

Distribution and abundance of birds in tidal creeks and estuaries of the Kenyan coast between the Sabaki River and Gazi Bay

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From January 1994 regular counts of wetland birds have been carried out by a team of researchers from the Kenya Marine Fisheries Research Institute—in close co-operation with the National Museums of Kenya, Department of Ornithology—in the major creek systems between Gazi Bay, north of Msambweni and Sabaki River at the Kenya coast. Total numbers in the area under study (Gazi Bay, Port Reitz, Tudor Creek, Mtwapa Creek, Kilifi Creek, Mida Creek and Sabaki River mouth) were estimated at 10 500, birds in September 1994 and 15 000 in February–March 1994. Palaearctic shorebirds form the majority (6500, 61 per cent and 11 000 73 per cent, respectively), followed by terns and gulls (2900, 28 per cent and 2300, 15 per cent) and large wading birds (500, 5 per cent and 800, 5 per cent).

Sixty different species were recorded with shorebirds best represented (23 species), followed by large wading birds (15 species) and gulls and terns (ten species). Only 20 species were found in nearly all the studied areas; the others have a more restricted distribution.

Mida Creek and Sabaki River mouth are the most important bird areas with 75 per cent of the total numbers and 80 per cent of the species. Out of the group of creeks, only Mida Creek (55–68 per cent) and Port Reitz/Tudor Creek (20–21 per cent) hold more than 10 per cent of the total number.

The Sabaki River mouth is characterized by large numbers of gulls and terns, a resident group of Lesser Flamingos *Phoeniconaias minor* and some rare species such as Broad-billed Sandpiper *Limicola falcinellus*. Mida Creek has a small overwintering population of Greater Flamingos *Phoenicopterus ruber* and an internationally important concentration of Crab Plovers *Dromas ardeola* (maximum 800). It is a stronghold at the Kenya coast for many shorebird species. Abiotic characteristics of the creeks determine the relative abundance of different trophic groups of birds, with benthivores dominant in Mida Creek and Port Reitz/Tudor (85 per cent), but much less so in the other creeks (50–60 per cent) and in Sabaki River mouth (38 per cent).

Temporal patterns of abundance and diversity are illustrated with data from Mida Creek and Gazi Bay. The importance of different habitats within the creeks and estuaries is discussed and suggestions towards future coastal wetland ornithological research are given.

Birds are widely recognized as good bio-indicators in monitoring environmental changes (Koskimies 1989, Morrison 1986). They move away actively from conditions unfavourable in terms of food availability, disturbance, etc. Relatively simple counting methods with a minimum of equipment can do a lot to obtain valuable information on bird distribution and abundance, reflecting in one way or another the state of the

environment (Pomeroy 1992). In many tropical and subtropical countries with vast natural systems to be monitored, bird counting can offer an ideal and affordable tool for easy monitoring, especially with the frequent lack of funds for detailed scientific studies.

In addition, basic data on bird abundance and bird diversity can be of over-riding importance in assessing the value of natural habitats and hence are essential tools for policy-making.

As reflected in many publications, ornithology in Kenya is well-organized with a well-structured framework and an active network of volunteers. A *bird atlas of Kenya* was produced in 1989 (Lewis & Pomeroy 1989) and data on bird distribution are being incorporated in a regional database. International co-operation in wetland bird research is illustrated by participation in the IWRB-counts (International Waterfowl and Wetland Research Bureau) carried out on the Rift Valley lakes since 1991 by the National Museums of Kenya, Department of Ornithology.

However, data on birds in Kenyan coastal estuaries, mangrove creeks and along beaches are rather scarce and many papers deal with single observations of rare species (e.g. Brown 1973, Britton & Duffus 1974, Cunningham-van Someren 1972, Taylor 1978, 1982 a, b).

Data on migration timing, on status and age structure, and on moult and weights have been obtained for a few shorebird species during a mist-netting and ringing programme at Mida Creek from 1978–1985 (Pearson & Britton 1980). Although shorebirds have quite frequently been counted at certain high tide roosting areas of the coast (Britton & Britton, 1976, Bryant, 1980), no systematic survey of numbers appears to have been attempted for any substantial stretch of the coast, apart from one mid-winter count made along 50-km of shore south of Mombasa by Pearson (1984). Terns were treated by Britton (1977) and the breeding seasons of gulls and terns by Brown & Britton (1980).

The need to collect additional data at the coast on a wider scale was remedied in 1994 by the Kenya Belgium Project in Marine Sciences (KBP) and the Kenya Marine and Fisheries Research Institute (KMFRI) in the training of a group of ornithologists in close co-operation with the National Museums of Kenya.

This paper presents the results of counts carried out by this KBP/KMFRI-team in 1994–1995 in all the major tidal creeks and estuaries between the Sabaki River (north of Malindi) and Msambweni, 190 km south. Another publication on the results of an extensive survey of the beaches and creeks of the southern half of the Kenya coast in February 1995 by National Museum and KMFRI staff is in preparation.

Methodology

Birds of five tidal creeks between Gazi Bay (50 km south of Mombasa) and the Sabaki River (140 km north of Mombasa) (Fig. 1) were counted in February–March 1994 and September 1994 (Table 1). In Gazi Bay and Mida Creek five additional counts were made in 1994–1995 in order to study the temporal distribution pattern over the year. The Sabaki River mouth was counted during one visit in September 1994.

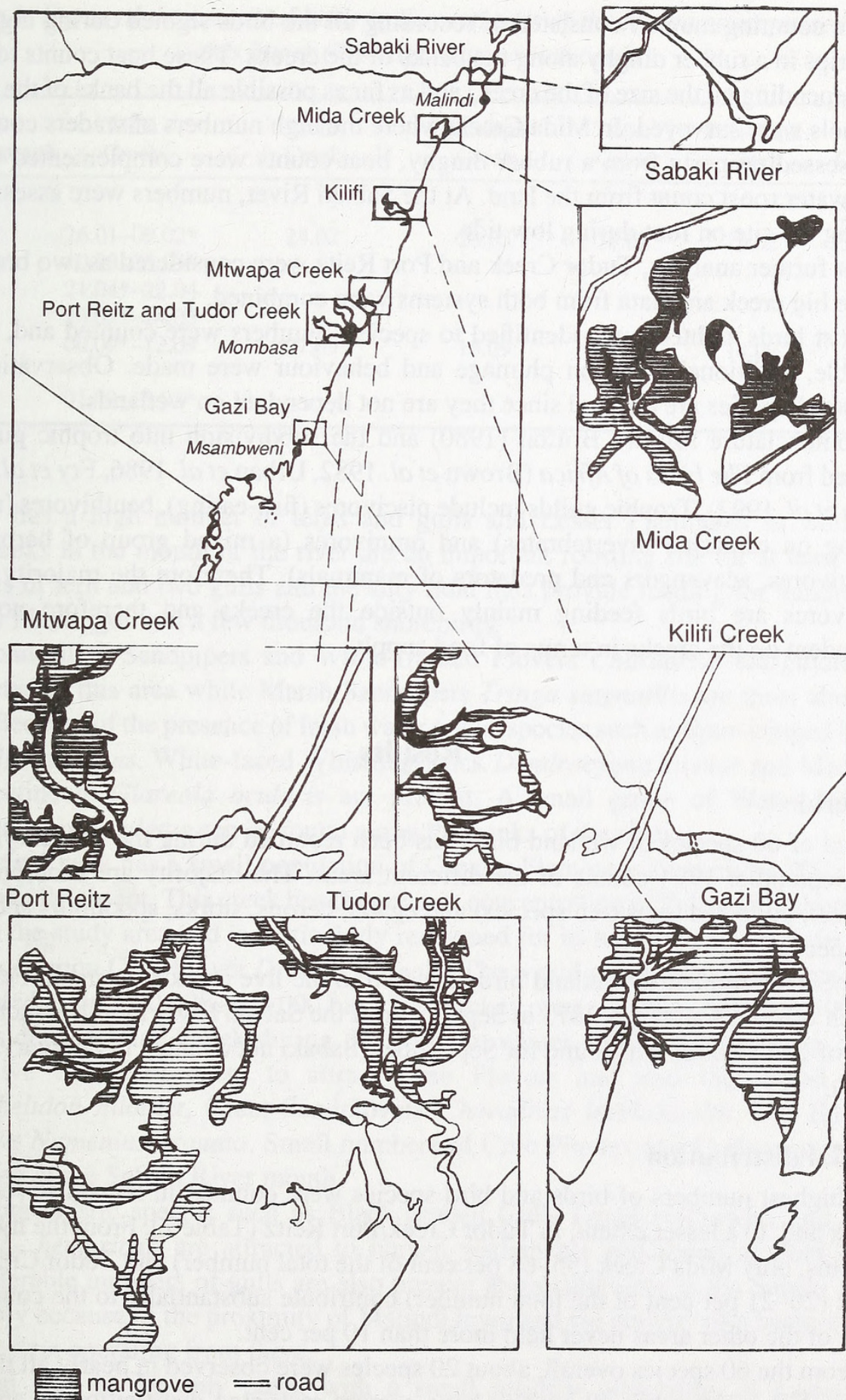


Fig. 1. Maps of the study area at the Kenya coast showing the five creek systems and the Sabaki River mouth

The counting method consisted of recording all the birds sighted during high-tide boat trips in a rubber dinghy along the banks of the creeks. These boat counts took 3–6 h (depending on the size of the creek) and as far as possible all the banks of the major channels were surveyed. In Mida Creek, where the high numbers of waders could not be assessed properly from a rubber dinghy, boat counts were complemented with a high-water roost count from the land. At the Sabaki River, numbers were assessed by visiting the site on foot during low tide.

For further analysis, Tudor Creek and Port Reitz were considered as two branches of one big creek and data from both systems were combined.

Most birds sighted were identified to species, numbers were counted and, where possible, additional notes on plumage and behaviour were made. Observations of terrestrial species are omitted since they are not dependent on wetlands.

Nomenclature follows Britton (1980) and the subdivision into trophic guilds is derived from *The birds of Africa* (Brown *et al.* 1982, Urban *et al.* 1986, Fry *et al.* 1988, Keith *et al.* 1992). Trophic guilds include piscivores (fish-eating), benthivores (mainly relying on estuarine invertebrates) and omnivores (a mixed group of herbivores, insectivores, scavengers and predators of mammals). Therefore the majority of the omnivores are birds feeding mainly outside the creeks and therefore not very dependent on the creeks in terms of food supply.

Results

General

A total of 60 species of wetland birds has been recorded during the February/March and September 1994 counts of the different areas. The majority are shorebirds (23 species), gulls and terns (ten species) and egrets, herons, storks, spoonbills and ibises (15 species).

The total number of wetland birds counted in the five creek systems in February/March was 8921 and only 3873 in September. If the Sabaki River mouth is included, a total of 10 186 birds was found for September (Sabaki not counted in February/March 1994).

Spatial distribution

The highest numbers of birds and bird species were counted in Sabaki River, Mida Creek and, to a lesser extent, in Tudor Creek/Port Reitz (Table 2). From the five creek systems, only Mida Creek (55–68 per cent of the total number) and Tudor Creek/Port Reitz (20–21 per cent of the total number) contribute substantially to the count total. Each of the other areas never held more than 10 per cent.

From the 60 species overall, about 20 species were observed in nearly all the areas under study. The other 40 species have a more restricted distribution or are rather uncommon along the Kenya coast.

Whereas most areas are numerically dominated by Palaearctic shorebirds, **Sabaki**

Table 1. Dates of the counts of birds in the wetlands of the Kenya coast presented in this paper (* = high water roost count)

Sabaki River mouth	Mida Creek	Kilifi Creek	Mtwapa Creek	Tudor Creek	Port Reitz Creek	Gazi Creek
1994						28.01
	26.01–09.02*	24.02	28.03	18.02	23.02	31.03
	10.03–23.03*					09.05
	21.04*–22.04					21.06
	20.05*–24.05					20.07
13.09	06.09*–12.09	07.09	15.09	08.09	14.09	16.09
1995	01.03–15.03*					15.03

River has a high number of terns and gulls and Lesser Flamingos as well. The sandbanks in the mouth of the river are an important roosting site for at least seven species of tern and two gulls and the silty tidal flats provide feeding for hundreds of Lesser Flamingos and a few thousand shorebirds.

Broad-billed Sandpipers and White-fronted Plovers *Charadrius marginatus* are restricted to this area while Marsh Sandpipers *Tringa stagnatilis* are most abundant here. Because of the presence of fresh water pools, species such as Spur-winged Plover *Vanellus spinosus*, White-faced Whistling Duck *Dendrocygna bicolor* and Madagascar Pratincole *Glareola ocularis* are present. A small group of Water Dikkops *Burhinus vermiculatus* can be found along the banks of the river.

Mida Creek has a small population of Greater Flamingos (maximum 200); gulls are typically absent. This creek has the greatest concentration of Palaearctic shorebirds within the study area and is particularly renowned for its non-breeding population of the uncommon Crab Plover *Dromas ardeola*. The world population of this species is estimated as only 50 000–100 000 birds (P. Hockey, pers. comm.), of which 500–800 are resident at Mida Creek during the northern winter. The rich crab fauna on the extensive tidal flats seem to attract Crab Plovers and also Gull-billed Terns *Gelochelidon nilotica*, Great Sandpipers *Charadrius leschenaultii*, and Eurasian Curlews *Numenius arquata*. Small numbers of Crab Plovers and Curlews were also recorded at the Sabaki River mouth.

Opportunistic species such as Black-headed Gulls *Larus ridibundus* and Sooty Gulls *L. hemprichii* are attracted to human settlements and found at **Port Reitz**. Considerable numbers of gulls are also present at roosting sites at the Sabaki River, probably because of the proximity of Malindi town and the activity of a beam-trawler fishing fleet operating from there.

Gazi Bay is the only creek with a small resident population of Long-tailed Cormorants *Phalacrocorax africanus*, Palm-nut Vultures *Gypohierax angolensis* and Woolly-necked Storks *Ciconia episcopus*.

[illegible]

Species	MI ¹	MI ²	KI ¹	KI ²	MT ¹	MT ²	TP ¹	TP ²	GA ¹	GA ²	SA
<i>T. nebularia</i>	155	60	39	35	0	9	39	65	27	0	30
<i>Xenus cinereus</i>	140	40	0	1	0	12	28	24	0	15	2
<i>Actitis hypoleucos</i>	4	22	32	48	76	21	39	61	33	3	5
<i>Arenaria interpres</i>	2	4	0	0	0	0	0	0	0	0	2
small waders species	0	0	0	0	0	0	250	17	0	0	0
<i>Larus hemprichii</i>	0	0	2	0	1	0	50	0	2	0	75
<i>L. ridibundus</i>	0	0	0	0	0	0	21	0	0	0	0
<i>L. fuscus</i>	0	0	0	0	0	0	1	0	0	0	30
<i>Gelochelidon nilotica</i>	190	68	0	1	0	0	0	4	0	0	50
<i>Sterna caspia</i>	0	0	0	0	0	0	0	0	0	0	2
<i>S. bergii</i>	0	0	0	0	0	0	0	0	0	0	1
<i>S. bengalensis</i>	2	0	1	0	0	0	22	0	0	0	30
<i>S. dougallii/S. hirundo</i>	0	0	0	0	0	0	1	0	0	0	2600
<i>S. albifrons/S. saundersi</i>	2	0	0	0	0	0	2	0	0	0	5
<i>Chlidonias leucopterus</i>	0	3	0	0	0	0	2	0	0	0	0
<i>Halcyon senegaloides</i>	0	0	0	0	0	1	0	0	0	0	0
<i>Alcedo cristata</i>	0	0	0	0	0	2	0	1	0	1	0
<i>Ceryle rudis</i>	19	34	11	31	12	3	10	9	4	0	5
Total number of birds	6049	2134	355	369	177	351	1879	788	461	231	6313
No. of piscivores	93	100	32	72	18	8	122	38	129	12	2690
No. of benthivores	5531	1943	210	241	81	331	1635	683	242	118	2398
No. of omnivores	425	91	113	56	78	12	122	67	90	101	1225
Total number of species	30	29	20	20	14	12	36	26	23	13	40
No. of piscivorous species	10	8	10	8	4	4	14	7	8	2	10
No. of benthivorous species	15	17	6	8	3	6	12	13	9	8	22
No. of omnivorous species	5	4	4	4	7	2	10	6	6	3	8

Small groups of Pink-backed Pelicans *Pelecanus rufescens* can be encountered in most of the coastal creeks where they roost in mangrove trees. At the Sabaki River mouth small mixed groups of Pink-backed and White Pelicans *Pelecanus onocrotalus* were found. Species such as Cattle Egret *Bubulcus ibis*, Hadada Ibis *Bostrychia hagedash*, Yellow-billed Egret *Egretta intermedia*, Open-billed Stork *Anastomus lamelligerus* and Ruff *Philomachus pugnax* are rare visitors to the creeks, since their preferred habitats are fresh water areas or terrestrial biotopes rather than brackish or marine systems.

Skulking species such as the Green-backed Heron *Butorides striatus* are easily overlooked and are certainly underestimated. They were frequently observed at fish traps at the mouth of different estuaries (Boera *et al.*, in prep.). Large wading birds (egrets, herons, storks, ibises, spoonbills) have several communal roosting sites in the creeks and are found in gatherings of up to 150 birds in mangrove trees. They seem to remain faithful to the same roosting sites for long periods.

Shorebirds are found foraging on the tidal flats during low tides with a preference for the more silty and open areas. Deeper into the mangrove forests numbers of shorebirds are much smaller and dominated by Common Sandpipers *Actitis hypoleucos*. During high tide, Greenshanks *Tringa nebularia*, Whimbrels *Numenius phaeopus*, Grey Plovers *Pluvialis squatarola* and Terek Sandpipers *Xenus cinereus* are

also found roosting on mangrove trees. Plovers and other species of sandpiper prefer the more open areas, such as beaches, for roosting. On the tidal flats in the creeks and at Sabaki River mouth the most common species are Curlew Sandpiper *Calidris ferruginea*, Little Stint *C. minuta*, Grey Plover, Whimbrel, Great Sandplover and Mongolian Sandplover *Charadrius mongolus*. Great Sandplovers are dominant on sandy beaches (over 90 per cent), equally abundant as Mongolian Plovers on sandy tidal flats (Mida Creek) and less frequent on silty flats such as in Sabaki River mouth.

Ospreys *Pandion haliaetus* have been observed from September to April in most of the creeks but seem to be most common at Mida Creek (2–3 birds apparently regular). After catching medium-sized fish they can be seen devouring their prey on the sandbanks. Pied Kingfishers *Ceryle rudis* are common in all creeks but we only found a breeding colony in Kilifi Creek.

Trophic guilds

Benthivores are dominant in all the creeks (Fig. 2, Table 2) accounting for over 85 per cent in Mida Creek and Tudor Creek/Port Reitz, 50–60 per cent in the other creeks (not taking into account the aberrant value for Mtwapa Creek in September: the high percentage of benthivores in Mtwapa Creek in September was due to one large flock of shorebirds at a temporary roosting site at the mouth of the creek) but only 38 per cent

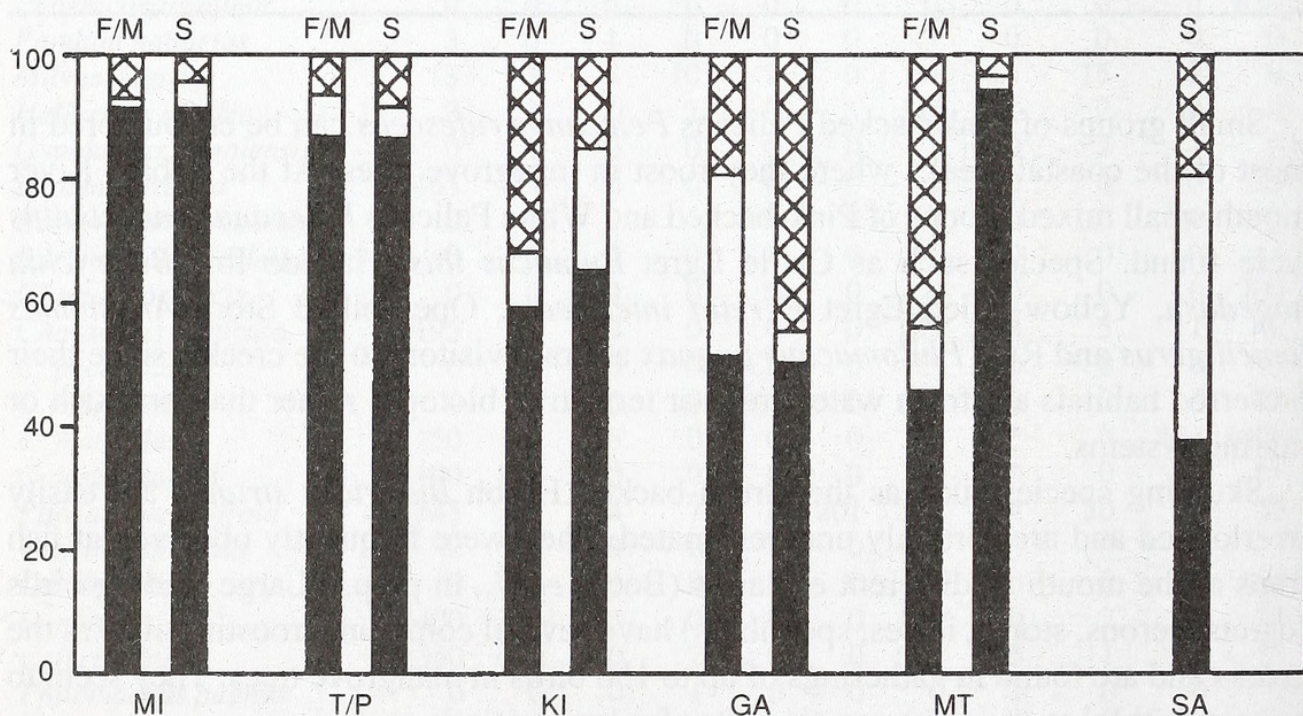


Fig. 2. Relative abundance (in per cent) of the different trophic guilds of birds as found during a February/March (F/M) and a September (S) 1994 count of Mida Creek (MI), Tudor Creek/Port Reitz (T/P), Kilifi Creek (KI), Gazi Bay (GA), Mtwapa Creek (MT) and Sabaki River mouth (SA). Key: solid = benthivores, unfilled = piscivores, hatched = omnivores

in Sabaki River. The low value in Sabaki is mainly due to the large numbers of flamingos (considered as herbivores are classified here under the omnivores) and terns and gulls (piscivores and omnivores).

Extrapolation

The total numbers of birds in the five creek systems between Gazi Bay and Mida Creek as described above are minimal values. Due to the technique used—counting from a rubber boat during high tide—a number of shorebirds might have left the estuary for high-water roost sites outside the area. Also, an additional number of birds can be added for some tidal channels in the mangrove woods of Mtwapa Creek and Tudor Creek/Port Reitz which were not counted completely. Therefore the total number of wetland birds in all the main creek systems between Msambweni and Malindi is estimated at about 10 000 in February/March and 4200 in September. Based on new data for Sabaki River collected during the February 1995 survey, we can assume that the total number of wetland birds in February–March at this estuary is not much higher than 5000 birds, compared to 6313 in September. The slightly higher number in September is caused by larger numbers of Roseate/Common Terns *Sterna dougallii/hirundo* and Lesser Flamingos. A general total figure for all the creeks and estuaries between Sabaki River and Msambweni of 10 500 in February/March and 15 000 in September can be put forward. Shorebirds are most common (6500–11 000, or 61–73 per cent), followed by terns and gulls (2900–2300, or 28–15 per cent) and large wading birds (500–800, or 5 per cent in both periods).

Temporal distribution pattern in Gazi Bay and Mida Creek

Total numbers of birds peak in December–January and are minimal between May and July (Table 3, Fig. 3). The September counts give values of 28–46 per cent of the peak numbers. Migration of Palaearctic waders is the main cause of decreasing numbers in the coastal creeks from May onwards. In Mida Creek most of the shorebirds oversummer in small numbers. Only Great Sandplover, Common Sandpiper and Little Stint were not observed from May onwards.

Resident species also seem to disappear from the creeks during this period; some, such as Great Egrets *Egretta alba* and Pied Kingfishers apparently in search of suitable breeding areas, others probably because of newly available feeding areas (fresh water swamps) during the rainy season. There is a remarkable decline in the number of Pied Kingfishers in Mida Creek between April and May.

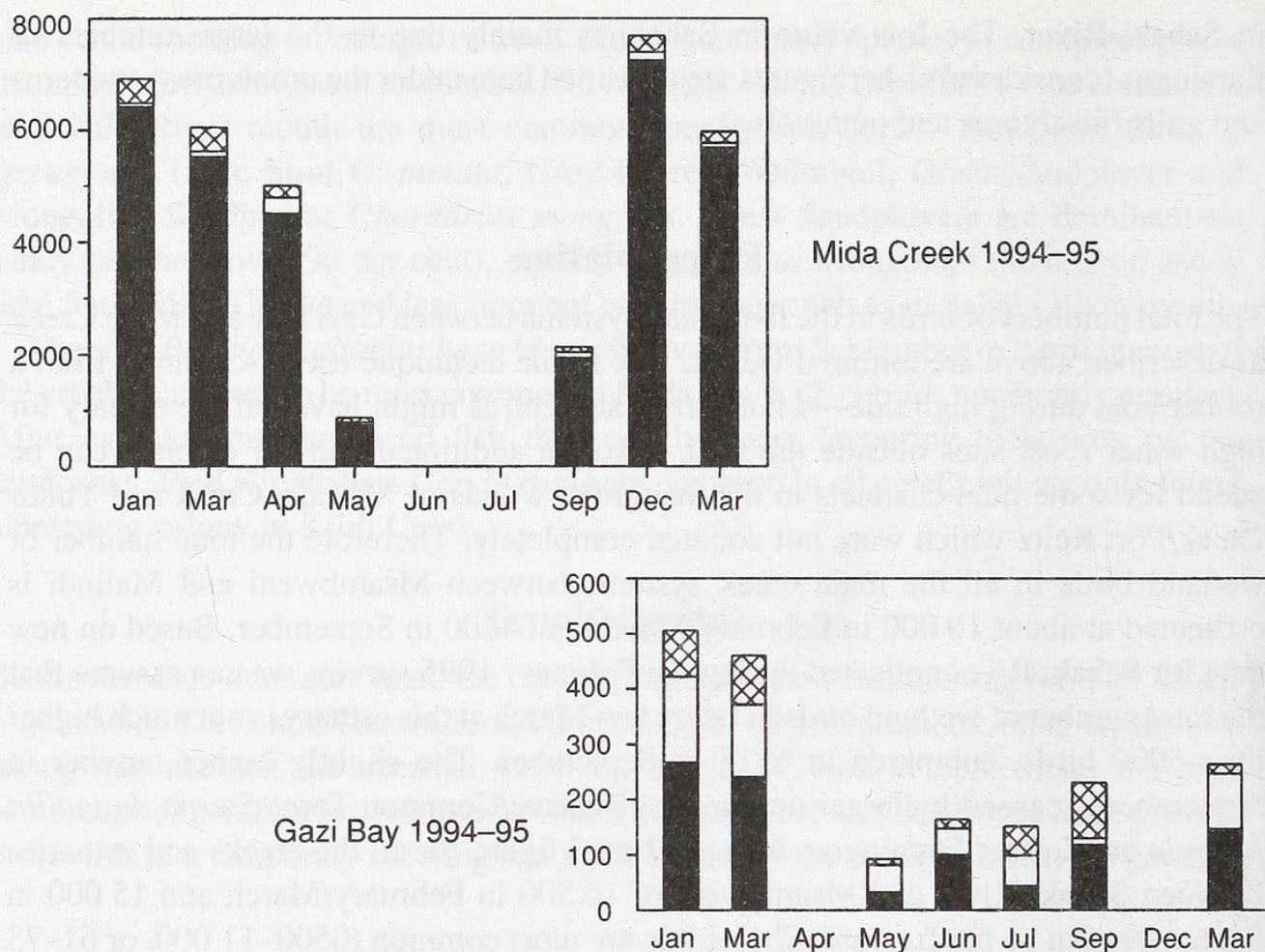


Fig. 3. Temporal distribution pattern of coastal wetland birds as found during seven counts in Mida Creek and Gazi Bay in 1994–1995. Total numbers as well as numbers for each trophic guild are illustrated. Key to shading patterns as in Fig. 2

Discussion

The results of this study are original in at least two aspects. First of all, a general survey of all the major creek systems of part of the Kenya coast has never been carried out before. The total number of birds found in this area in mid-winter was estimated at 15 000, including 11 000 shorebirds. For the same stretch of coast from Msambweni to the Sabaki, Pearson (1984) gave an estimate of almost 30 000 (shorebirds only), including birds from Gazi Bay and Mida Creek. Including all the creeks would bring his total number of shorebirds along this 200-km of coastline to 35 000, a figure very close to the value of 36 000 published by Summers *et al.* (1987).

Secondly, the data collected here include coastal bird species other than shorebirds. Large wading birds and other species dependent in one way or another on the coastal creeks are important indicators of the quality of the ecosystem. Regular counts of these birds can reveal a lot about changes occurring in their habitat, making counts important as a management tool.

The comparison of the abundance and diversity of birds in the different creeks reveals that Mida Creek and the Sabaki River mouth as the most important areas.

Table 3. Number of wetland birds in Gazi Bay and Mida Creek as counted during seven surveys in 1994–95. The dates of the counts are listed in Table 1. Total number of birds, number of species and abundance of the different trophic guilds are included

Species	Gazi Bay							Mida Creek						
	Jan	Mar	May	Jun	Jul	Sep	Mar	Jan	Mar	Apr	May	Sep	Dec	Mar
<i>Phoenicopterus ruber</i>	0	0	0	0	0	0	0	188	192	105	0	0	57	97
<i>Phalacrocorax africanus</i>	3	24	0	0	0	0	11	0	0	1	0	0	0	0
<i>Ardea cinerea</i>	6	9	2	0	1	0	0	6	14	16	13	18	2	13
<i>Ardea melanocephala</i>	0	1	0	0	0	0	2	11	18	6	0	0	0	5
<i>Ardea goliath</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Egretta alba</i>	113	46	5	1	21	10	57	0	15	7	1	15	0	9
<i>Egretta garzetta</i>	1	9	7	1	8	2	9	25	46	59	4	26	5	37
<i>Egretta gularis</i>	0	7	0	0	2	0	0	0	0	0	0	6	0	1
<i>Egretta ardesiaca</i>	2	3	2	0	0	0	6	0	3	4	2	1	0	3
<i>Bubulcus ibis</i>	30	0	0	0	0	0	0	0	0	14	3	0	0	0
<i>Butorides striatus</i>	0	1	1	0	0	0	0	0	0	0	0	0	0	0
<i>Mycteria ibis</i>	59	65	50	91	55	1	40	30	21	20	24	16	9	10
<i>Ciconia episcopus</i>	0	13	7	3	2	0	1	0	0	0	0	0	1	0
<i>Anastomus lamelligerus</i>	0	0	0	0	0	0	0	0	0	22	0	0	0	0
<i>Threskiornis aethiopicus</i>	44	57	3	10	48	98	6	14	12	20	51	15	0	8
<i>Bostrichia hagedash</i>	0	0	0	0	1	0	0	0	0	5	2	0	0	0
<i>Platalea alba</i>	0	0	0	0	0	0	0	1	9	11	0	0	0	0
<i>Gypohierax angolensis</i>	2	2	1	2	0	1	1	0	0	0	0	1	0	0
<i>Pandion haliaetus</i>	0	0	0	0	0	0	0	2	3	1	0	0	0	3
<i>Haliaetus vocifer</i>	1	2	0	0	0	0	0	2	2	2	2	2	1	0
<i>Milvus migrans</i>	5	15	0	2	2	2	6	3	13	16	3	7	3	9
<i>Dromas ardeola</i>	0	0	0	0	0	0	0	800	465	300	170	25	666	490
<i>Charadrius hiaticula</i>	0	5	0	0	0	1	0	50	195	21	2	7	30	75
<i>Charadrius leschenaultii</i>	0	0	0	0	0	65	0	450	100	550	0	195	1000	1250
<i>Charadrius mongolus</i>	0	0	0	0	0	0	0	650	150	350	244	65	1500	1250
<i>Calidris ferruginea</i>	0	11	0	0	0	8	12	900	2360	1550	30	600	1500	900
<i>Calidris alba</i>	0	0	0	0	0	0	0	5	0	3	0	2	7	3
<i>Calidris minuta</i>	200	2	0	0	0	0	0	2500	1400	750	0	140	1500	500
<i>Pluvialis squatarola</i>	0	20	4	8	0	0	27	316	345	590	71	255	425	395
<i>Actitis hypoleucos</i>	1	33	0	0	12	3	4	5	4	6	0	22	12	6
<i>Arenaria interpres</i>	0	0	0	0	0	0	0	1	2	3	6	4	0	5
<i>Xenus cinereus</i>	0	0	0	1	0	15	35	200	140	185	39	40	100	250
<i>Tringa nebularia</i>	14	27	0	9	0	0	1	180	155	35	41	60	155	150
<i>Numenius phaeopus</i>	21	103	0	37	0	24	43	250	170	95	120	470	304	358
<i>Numenius arquata</i>	0	0	0	0	0	0	0	80	0	8	13	30	40	30
<i>Limosa lapponica</i>	0	0	0	0	0	0	0	1	0	0	1	3	3	2
<i>Larus hemprichii</i>	3	2	0	0	0	0	1	0	0	0	0	0	0	0
<i>Sterna caspia</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0
<i>Sterna bengalensis</i>	0	0	9	0	0	0	0	20	2	148	6	0	123	19
<i>Gelochelidon nilotica</i>	0	0	0	0	0	0	0	220	190	45	22	68	230	84
<i>Sterna albifrons/saundersi</i>	0	0	0	0	0	0	0	0	2	4	0	0	10	3
<i>Sterna hirundo/dougallii</i>	0	0	0	0	0	0	0	0	0	7	0	0	0	0
<i>Chlidonias leucopterus</i>	0	0	0	0	0	0	0	0	0	0	0	3	2	0
<i>Ceryle rudis</i>	0	4	2	0	0	0	2	7	19	47	1	34	0	5
<i>Alcedo cristata</i>	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Total number of birds	506	461	93	164	152	231	264	6918	6049	5006	871	2134	7685	5970
No. of piscivores	155	129	49	47	55	12	100	65	93	276	39	100	145	79
No. of benthivores	267	242	33	101	44	118	147	6417	5531	4519	751	1943	7249	5688
No. of omnivores	84	90	11	16	53	101	17	436	425	211	81	91	291	203
Number of species	17	23	12	11	10	13	18	29	30	35	24	29	25	30

These two areas together hold about 75 per cent of the total number of birds in the creeks of this 200-km stretch, and more than 80 per cent of the species list were recorded here. Species that are globally rare, such as the Crab Plover, are concentrated in Mida Creek, with numbers probably peaking at more than 1 per cent of the total world population. Other interesting species in these two areas are Broad-billed Sandpiper, White-fronted Plover, Lesser Flamingo, several tern and gull species at Sabaki and Greater Flamingo, Gull-billed Tern, Terek Sandpiper, Eurasian Curlew and Mongolian Plover at Mida.

Very specific environmental conditions in both areas apparently attract this rich avifauna. Within this context, one can wonder why Redshanks *Tringa totanus*, previously occurring in small numbers (5–20) at Mida Creek, were not detected in our survey. There are also indications that the number of Sanderlings *Calidris alba* is smaller than in the late seventies when the species was described as one of the commoner wader species occurring in thousands on all tidal sandflats and sandy beaches (Pearson & Britton 1980).

Differences in environmental parameters in the six creeks and estuaries are also illustrated by the different trophic roles played by the birds. Mida Creek and Tudor Creek/Port Reitz are dominated by benthivorous birds, whereas Sabaki River, and to a lesser extent Gazi Bay, have a much higher proportion of fish-eating birds. Monitoring these ratios in the future can help to reveal valuable information on changes occurring to the system.

The observed temporal distribution pattern in waders corresponds to previous observations. The main influx of adult Palaearctic waders on the Kenya coast occurs during August and September, followed by a peak in October in numbers of first-year passage birds (Pearson & Britton 1980). Local wintering populations appear to maintain full numbers up to early April, but dwindle rapidly later that month.

Within the areas under study, the different habitats play a different role for the avifauna. The tidal flats are certainly the areas with highest densities and feeding activity of mainly shorebirds and large wading birds. Silty flats such as in the Sabaki River mouth can carry high densities of sandpipers, while more sandy tidal flats have large numbers of plovers as well. Food availability in terms of small benthic organisms tends to be higher in fine sediments than in coarse ones while sandbanks are favourite habitats for certain crab species on which birds such as Crab Plovers, Gull-billed Terns and Great Sandpipers rely. While the mangrove system plays only a limited role in the feeding habits of these shorebirds, it is critical to the safety of certain species. At high tide, when the wide stretches of beach and mud are inaccessible, many shorebirds move upstream along the maze of channels and take shelter either on the last remaining stretches of mud, or in the lower parts of mangrove trees, preferring the stilt roots of *Rhizophora mucronata*. A number of herons and egrets, on the other hand, are highly dependent on mangroves. Although not encountered as such in the mangrove areas under study, many species breed in these forests. As a high-tide roosting site, taller open mangrove trees are preferred by mixed flocks of egrets, storks, ibises, spoonbills, pelicans and herons. Indirectly, large wading birds as well as shorebirds are dependent

on mangroves when the organic output of the forests as the triggering factor for the productivity of prey organisms such as molluscs, crustaceans, worms, etc is considered.

Since mangroves are much less affected by drought than other wetlands, they can also be important for passerines (Altenburg & Van Spanje 1989). Published data on the utilization of African mangrove forests by birds are limited to notes concerning the Gambia (Cawkell 1964), Sierra Leone (Field 1968) and Guinea-Bissau (Altenburg & Van Spanje 1989). Therefore, collection of data on passerine birds and their dependence on the mangroves is a priority for future research in the region. More effort should also go into monitoring breeding colonies of coastal wetland species and into detailed food-ecological work. Beach counts from the Tanzanian border up to Sabaki River (coverage 80 per cent) were conducted during an NMK/KMFRI survey in February 1995. However, no reliable data are available for the northern half of the Kenya coast. Counts of creeks and beaches in the southern half should be repeated at least once a year within the framework of the counts of the International Wetland and Waterfowl Research Bureau (IWRB).

It would be useful if ringing activities were to be resumed at certain key sites in order to obtain data on age structure, site fidelity (through colour marking), and moult.

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Corrigenda

In J. S. Ash's paper "Bird-ringing recoveries from Ethiopia: II", *Scopus* 17, the recovery date of the Tropical Boubou *Laniarius aethiopicus* at the foot of p. 116 should have been 11.05.75.



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