recorded*

Two species of conservation interest, known from the East Usambaras, were not recorded in either FR.

4.3.1. *Swynnerton's forest robin* *Swynnertonia swynnertoni*

This terrestrial robin is limited to a few forest patches, including Chirinda in Zimbabwe, Mount Gorongosa in Mozambique, the Udzungwas, and the East Usambaras (endemic race *S. s. rodgersi*, Anderson et al., 1997) (Britton, 1980; Zimmerman et al., 1996).

This species is known to inhabit montane forest up to 1750 m in Zimbabwe, but it is only known from below 550 m in the East Usambara lowland forests (Tye, 1993; Evans et al., 1994). Although Swynnerton's forest robin was not recorded in Nguu North FR, it may occur in moister submontane forest at higher altitudes in the adjacent Derema FR.

4.3.2. *Dappled mountain robin* *Modulatrix orostruthus*

This species occurs in three isolated populations in the East Usambaras, the Udzungwas and in Mozambique. It is only known from moist forest at 900 m in the vicinity of Amani in the East Usambaras, where, following its discovery in 1935 (Sclater and Moreau, 1935), it was not recorded again until 1962 (Britton, 1980; Keith et al., 1992).

This highly elusive species may have been overlooked in this study and the 1995 survey (Cordeiro, 1998) since apparently suitable habitat is present in Nilo FR. The absence of records from the Nguu North FR possibly relates to the dryness of the forest, but further surveys should be carried out at higher altitudes and on the wetter eastern slopes. The lack of records despite much ornithological effort (e.g. Evans and Anderson, 1993) implies that the range of this species within the East Usambaras is limited. It may be restricted to the Amani area, and the population may be as small as 85–200 individuals (Stuart and Hutton, 1978).

4.4. *The relative importance of Nilo FR, the East Usambaras and the Ngus for the conservation of montane forest birds in Tanzania*

Fig. 5a illustrates the avifaunal composition of Nilo FR, the Amani FRs and Mount Mlali FR in terms of the number of (a) total montane forest species, (b) restricted range and near-threatened montane species, and (c) threatened montane species known from Tanzania. Fig. 5b illustrates the avifaunal composition for each of the nine areas of montane and/or submontane forest that are included in the Tanzania–Malawi Endemic Bird Area (Fig. 1).

The forest in and adjacent to Nilo FR supports four globally threatened and two globally near-threatened species, two regionally threatened and two regionally near-threatened species, and ten species in total with restricted ranges. Nilo FR supports a similar number of Tanzania's montane forest species (35 species, 58%) to the Amani FRs (37 species, 62%), but it has a much

greater diversity than Mount Mlali FR, which is so far known to support only 18 species (30% of montane species). This result is not surprising as Mount Mlali encompasses the smallest area of submontane forest (309 ha) and full surveys have not been conducted either at high altitudes or on the wetter eastern slopes (A. Tye, pers. comm.). Nilo FR (2720 ha) harbours as many near-threatened, restricted range and threatened montane species as the Amani FRs (2434 ha), and considerably more than Mount Mlali FR which only contains 20% (three species) of near-threatened and restricted range montane and 25% (three species) of globally threatened montane species known from Tanzania. Within the East Usambaras, Nilo FR thus ranks highly in all three measures of conservation importance. Furthermore, it is the last remaining stronghold in the East Usambaras for the nominate race of Usambara weaver, it harbours one of only two populations of the critically endangered long-billed tailorbird, and it may possess an important population of Usambara eagle owl. As the highest peak in the East Usambaras, Nilo FR has a unique assemblage of high altitude fauna and flora. Nilo FR is an important site in the East Usambaras, and although these mountains do not possess a single forest block endemic bird species (cf. the Udzungwas, Ulugurus and West Usambaras), the East Usambaras are a very high priority for the conservation of montane forest birds among other Tanzanian forest blocks. They harbour 68% (40 species) of all montane forest-dwelling species known from Tanzania, 40% (six species) of threatened montane species, and 50% (six species) of near-threatened and restricted range species.

Nguu North FR supports eight species of conservation interest, including two globally threatened and two globally near-threatened species, one regionally threatened and two regionally near-threatened species and four species in total with restricted ranges. Nguu North FR, and possibly the whole forest block, possesses fewer species of conservation interest (e.g. 25% of near-threatened and restricted range species) than other forest blocks in Tanzania (Fig. 5b), and does not possess any single forest block endemic bird species. Additionally, it has a lower overall diversity of montane forest species (19 species, 32%). Despite this, the Ngus are important for supporting the largest known population of east coast akalat in Tanzania. Furthermore, the Ngus may represent an important site for species such as Moreau's sunbird and banded green sunbird whose survival elsewhere is threatened by habitat destruction.

It is very likely that further work in many of these areas (especially other FRs in the Ngus where there is intact submontane forest up to 1600 m) may reveal populations of further species of conservation interest, elevating the relative conservation importance of these areas within Tanzania.

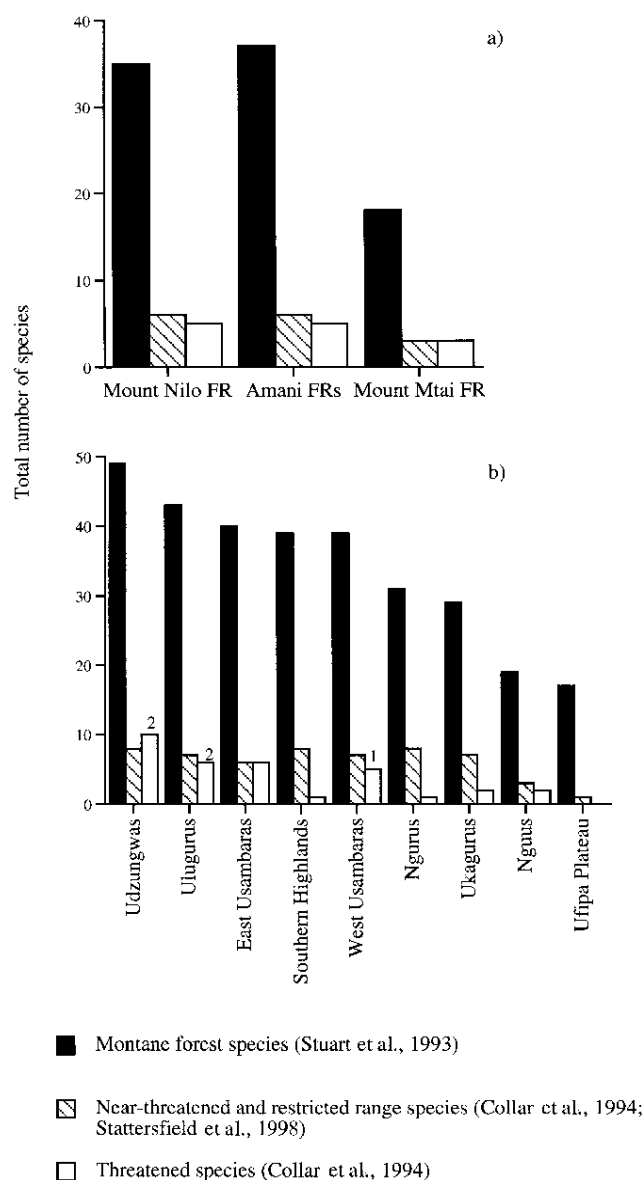


Fig. 5. A comparison of the avifaunal composition of (a) three FRs in the East Usambaras and (b) nine forest blocks in Tanzania. Figures above the bars give numbers of single forest block endemic bird species.

4.5. Threats to the forest

We found that, despite their FR status, Nilo and North Ngau FRs are subject to the various forms of habitat degradation prevalent in forests throughout Tanzania (see Rodgers, 1993). Cultivation and pole collecting are currently the main threats to the forest in Nilo FR, and pit-sawing represents a serious threat to the forest in the public land. We predict that pit-sawing in the reserve will increase once the large, valuable timber trees *Newtonia* sp. and *Albizia* sp. have been removed from the public land, and that livestock grazing will increase in intensity once suitable forage within

the public land has been exhausted. There was considerably less human disturbance in Ngau North FR than in Nilo FR. Nonetheless, pit-sawing does represent a serious threat and we predict that this practice, along with mechanical logging, will increase in frequency once the road south of Luago has been constructed. Cultivation within this reserve was minimal in 1995 but may increase owing to rising population pressures on the land. For a detailed description of the threats to the forest in both reserves see Seddon et al. (1995).

In 1995 there was a growing concern in the local communities about the rate and extent of forest loss and the impact of deforestation on water supplies. Local people seemed willing to become involved with sustainable forest management and to start alternative schemes such as pole plantations. Given the conservation importance of the forest within and adjacent to both FRs and the impact habitat degradation is likely to have on birds, we conclude that there is an urgent need for an effective, long-term conservation programme, which should take advantage of the opportunities currently afforded by local interest.

4.6. Recommendations for the management of Nilo and Ngau North FRs

We recommend that both FRs should be enlarged by incorporation of adjacent forested land. In the Ngus this should involve the amalgamation of Derema FR with Ngau North FR. In both areas the boundaries need clear demarcation. The conflict between the need to conserve the forest and the dependence of the local people on it for fuel and building materials could be resolved by spatial separation of land use practices through zoning (Hamilton, 1989). Following Rodgers (1993), we recommend that the two FRs be divided into three zones, which should be managed by the regional forestry office with the involvement of the local community, as follows:

Biodiversity zone. This area should encompass intact submontane forest above 1000 m in Lutindi and at 900–1200 m in Kilanga in Nilo FR, and at 1100–1600 m in Ngau North FR. This zone would protect the habitat of species of conservation interest that are dependent on intact forest and/or a dense understorey. Any form of disturbance or exploitation should be strictly prohibited.

Catchment zone. This area would incorporate forest on slopes of $>40^\circ$ and areas 50 m either side of the streams and watershed ridges, and would protect the natural catchment properties of the forest and prevent erosion. In Ngau North FR, this would secure future water supplies to villages such as Gombero, which are seriously

short of water. Pit-sawing, pole-collecting, cultivation and in particular mechanical logging should be prohibited within this zone.

Productive zone: This zone should include some of the forested public land adjacent to both FRs (e.g. at 1000–1200m in Kilanga and at 900–1100m near Luago) and cultivated public land (e.g. at 800–1200m in Lutindi and 700–900m in Kilanga). Within this zone sustainable production of poles with rotations and replanting (Hamilton, 1989), wood for fuel, medicinal plants, fodder and other forest products would be permitted. A quota system for pit-sawing and pole-collection could be instigated and managed by the local community. Only light machinery would be permitted to enter this zone in order to minimise soil compaction and erosion. To support these initiatives, we recommend that environmental education activities be initiated in the villages adjacent to the FRs (e.g. Kwenkole, Kizara, Gombero and Luago).

Prior to our work, the Nguu Mountains were poorly known and they are probably still under-rated in terms of their biological and conservation importance. We therefore strongly recommend that more biological research be carried out in Nguu North FR and the adjacent FRs (especially Derema and Kilindi) which we believe may hold important populations of animals and plants of conservation interest.

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