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CENTRE FOR BIODIVERSITY
RESEARCH REPORTS:
ORNITHOLOGY

NO. 36, JUNE 2000

Supported by the
Global Environment Facility
Tana River Primate National Reserve Project

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Research Reports of the Centre for Biodiversity,
National Museums of Kenya: Ornithology, 36 (2000)

Introduction

The lower Tana River forest patches in coastal Kenya are remnants of a vast tropical forest that once extended from the east coast of Africa to the Congo Basin during the Miocene (some 26 million years ago). The forests now occur patchily on each side of the river. These present remnants are the only true representative in East Africa of a West African type of riverine forest, and comprise of deciduous woodland and lowland evergreen forest.

The lower Tana River forests are listed among the key forests for bird conservation in Africa (Collar & Stuart 1988) and qualify as an Important Bird Area (Bennun & Njoroge 1999). Several species in these forests are either globally threatened or near threatened (Bennun & Njoroge 1999). However, there has been little systematic ornithological work in the lower Tana, and information on the avifauna is patchy and scant. The forest fragments are at different successional stages and are unlikely to be of equal conservation importance for birds. Some general surveys were carried out in the 1970s (Andrews *et al.* 1975, Marsh *et al.* 1975). More recently, there have been focused avifaunal surveys of particular forest patches (Oyugi & Amutete 1999). This series of surveys was continued in February 2000, covering an additional three fragments within the Tana River Primate National Reserve.

Sites and methods

Study areas

The lower Tana River forest patches lie at an altitude of 40-70 m within the floodplain of the river in Tana River District of Coast Province, at approximately 2°30'S and 40°30'E.

Assessments of avifauna and vegetation were made in three forest fragments, Guru North (5 ha), Guru South (46 ha) and Makere West (48 ha), from 18–23 February 2000. Accessibility and security influenced the choice of fragments, all three of which are all on the western bank of the River Tana.

Weather

During our survey the weather was cool in the early morning, becoming sunny and hot by mid-morning, with clear skies.

Avifauna survey

Birds were surveyed by a combination of mist-netting, timed species-counts (TSC) and general observations.

i) Mist-netting

To survey understory birds, mist-netting was carried out on a cleared narrow trial 105 m long. Small-mesh mist-nets, 3 m high and 105 m in total length were erected and operated for two mornings at each site. Nets were opened for four hours each morning, starting from between 06:30–07:30 h depending on the availability of security personnel.

Table 1: Mist-netting effort at the three forest fragments in the Tana River Primate Reserve

Site	Date	Area (ha)	Net length (m)	Hours	Total m h
Guru North	18–19/2/00	5	105	8.58	942
Guru South	20–21/2/00	46	105	9.00	945
Makere West	22–23/2/00	48	105	9.20	980

ii) Timed species counts

TSCs were perormed simultaneously with mist-netting. The procedure followed Bennun & Waiyaki (1993). Every time a new bird species was detected during a count, the time was recorded, together with an indication whether the detection was by sight or sound, whether the bird was within 25 m of the observer and, if so, whether it was above 3 m from ground. Each count was 40 minutes long. A total of 12 counts were conducted in each study area.

Relative abundance indices for canopy/mid-canopy level species were calculated using only records for birds detected within 25 m of the observer and above 3 m from ground. For each count, each species was scored according to when it was first recorded (4 in the first ten minutes, 3 if in next ten minutes and so on). The scores were then averaged over all counts to give a simple relative abundance index.

General observations of birds were also made at any time.

Vegetation survey method

We walked along randomly selected directions in the forests and marked 60 points at intervals of 20 m. At each point, canopy height was estimated to the nearest 1 m and canopy cover was visually estimated as a percentage. Shrub density was determined by measuring the number of squares visible on a chequered board (40 cm x 40 cm, with 8 cm x 8 cm black and white squares) held at 1.5 m height at 5 m distance directly north and south of each sample point. Two plots (1 m x 1 m) were also established on the north and south compass bearings at a distance of 5 m from the point. In each plot, percentage herb and litter cover and bare ground were visually estimated. All vegetation parameters were averaged for each forest patch and Student-Newman-Keuls multiple range tests (STATISTICA version 5.0) used to assess structural differences among the fragments.

Categorisation of birds

a) Three forest-dependence categories were used following Bennun *et al.* (1996). The categories were:

- I 'FF species' (forest specialists). These are true forest birds, characteristic of the interior of undisturbed forest.
- II 'F species' (forest generalist). These may occur in undisturbed forest but are also regularly found in forest strips, edges and gaps.
- III 'f species' (forest visitors). These are birds that are often recorded in forest but are not dependent upon it.

b) Global threat categories follow Collar *et al.* (1994).

c) Regional threat categories follow Bennun & Njoroge (1996).

d) Birds characteristic of the East African Coast Biome follow the list in Fishpool (1996).

Results

Species list

A total of 82 species was recorded in the three fragments (Table 2). These included seven forest specialists (FF), 19 forest generalists (F) and 22 forest visitors (f). Five species recorded were characteristic of the East African Coast Biome. The 48 forest birds recorded represent 57.1% of the 84 species recorded for the lower Tana River forests by Mlingwa *et al.* (in press), and the five species of the East Coast biome represent 25% of the 20 known from this area (Bennun & Njoroge 1999).

We recorded the globally near-threatened Fischer's Turaco *Tauraco fischeri* in Guru North and Guru

South, but not in Makere. Two other Red Data Book forest species, East Coast Akalat *Shephardia gunningi* (Vulnerable) and Plain-backed Sunbird *Anthreptes reichenowi* (near-threatened) were not recorded. The regionally Vulnerable Little Yellow Flycatcher was recorded at all three sites. Another notable record was Pel's Fishing Owl, an uncommon species whose stronghold in Kenya is the Tana River forests. Brown Hooded Kingfisher *Halcyon albiventris* was the most obvious non-forest species at all the sites.

Table 2. Birds recorded in the three study areas

English name	Scientific name	Status	Guru N	Guru S	Makere W
Green-backed Heron	*Butorides striatus*	w	X	X	X
Grey Heron	*Ardea cinerea*	w	X	X	X
Black-headed Heron	*Ardea melanocephala*	w	-	-	X
Hamerkop	*Scopus umbretta*	w	X	-	-
African Open-billed Stork	*Anastomus lamelligerus*	w	X	X	X
Hadada Ibis	*Bostrychia hagedash*	w	X	X	X
African Cuckoo Hawk	*Aviceda cuculoides*	F	-	-	X
African Harrier Hawk	*Polyboroides typus*	F	-	-	X
E. Pale Chanting Goshawk	*Melierax poliopterus*	S	X	X	X
African Goshawk	*Accipiter tachiro*	F	X	X	X
Little Sparrowhawk	*Accipiter minullus*	F	X	X	-
African Fish Eagle	*Haliaeetus vocifer*	w	X	X	X
Crested Guineafowl	*Guttera pucherani*	F	-	X	-
Water Thick-knee	*Burhinus vermiculatus*	w	X	X	X
Spur-winged Plover	*Vanellus spinosus*	w	X	X	X
Common Sandpiper	*Actitis hypoleucos*	w	X	X	X
African Green Pigeon	*Treron calva*	F	X	X	-
Tambourine Dove	*Turtur tympanistria*	F	X	X	X
Emerald-spotted Wood Dove	*Turtur chalcospilos*	F	X	X	X
Red-eyed Dove	*Streptopelia semitorquata*	f	X	X	X
Ring-necked Dove	*Streptopelia capicola*	f	X	X	X
African Orange-bellied Parrot	*Poicephalus rufiventris*	S	-	X	-
Fischer's Turaco	*Tauraco fischeri*	FCNt	X	X	-
Levaillant's Cuckoo	*Oxylophus levaillantii*	F	X	-	-
White-browed Coucal	*Centropus superciliosus*	S	X	X	X
Pel's Fishing Owl	*Scotopelia peli*	F	X	-	-
African Palm Swift	*Cypsiurus parvus*	S	X	-	X
Narina Trogon	*Apaloderma narina*	F	-	X	-
Grey-headed Kingfisher	*Halcyon leucocephala*	F	X	X	-
Brown-hooded Kingfisher	*Halcyon albiventris*	S	X	X	X
African Pygmy Kingfisher	*Ispidina picta*	F	X	-	-
Pied Kingfisher	*Ceryle rudis*	w	X	X	X
Carmine Bee-eater	*Merops nubicus*	S	X	X	X
White-throated Bee-eater	*Merops albicollis*	S	-	-	X
Lilac-breasted Roller	*Coracias caudata*	S	X	X	X
Green Wood-hoopoe	*Phoeniculus purpureus*	F	X	X	X
Common Scimitarbill	*Rhinopomastus cyanomelas*	S	X	X	X
Crowned Hornbill	*Tockus alboterminatus*	F	-	-	X
Trumpeter Hornbill	*Bycanistes bucinator*	F	X	X	-
Yellow-rumped Tinkerbird	*Pogoniulus bilineatus*	f	X	X	X
Red-fronted Tinkerbird	*Pogoniulus pusillus*	s	-	X	X
Black-collared Barbet	*Lybius torquatus*	f	X	X	-
Scaly-throated Honeyguide	*Indicator variegatus*	f	-	X	-
Greater Honeyguide	*Indicator indicator*	f	X	X	X

English name	Scientific name	Status	Guru N	Guru S	Makere W
Lesser Honeyguide	*Indicator minor*	f	X	-	-
Mombasa Woodpecker	*Campethera mombassica*	FC	-	X	X
Little Spotted Woodpecker	*Campethera cailliautii*	f	-	X	-
Cardinal Woodpecker	*Denropicos fuscescens*	f	-	X	-
Bearded Woodpecker	*Thripias namaquus*	f	X	X	-
Wire-tailed Swallow	*Hirundo smithii*	s	-	-	X
Fischer's Greenbul	*Phyllastrephus fischeri*	FC	X	-	-
Northern Brownbul	*Phyllastrephus strepitans*	fC	X	X	-
Terrestrial Brownbul	*Phyllastrephus terrestris*	F	X	-	-
Red-capped Robin Chat	*Cossypha natalensis*	F	X	X	X
Red-tailed Ant Thrush	*Neocossyphus rufus*	FF	-	X	-
Eastern Bearded Scrub Robin	*Cercotrichas quadrivirgata*	f	-	X	X
Pale Flycatcher	*Bradornis pallidus*		-	-	X
Grey-backed Camaroptera	*Camaroptera brachyura*	f	X	-	X
Black-headed Apalis	*Apalis melanocephala*	FF	X	X	X
Little Yellow Flycatcher	*Erythrocercus holochlorus*	FFCvu	X	X	X
Blue-mantled Cr. Flycatcher	*Trochocercus cyanomelas*	FF	-	X	-
African Paradise Flycatcher	*Terpsiphone viridis*	f	X	X	X
Pale Batis	*Batis soror*	FC	X		X
Black-throated Wattle-eye	*Platysteira peltata*	F	X	X	
Retz's Helmet-shrike	*Prionops retzii*	F	-	-	X
Brubru	*Nilaus afer*	s	X	X	X
Four-coloured Bush-shrike	*Malaconotus quadricolor*	FC	-	-	X
Tropical Boubou	*Laniarius aethiopicus*	f	X	X	X
Black-backed Puffback	*Dryoscopus cubla*	F	X	X	X
Common Drongo	*Dicrurus adsimilis*	s	X	X	X
Square-tailed Drongo	*Dicrurus ludwigii*	F	-	X	X
Black-headed Oriole	*Oriolus larvatus*	f	X	X	-
Black-bellied Starling	*Lamprotornis corruscus*	FF	X	X	X
Collared Sunbird	*Anthreptes collaris*	F	-	X	-
Olive Sunbird	*Nectarinia olivacea*	FF	X	X	X
Hunter's Sunbird	*Nectarinia hunteri*	s	-	-	X
Black-necked Weaver	*Ploceus nigricollis*	f	-	X	-
Spectacled Weaver	*Ploceus ocularis*	s	-	X	X
Golden Palm Weaver	*Ploceus bojeri*	F	-	-	X
Dark-backed Weaver	*Ploceus bicolor*	F	X	-	-

Key: FF, forest-specialist species; F:, forest-generalist species ; f, forest visitors; s, savanna/woodland species; w, wetland species; Nt, globally near-threatened species; vu, regionally Vulnerable species; C, East Coast Biome species; X, present; -, not recorded.

Table 3. Summary of the bird species recorded from the three study sites

	Guru N	Guru S	Makere W
Total no. species	54	58	52
Total no. terrestrial species	44	49	42
FF species	4	6	4
%FF species	9.1	12.2	9.5
F species	19	17	15
% F species	43.2	34.7	35.7
Forest dependent species (FF+F)	23	23	19
% forest dependents	52.3	46.9	45.2
f species	12	15	8
%f species	27.3	30.6	19.0
s species	9	11	15
% s species	20.5	22.4	35.7

Key: FF, forest-specialist species; F:, forest-generalist species ; f, forest visitors; s, savanna/woodland species

All sites showed a similar species composition, with 42–49 terrestrial species recorded overall, of which 45.2–52.3% were forest-dependent birds. At all sites a substantial proportion of the bird species recorded are not usually found in forest (i.e, savanna or woodland species), the proportion being least at Guru North (20.5%) and greatest at Makere West (35.7%).

Undergrowth species

Results of mist-netting are shown in Tables 4–6. The Olive Sunbird was the most captured species at both Guru North and Guru South with capture rates of 5.3 and 4.2 birds/1000 m h respectively. However this species was not trapped at Makere West. African Pygmy Kingfisher was second-ranked at Guru North with a high capture rate of 4.3 birds/1000 m h; in Guru South Eastern Bearded Scrub Robin took second place. The percentage of forest-dependent individuals was highest at Guru South (62.5%) and lowest at Makere West (40.0%). A Yellow-rumped Tinkerbird *Pogoniulus bilineatus* was captured and ringed in Guru North, constituting a new record for atlas square 79C (Lewis & Pomeroy 1989).

Overall numbers captured were low. Makere West was notably impoverished in forest undergrowth birds, with only three individuals of two species, compared to Guru South and Guru North (16 individuals of seven species and 13 individuals of six species respectively). Capture rates were also notably low, and no forest-specialist undergrowth species occurred in Makere West.

Table 4. Bird species ringed at Guru North in order of abundance

Common name	Status	No.	Capture/ 1000 m h	Rank
Olive Sunbird	FF	5	5.3	1
African Pygmy Kingfisher	f	4	4.3	2
African Goshawk	F	1	1.1	3
Grey-headed Kingfisher	f	1	1.1	3
Yellow-rumped Tinkerbird	FF	1	1.1	3
Grey-backed Camaroptera	f	1	1.1	3

Table 5. Bird species ringed at Guru South in order of abundance

Species	Status	No.	Captures/ 1000 m h	Rank
Olive Sunbird	FF	4	4.2	1
Eastern Bearded Scrub Robin	f	3	3.2	2
Red-tailed Ant Thrush	FF	2	2.1	3
Terrestrial Brownbul	F	2	2.1	3
African Pygmy Kingfisher	f	2	2.1	3
African Goshawk	F	2	2.1	3
Grey-backed Camaroptera	f	1	1.1	4

Table 6. Birds ringed in Makere West, in order of abundance

Species	Status	No.	Captures/ 1000 m h	Rank
Northern Brownbul	fCC	3	3.1	1
Collared Sunbird	F	2	2.0	2

Table 7. Summary of ringing results for the three study sites

Variable	Guru N	Guru S	Makere W
No. captured	13	16	5
Capture rate (birds/1000 m h)	123.8	152.4	47.6
No of species	6	7	2
No. of FF species	2	2	0
% of FF species	33.3	28.6	0.0
No. of F species	1	2	1
% of F species	16.7	28.6	50.0
No of f species	3	3	1
% of f species	50.0	42.9	50.0
No. of FF individuals	6	6	0
% of FF individuals	46.2	37.5	0.0
No. of F individuals	1	4	2
% of F individuals	7.7	25.0	40.0
No of f individuals	6	6	3
% of f individuals	46.2	37.5	60.0

Timed species-counts

The results of the timed species-counts are shown in Tables 8–10. Of the species in the top ten ranks at each site, the proportion of forest-dependent birds was 60% at Guru North (n = 15), 52.9% at Guru South (n = 17) and 45.5% at Makere West (n = 11).

Table 8. Results of timed-species counts at Guru North (n = 12)

Species	Status	Index	Rank
Tropical Boubou	f	2.50	1
Brown-hooded Kingfisher	s	1.67	2
Black-bellied Starling	F	1.42	3
Black-headed Apalis	FF	1.42	3
Olive Sunbird	FF	1.42	3
Yellow-rumped Tinkerbird	f	1.17	4
Pale Batis	FC	1.08	5
Red-capped Robin-Chat	F	1.00	6
Fischer's Turaco	FCNt	0.92	7
Tambourine Dove	f	0.92	7
Dark-backed Weaver	F	0.83	8
Green Wood-hoopoe	f	0.83	8
Red-eyed Dove	f	0.83	8
African Goshawk	F	0.67	9
Black-backed Puffback	F	0.58	10
Black-headed Oriole	f	0.50	11
Hamerkop	-	0.50	11
Little Yellow Flycatcher	FFCvu	0.50	11
Terrestrial Brownbul	F	0.50	11
Trumpeter Hornbill	F	0.50	11
Greater Honeyguide	S	0.42	12
Grey-headed Kingfisher	F	0.42	12
African Green Pigeon	F	0.33	13
African Pygmy Kingfisher	F	0.33	13
Bearded Woodpecker	F	0.33	13
Emerald-spotted Wood Dove	F	0.33	13
Hadada Ibis	w	0.33	13
Lesser Honeyguide	F	0.33	13
White-browed Coucal	S	0.33	13
African Paradise Flycatcher	F	0.25	14
Fischer's Greenbul	FC	0.25	14
Grey-backed Camaroptera	f	0.25	14
Pel's Fishing Owl	F	0.25	14
African Fish Eagle	w	0.17	15
Black-collared Barbet	F	0.17	15
Levaillant's Cuckoo	F	0.17	15
African Palm Swift	s	0.08	16
Black-throated Wattle-eye	F	0.08	16
Little Sparrowhawk	f	0.08	16
Northern Brownbul	fC	0.08	16

Only data for birds recorded above 3 m and within 25 m are included. For status codes, see Table 1.

Table 9. Results of timed species-counts at Guru South (n = 12)

Species	Status	Index	Rank
Brown-hooded Kingfisher	s	3.57	1
Tropical Boubou	f	3.43	2
Black-backed Puffback	F	2.14	3
Olive Sunbird	FF	2.14	3
Four-coloured Bush-shrike	FC	1.86	4
Square-tailed Drongo	F	1.86	4
Red-eyed Dove	f	1.57	5
Yellow-rumped Tinkerbird	f	1.43	6
Black-bellied Starling	F	1.29	7
Emerald-spotted Wood Dove	f	1.29	7
Trumpeter Hornbill	F	1.14	8
African Paradise Flycatcher	f	1.00	9
Bearded Woodpecker	f	1.00	9
Collared Sunbird	F	1.00	9
Red-fronted Tinkerbird	s	1.00	9
African Goshawk	F	0.86	10
Tambourine Dove	F	0.86	10
Fischer's Greenbul	FC	0.71	11
Grey-backed Camaroptera	f	0.71	11
African Fish Eagle	w	0.57	16
African Orange-bellied Parrot	s	0.57	16
Black-headed Apalis	FF	0.57	11
Blue-mantled Crested Flycatcher	FF	0.57	16
Crested Guineafowl	F	0.57	16
Eastern Bearded Scrub Robin	F	0.57	16
Greater Honeyguide	f	0.57	16
Green Wood-hoopoe	f	0.57	16
Northern Brownbul	FC	0.57	16
African Green Pigeon	F	0.43	17
Cardinal Woodpecker	f	0.43	17
Little Spotted Woodpecker	f	0.43	17
Little Yellow Flycatcher	FFCvu	0.43	17
Narina Trogon	F	0.43	17
Red-capped Robin-Chat	F	0.43	17
Scaly-throated Honeyguide	F	0.43	17
White-browed Coucal	S	0.43	17
Black-necked Weaver	f	0.29	18
Little Sparrowhawk	f	0.29	18
Red-tailed Ant Thrush	FF	0.29	18
Black-collared Barbet	F	0.14	19
Black-headed Oriole	f	0.14	19
Black-throated Wattle-eye	F	0.14	19
Hamerkop	w	0.14	19
Spectacled Weaver	s	0.14	19

Only data for birds recorded above 3 m and within 25 m are included. For status codes, see Table 1.

Table 10. Results of timed species-counts at Makere (n=12)

Species	Status	Index	Rank
Red-fronted Tinkerbird	s	1.92	1
Tropical Boubou	f	1.92	1
Yellow-rumped Tinkerbird	f	1.75	2
Brown-hooded Kingfisher	s	1.67	3
Red-eyed Dove	f	1.58	4
Emerald-spotted Wood Dove	f	1.33	5
Square-tailed Drongo	F	1.25	6
Tambourine Dove	F	1.00	7
Collared Sunbird	F	0.92	8
Black-backed Puffback	F	0.83	9
Black-bellied Starling	F	0.75	10
Red-capped Robin-Chat	F	0.75	11
Black-headed Apalis	FF	0.67	12
White-browed Coucal	s	0.67	12
African Cuckoo Hawk	F	0.58	13
Grey-backed Camaroptera	f	0.58	13
Pale Flycatcher	s	0.58	13
Green Wood-hoopoe	f	0.50	14
Hadada Ibis	w	0.50	14
Crowned Hornbill	F	0.42	15
Retz's Helmet-Shrike	F	0.42	15
African Fish Eagle	w	0.33	16
African Paradise Flycatcher	f	0.33	16
Black-headed Heron	w	0.33	16
Four-coloured Bush-Shrike	F	0.33	17
Golden Palm Weaver	s	0.33	17
Mombasa Woodpecker	F	0.33	17
Greater Honeyguide	f	0.25	18
Little Yellow Flycatcher	FFCvu	0.25	18
Spectacled Weaver	s	0.25	18
Green Wood-hoopoe	f	0.25	18
White-throated Bee-eater	f	0.25	18
African Goshawk	F	0.08	19
African Harrier Hawk	f	0.08	19
African Palm Swift	s	0.08	19
Hunter's Sunbird	s	0.08	19
Pale Batis	FC	0.08	19
Wire-tailed Swallow	s	0.08	19

Only data for birds recorded above 3 m and within 25 m are included. For status codes, see Table 1.

Vegetation structure

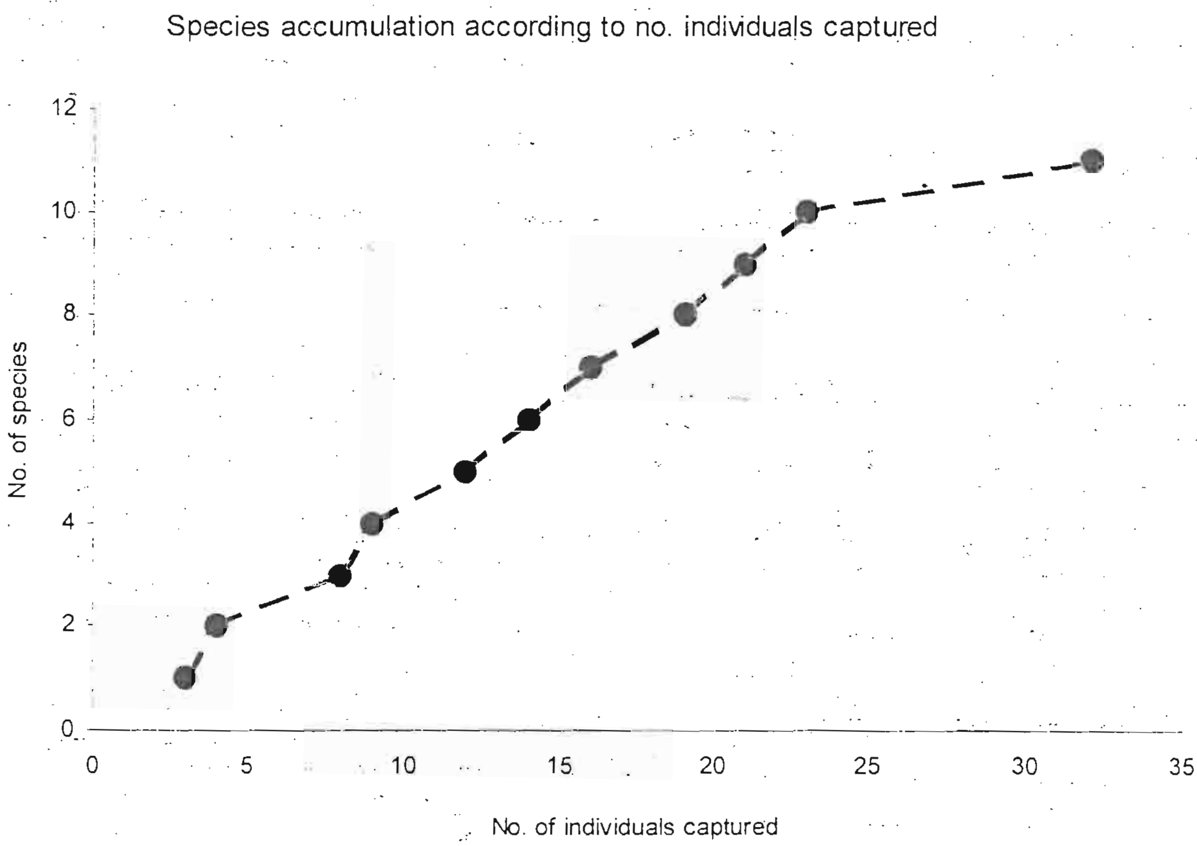
The mean values of vegetation variables measured in each fragment are shown in Table 11. Although statistically significant in several cases, the absolute differences between particular sites were small. In terms of canopy height and cover, and shrub density, Guru North appeared to be in better condition than the other two sites.

Table 11. Mean values of vegetation variables measured in each fragment. F values and associated probabilities are shown for an analysis of variance testing for differences among the means. The mean values with the same letters are not significantly different (at the 5% level) on a Student-Newman-Keuls test

Variable	Site	Mean	s.d.	F	df	P
Canopy height (m)	Guru North	19.9	14.08 b			
	Guru South	13.6	6.83 a			
	Makere West	17.1	5.79 b			
	All sites	16.9	9.93	6.4	2,182	0.002
% canopy cover	Guru North	68.8	21.40 b			
	Guru South	62.6	17.92 a			
	Makere West	61.1	14.63 a			
	All sites	64.2	18.40	3.3	2,182	0.04
Shrub density (no. squares visible)	Guru North	18.1	7.90 a			
	Guru South	19.3	5.64 a			
	Makere West	22.6	4.42 b			
	All sites	20.0	6.44	15.3	2,367	<0.0001
% bare ground	Guru North	10.3	19.76 a			
	Guru South	14.3	16.15 a			
	Makere West	11.5	13.53 a			
	All sites	12.0	16.71	1.4	2,367	0.26
% litter	Guru North	76.9	25.14 a			
	Guru South	80.9	19.20 a			
	Makere West	76.8	19.28 a			
	All sites	78.19	21.42	1.0	2,367	0.4
% herb cover	Guru North	12.8	17.72 a			
	Guru South	4.8	7.99 b			
	Makere West	11.7	14.84 a			
	All sites	9.8	14.54	9.2	2,367	0.0002

Species accumulation

Figure 1 shows that species accumulation had begun to level off, but probably had not reached a plateau completely, at the very end of the survey.



Discussion

A characteristic, moderately rich avifauna of coastal forests was supported in all the three fragments. Butynski & Wahungu (1994) rated human activity very low at Guru North and Guru South but very high at Makere West. This was borne out by the ranking of vegetation structure measures, although absolute differences between the sites were not large. At all sites there was evidence of disturbance both from human influences such as fires and tree-cutting, and natural effects of flooding and succession through the river changing its course. The overall low number of forest dependent species – even by the standards of coastal forests, which are relatively impoverished in such birds — is an indication of disturbance. This may also account for the absence of several key coastal species at all the sites.

The number and proportion of forest-dependent birds is a useful indicator of overall forest condition (Bennun & Fanshawe 1997). In this respect Guru South took top rank on various measures (Table 12), with a mean ranking of 1.4. Guru North also scored highly (mean rank 1.7) but Makere West ranked lowest in almost all respects, and was particularly impoverished in undergrowth birds – capture rates were extremely low, and no forest-specialist birds were captured. Especially considering that Guru North is only 5 ha, compared to Makere West's 48 ha, this in an indication of Makere West's relatively poor condition.

Canopy cover and height have been shown to be important structural variables for many forest dependent birds (Fanshawe 1995, Matiku 1996, Kosgey 1998). Guru North had highest canopy cover and height and emerged 'best' in terms of the canopy avifauna.

The understory variables remained difficult to interpret. Makere showed thickest shrub density and reasonable high level of herb cover, which are associated with disturbance. Increasing the sample from 40 (Oyugi & Amutete 1999) to 60 samples per fragment has improved the resolution of structural differences, but the interpretation of these remains problematic.

The very evident habitat modification taking place could be having a substantial impact on the forest-dependent species with worst effect on habitat modification sensitive species such as East Coast Akalat *Sheppardia gunningi* (Matiku 1996, Nemeth 1996). As in the earlier survey (Oyugi & Amutete 1999), this globally threatened species was not encountered in any of the forest patches.

Snares, burning (fires that escape agricultural plots and pastures and honey harvesting), canoe construction and pole cutting were very evident at Makere West. Ideally, proper information on all the fragments, including their avifauna, rate of habitat loss and other human impacts, is needed. The riverine forests are best viewed as a dynamic patch mosaic of colonising forests, young forests with low species diversity, mature forests of considerable diversity, and dying or senescent forests. This creates a major conservation challenge: how to retain the late successional stages and a mix of all successional types within the landscape, and avoid assuming that the ecosystem as static and unchanging — as it may appear on our short time-scales of human observation.

Table 12. The three forest patches ranked according to several measures that indicate disturbance. Ranks are 1 (most intact) to 3 (most disturbed)

Variable	Guru North	Guru South	Makere West
No.of forest-dependent species recorded	1.5	1.5	3
% forest-dependent species recorded	1	2	3
No. of forest-dependent species captured	2	1	3
% of forest-dependent species captured	2.5	1	2.5
No. of forest-dependent birds captured	2	1	3
% of forest-dependent birds captured	2	1	3
% of forest-dependent species among top 10 on TSCs	1	2	3
Mean rank	1.7	1.4	2.9

Acknowledgements

We thank the GEF Tana River Primate Reserve Project for financial and logistical support, and Kenya Wildlife Service for assistance with logistics and security. Within the Ornithology Department, thanks to Patrick Gichuki and James Wachira, who assisted tirelessly with data collection, Oliver Nasirwa and Alfred Owino, for help with the analysis, and Leon Bennun for comments on the draft report.

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