Future work needs to extend the range of species studied, as well as providing the information necessary for a proper assessment of the effects of a barrage. High on the list of priorities is the need for detailed studies of Shelduck, Redshank and Curlew. Besides being present in internationally important numbers, these species show a number of anomalous and interesting changes in distribution within the Estuary from year to year (Ferns, in press), which may be correlated with local variations in the availability of prey. However, the fundamentally important questions are the same in the Severn as they are in any other estuary, and amongst the more important of these are the following. What factors determine the density of foraging birds? Is the settlement of birds in a particular area density-dependent? Do birds forage optimally for energy or are other factors important in determining their choice of foods and feeding methods? How can estimates be obtained of prey availability, as opposed to mere prey density? Is the winter cycle of body condition, which appears to be similar in many species, adaptive or is it a direct consequence of variations in the birds ability to obtain food? These are the issues upon which attention will focus during the forthcoming years.

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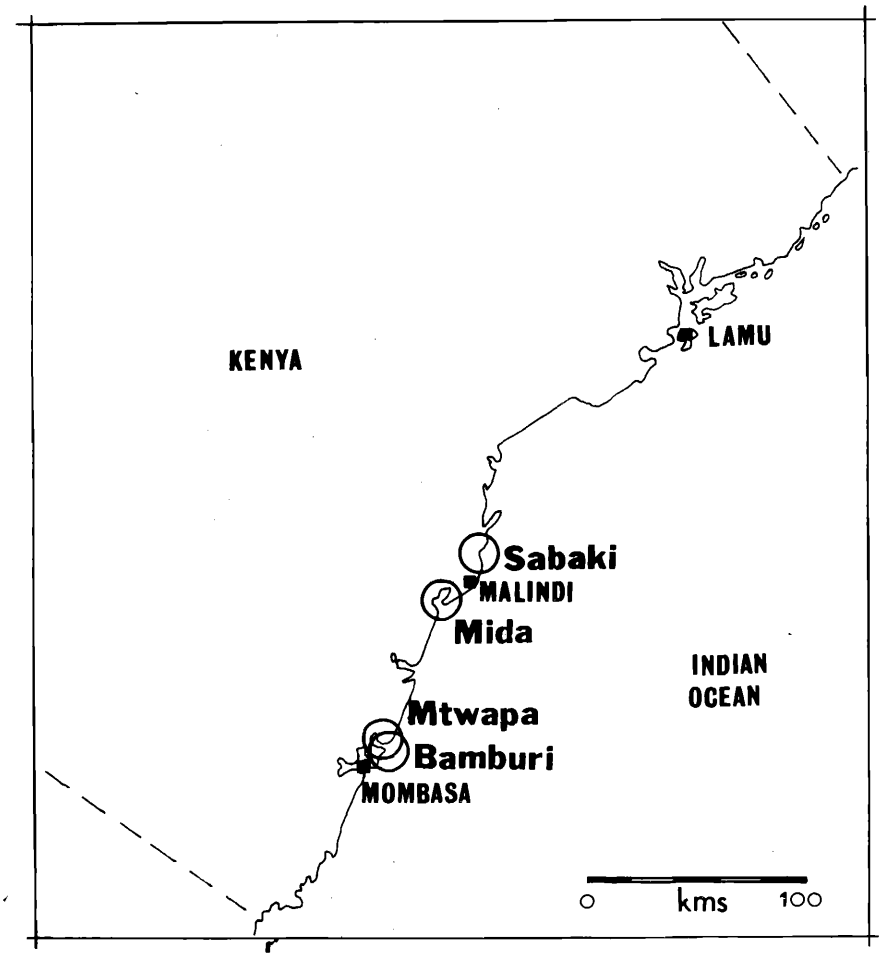

FIG. I STUDY SITES ON THE KENYAN COAST ○

WADERS ON THE COAST OF KENYA : JANUARY 1979

by D. M. Bryant

Introduction

Relatively little attention has been given to the coast of tropical Africa as a habitat for wading birds. Observations on the west coast however have shown important concentrations of some palaearctic species in both Senegal (De Smet & Gompel 1979) and Ghana (Taylor 1978). Comprehensive counts on islands in the west Indian Ocean can provide a guide to the timing and species composition of wader movements on the east African coast (Benson 1960, Bailey 1967, Penny 1971, Appert 1971/2, Feare & High 1977) but clearly cannot demonstrate directly the importance of the coast as a passage and wintering area. The fullest studies of waders on the east coast have been made in Kenya and Tanzania and include the migration observations of Fogden (1963) in north Kenya and the year round work of Milligan (1979) in southern Kenya and Harvey (1974) in the Dar es Salaam area. Further details of the less common species can be found in the bulletins of the East African Natural History Society and in Backhurst, Britton and Mann (1973). More information of numbers of the commoner species is still required however and to this end four sites were counted on the Kenya coast in early January 1979, covering a range of habitat types at a time of year when wader migration is generally slack.

Study Areas

Bamburi Beach lies just to the north of Mombasa and has a sandy beach and fringing reef. It is a favoured tourist area. Immediately to the north, Mtwapa Creek is characterized by mangroves and narrow sand flats in the upper reaches and by a reef near the mouth. Further north near Malindi, Mida Creek is the name given to a tidal basin almost completely surrounded by mangroves. Away from the vicinity of mangroves the extensive substrate is a coarse sand. The mouth of the Sabaki river is a rather narrow estuary, sandy and dune fringed at the mouth but the muddiest of the four sites upriver where most waders were concentrated.

Results and conclusions

Altogether 6000 waders were counted on the Kenyan coast of which the majority (90%) were of palaearctice origin (Table 1). Midwinter (January) counts near Dar es Salaam indicated a similar total (4500 - 6000, Harvey 1974) but Milligan (1979) found less than 200, again mainly palaearctic species, at Msambweni Reef. It would be a mistake to conclude however that simply because concentrations comparable with those of western Europe in winter have yet to be found, that the tropical African coast is of little importance to waders. Comparisons of wader density, used as a measure of the carrying capacity of intertidal areas, shows that densities on the Kenyan coast (160-1255/km^2) are broadly similar to those from a sample of sites in the U.K. (105-1655/km^2) (Table 2). In both areas the poorest sandy substrates support fewest birds at densities of $<$500/km^2 whereas mainly muddy sites hold $>$1000/km^2. In both the tropics and U.K. furthermore some sites are evidently exceptionally rich, such as Langstone Harbour with 1995 waders/km^2 (Tubbs 1977), the Tees Estaury with 3000-5300/km^2 (Pienkowski 1973) and Victoria flats, Mahé with 3755/km^2 (Feare & High 1977).

It may be concluded that, given a total of 6000 waders from a survey of 31.5 km of shore with bird densities broadly similar to those found in the temperate regions and the vast tracks of coastline awaiting survey, suitable areas of the tropical African coast harbour significant wintering populations of several palaearctic waders.

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TABLE 1. Wader counts at four sites on the coast of Kenya in January 1979.

	BAMBURI BEACH	MTWAPA CREEK	MIDA CREEK	SABAKI ESTAURY
Crab Plover *Dromas ardeola*			495	
Water Dikkop *Burhinus vermiculatus*				1
Little Ringed Plover *Charadrius dubius*			1	2
Ringed Plover *C.hiaticula*	42-71[a]	23	55	20
Kentish Plover *C.alexandrinus*				1
Three Banded Plover *C.tricollaris*			1	
White Fronted Sand Plover *C.marginatus*				64
Lesser Sandplover *C.mongolus*	23-51		660	25
Greater Sandplover *C.leschenaultii*	19-32	13	560	42
Grey Plover *Pluvialis squatarola*	10-24	8	560	15
Spur-winged Plover *Hoplopterus spinosus*				3
Sanderling *Calidris alba*	40-140	11	12	60
Little Stint *C.minuta*			230	105
Temminck's Stint *C.temminckii*				5
Curlew Sandpiper *C.ferruginea*	89-175	62	715	500
Broad Billed Sandpiper *Limicola falcinellus*				1
Ruff *Philomachus pugnax*			4	
Bar-tailed Godwit *Limosa lapponica*			1	
Whimbrel *Numenius phaeopus*	2-11	8	250	13
Curlew *N.arquata*			13	4
Redshank *Tringa totanus*			6	
Marsh Sandpiper *T.stagnatilis*				18
Greenshank *T.nebularia*	1-3	3	180	52
Wood Sandpiper *T.glareola*			5	1
Terek Sandpiper *Xenus cinereus*	2-4	10	615	
Common Sandpiper *Actitis hypoleucos*	4-8	11	5+	8
Turnstone *Arenaria interpres*	31-44			
TOTAL WADERS	260-560[b]	150	4370	940

N.B. a. The largest and smallest of three counts on Bamburi Beach are given. For the other sites counts from observations over 1-2 days are shown. b. A complete count of Bamburi and Mtwapa together gave a total of 530 waders.
b. The Bamburi and Mtwapa counts were carried out at mid tide, Sabaki at low tide and Mida Creek at both high and low tide.

TABLE 2. Wader densities at four sites on the coast of Kenya and some comparative data for the Seychelles and the United Kingdom.

	SITE	AREA (km^2) (c)	WADER NUMBERS (n)	WADER DENSITY (n/km^2)
KENYA:	MIDA CREEK	5.80	4370	755
	SABAKI ESTUARY	0.75	940	1255
	MTWAPA CREEK	0.41	150	370
	BAMBURI BEACH	3.37	530	160
SEYCHELLES: (a)	VICTORIA FLATS	0.09	323	3755
UNITED KINGDOM: (b)	WASH	270.00	175700	650
	MORECAMBE BAY	310.00	230000	740
	FORTH ESTUARY	23.42	36060	1540
	EDEN ESTUARY	7.90	13070	1655
	DORNOCH FIRTH	39.70	4150	105
	ADD ESTUARY	2.64	380	145
	LANGSTONE HARBOUR	36.30	72415	1995
	DEE ESTUARY	100.00	121-148000	1200-1500
	TEES ESTUARY	6.60	25-35000	3800-5300

(a) Data derived from Feare & High (1977) using the midpoint of their ranges for wader numbers and Fig.1. to derive mudflat area.
(b) Data from Bryant (1976) Report to Nature Conservancy Council, and unpubl., Tubbs (1977), Reports of the Birds of Estuaries Enquiry 1971/72 & 1972/73, 'The Wash water storage scheme feasibility study,N.E.R.C. Publications Series C. No. 15 (1976), Pienkowski (1973). Forth Estuary refers to the Firth of Forth above the Forth Bridges.
(c) Areas derived from 1:63360 scale maps.