

ARTICLES

Diet of Roseate Terns during the breeding season at St Croix Island, Algoa Bay

Introduction

The Roseate Tern *Sterna dougallii* is possibly the rarest species of tern, and indeed seabird, regularly breeding off the coast of South Africa. The population is estimated to be less than 100 breeding pairs (Randall in prep.) and the status of the species in South Africa has been described as rare and endangered (Siegfried *et al.* 1976).

Little information is available on the diet of Roseate Terns but studies in other parts of the world have shown that they catch small fish (Dunn 1973) such as sand-eels *Ammodytes* and menhaden *Brevoortia* (Hays *et al.* 1973). The related Common Tern *S. hirundo* has been found to catch predominantly small sand-eels and sprats *Clupea* (Dunn 1973) and the Sooty Tern *S. fuscata* takes fish, squid and crustacean larvae (Feare 1976). It has been established that crabs make up about half the diet of Royal Terns *S. maxima* when the birds feed in shallow water, the remainder of the diet consisting of squid, shrimps and fish (Buckley & Buckley 1972).

During a study of the breeding biology of Roseate Terns at St Croix Island, Algoa Bay (33 48S, 25 33E), we had the opportunity to document the diet by recording fish found on the ground in the colony and in chick regurgitations. Obviously the scarcity of the species precluded destructive sampling to obtain stomach contents. We obtained samples during the breeding season (August and September) in 1976 and 1977, but mostly in September 1977. For fear of disturbing the birds, inspections of the colony were kept to the barest minimum and the shortest possible duration.

Methods

We conducted a quick search every few days during the breeding season for food items. Chicks occasionally regurgitated when handled, but as handling was restricted to ringing and measuring few samples were obtained in this way. Fish obtained by these two methods were identified by staff at the J.L.B. Smith Institute of Ichthyology, Rhodes University and at the Zoology Department of the University of Port Elizabeth. Well preserved specimens were weighed to obtain their mass, while the mass of less well preserved ones was obtained by extrapolation from their length.

Five hours' direct observation at the colony on three occasions was devoted to recording the types and numbers of fish brought to the colony. Identification, except for ratfish *Gonorhynchus gonorhynchus*, was not possible so that only the basic shapes of the other fish could be made out.

Results and Discussion

There was no evidence of invertebrates, or any other food source apart from fish, in the diet during the study period (Table 1). Although we could find no reference to Roseate Terns catching

invertebrates it would not be unexpected as several related species have squid and crustaceans in their diet (Feare 1976, Buckley & Buckley 1972).

The fish taken had very variable body proportions ranging from the slender rod-shaped *Gonorhynchus* to the short deep-bodied Cheilodactylidae, although long thin species predominated. Similar-shaped fish represented by sand-eels and menhaden are the main food source for Roseate Terns in America (Hays *et al.* 1973). The largest fish recorded was an 83 mm *Sardinella*, with a mass of approximately 3.9 g, which was regurgitated by a chick. Generally the fish taken were larger than those recorded by Dunn (1973) who found the mean length to be 45 mm and the optimal length 50-75 mm. Hays *et al.* (1973) found that when Roseate Terns carried more than one fish the sand-eels were often 50 mm and the menhaden less than 25 mm. In the Baltic Sea the similar-sized Common and Arctic *S. paradisaea* terns took fish varying in length from 20 - 150 mm (Lemmetyinen 1976). In Hawaii the slightly larger Sooty Tern took fish with a mean length of 69 mm (Brown 1975).

Fish found at the colony and in regurgitations

We suspect that there might be a difference between the fish brought to the colony and those fed to the chicks. Many of those brought to the colony and dropped were probably not intended for chicks but were used in ritualized displays (Fig. 1). It is apparent from Table 2 that the species' diversity was greater at the colony than in the regurgitations, but this can probably be ascribed to the larger sample obtained at the former. It is also possible that different size classes of the same species would be brought to the colony or fed to the chicks. This was found to be case with Fairy Terns *Gygis alba* where smaller fish were recorded in regurgitations than carried by adults (Ashmole 1968). We tested this with the most numerous species, viz. *Gonorhynchus*, and ascertained that there was no significant size difference between fish found in the colony and those in the regurgitations ($t=1.28$, $df=18$, $P < 0.1$).

When the fish found lying in the colony are considered separately the importance of *Gonorhynchus* is immediately apparent, constituting almost half of those found. The Cheilodactylidae and Clupeidae together make up the bulk of the remaining 54% with the other three families represented making up a mere 11%. The pattern is not repeated however when the fish found in the regurgitations are considered. With only 15 specimens from three genera, *Sardinella* is found to be as important as *Gonorhynchus*. On the limited data available it is difficult to assess the importance of the other three families represented, however they appear to be trace items.

When the estimated mass contribution of the fish found at the colony is calculated the importance of *Gonorhynchus* is shown to be even more marked. By contrast the relative importance of the Clupeidae is much reduced so that six clupeids contributed little more than the single *Pomatomus*. A similar trend is evident when the mass contribution of the species found in the regurgitations is examined, although the relative proportion of the clupeids is higher than at the colony. Had it not been for

Table 1

List of species, with mean lengths and ranges, of fish taken by Roseate Terns at St Croix Island, Algoa Bay. Both those found at the colony and regurgitated by the chicks are included

Species	Sample Size	Mean Length (mm)	Range (mm)
Gonorhynchidae			
<i>Gonorhynchus gonorhynchus</i>	20	83,5	80-92
Cheilodactylidae			
<i>Cheilodactylus fasciatus</i>	1	57,0	
<i>Chirodactylus grandis</i>	4	46,8	42-55
<i>Chirodactylus brachydactylus</i>	2	43,5	43-44
Clupeidae			
<i>Sardinella</i> cf. <i>gibbosa</i>	7	51,7	39-83
<i>Sardinops</i> cf. <i>ocellata</i>	2	47,0	39-55
<i>Spratelloides</i> sp.	3	53,3	45-65
cf. <i>clupeid</i>	1	58,0	
Pomatomidae			
<i>Pomatomus saltatrix</i>	1	84,0	
Carangidae			
<i>Trachinotus</i> sp.	1	22,0	
Sphyraenidae			
<i>Sphyraena</i> sp.	1	50,0	

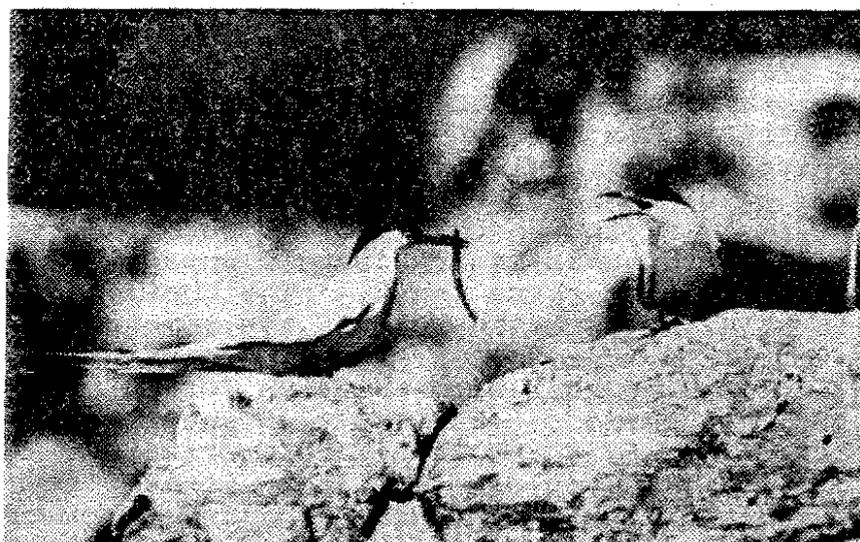


Figure 1

Adult Roseate Tern about to present a ratfish *Gonorhynchus* to its mate during courtship behaviour

Table 2

Percentage frequency of occurrence and percentage mass contribution of the fish species found at the Roseate Tern breeding colony, in regurgitations, and in a combination of the two

Species	Colony		Regurgitation		Colony+Regurgit.	
	%Freq Occur	%Mass Contr	%Freq Occur	%Mass Contr	%Freq Occur	%Mass Contr
<i>Gonorhynchus gonorhynchus</i>	46,4	60,8	46,7	55,7	46,5	59,1
<i>Cheilodactylus fasciatus</i>	3,6	4,6			2,3	3,1
<i>Chirodactylus grandis</i>	14,3	11,4			9,3	7,7
<i>C. brachydactylus</i>	3,6	2,4	6,7	5,0	4,7	3,3
<i>Sardinella cf. gibbosa</i>			46,7	39,3	16,3	13,0
<i>Sardinops cf. ocellata</i>	7,1	2,3			4,7	1,5
<i>Spratelloides</i>	10,7	5,7			7,0	3,8
cf. clupeid	3,6	2,3			2,3	1,5
<i>Pomatomus saltatrix</i>	3,6	9,9			2,3	6,6
<i>Trachinotus</i>	3,6	0,05			2,3	0,04
<i>Sphyræna</i>	3,6	0,5			2,3	0,4

Table 3

Percentage frequency of different fish brought to the colony on two occasions compared with their percentage frequency of occurrence found at the colony and in regurgitations

	Gonorhynchidae	Cheilodactylidae	Clupeidae	Others
8 September 1977	89,2	(-----10,8-----)		
19 September 1977	78,6	14,3	7,1	0
Colony + Regurgit.	46,5	16,3	30,2	7,0

one exceptionally large clupeid this figure would have been considerably lower.

If the data from fish found at the colony and in regurgitations is combined and plotted on log x log axes the relative importance of the six families can be clearly seen (Fig. 2). When presented in this way the closer any category approximates to the top right hand corner of the graph, the more important it is compared to the others.

Fish brought to the colony

Most of the 51 fish which we observed adults to bring to the colony were fed to the chicks, although the adults swallowed some themselves. During the four hour watch on 8 September 1977 we were too far away to distinguish any details, apart from whether they were *Gonorhynchus* or not. During the one hour observation on 18 September 1977 we were able to distinguish Cheilodactylidae and Clupeidae from *Gonorhynchus* by body colour and shape and from one another by shape.

The overwhelming proportion of *Gonorhynchus* during these counts (Table 3) can probably be ascribed to their increased availability at that time. During the period 8 - 19 September 1977 a total of 17 fish was collected at the colony or in regurgitations of which 65% were *Gonorhynchus*. This is higher than the figure of 45% over the entire breeding season, indicating a higher abundance or availability of *Gonorhynchus* over that period.

Foraging behaviour

Roseate Terns fed in small compact flocks, numbering about 80 birds. Feeding took place close to the colony, usually within 300 m of the island, in water about 20 m deep. Roseate Terns frequently fed in association with Jackass Penguins *Spheniscus demersus* and less often Sandwich Terns *S. sandvicensis*, Common Terns, Swift Terns *S. bergii*, Kelp Gulls *Larus dominicanus* and Cape Cormorants *Phalacrocorax capensis*. Of these only Sandwich Terns and Common Terns tended to form part of the Roseate flock. Roseate Terns drove off Arctic Skuas *Stercorarius parasiticus* but tolerated Kelp Gulls while feeding, whereas at the colony they drove off the gulls. Mixed groups of feeding seabirds are a common occurrence, especially those involving terns, as typified by an association of Black Terns *Chlidonias nigra* and Black-necked Grebes *Podiceps nigricollis* in Sandwich Harbour, South West Africa (Jensen & Berry 1972). Typically the birds in the flock flew about 2 m above the water and orientated so as to fly into the wind. They flew slowly over the shoal, diving hard onto the surface and then quickly up again when catching fish. As soon as those in the front had passed over the shoal they veered off rapidly to the side and joined the flock again from the rear.

References

Ashmole, N.P. 1968. Body size, prey size and ecological

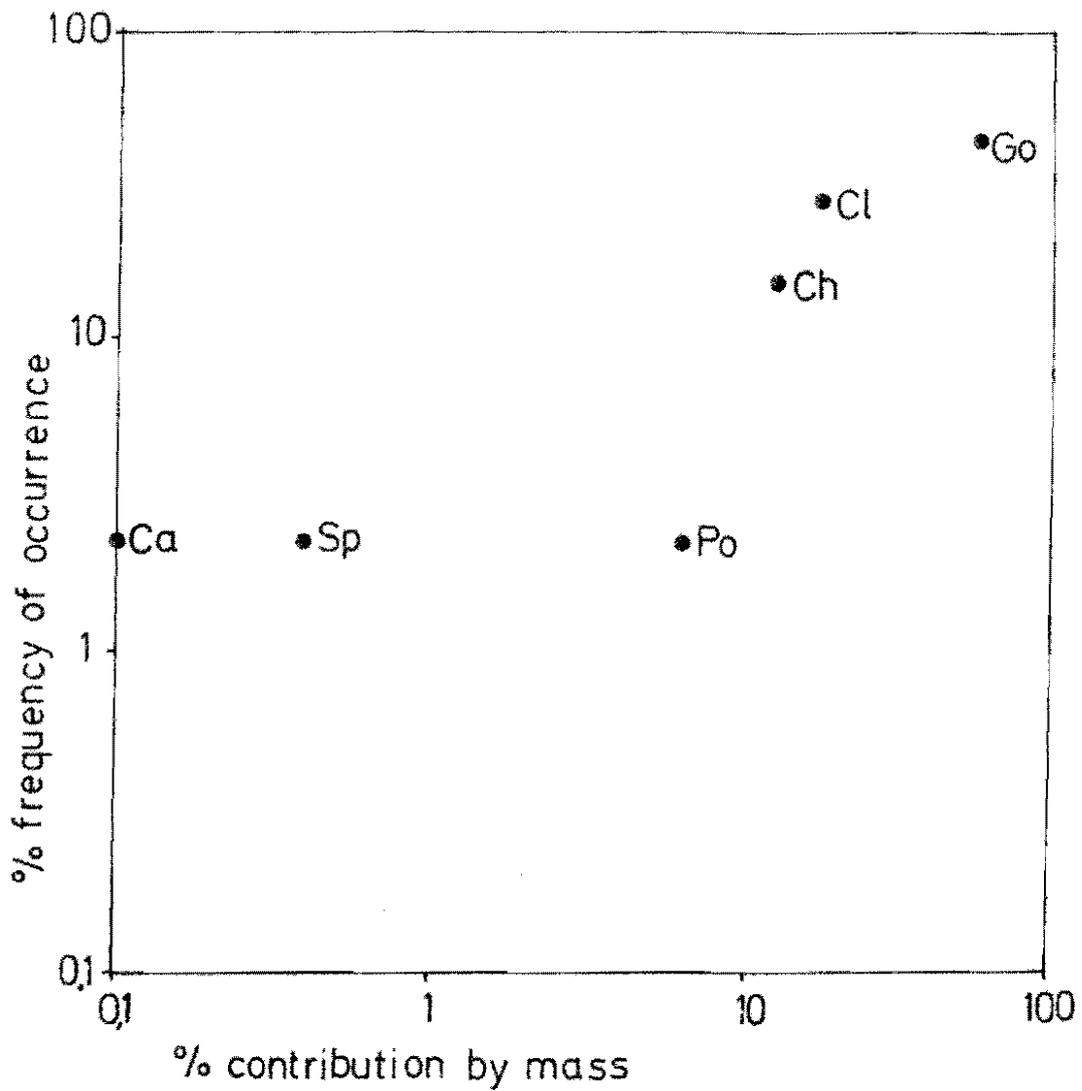


Figure 2

Relative importance of the six families of fish in the diet of Roseate Terns at St Croix Island, both those found in the colony and in regurgitations are included :

Ca - Carangidae; Ch - Cheilodactylidae; Cl - Clupeidae;
 Go - Gonorhynchidae; Po - Pomatomidae; Sp - Sphyraenidae

- segregation in five sympatric tropical terns (Aves: Laridae). System. Zool. 17: 292-304.
- Brown, W.Y. 1975. Parental feeding of young Sooty Terns (*Sterna fuscata* (L.)) and Brown Noddies (*Anous stolidus* (L.)) in Hawaii. J. Anim. Ecol. 44: 731-742.
- Buckley, F.G. & Buckley, P.A. The breeding ecology of Royal Terns *Sterna (Thalasseus) maxima maxima*. Ibis 114: 344-359.
- Dunn, E.K. 1973. Robbing behavior of Roseate Terns. Auk 90: 641-651.
- Feare, C.J. 1976. The breeding of the Sooty Tern *Sterna fuscata* in the Seychelles and the effects of experimental removal of its eggs. J. Zool., Lond. 179: 317-360.
- Hays, H., Dunn, E.K. & Poole, A. 1973. Common, Arctic, Roseate and Sandwich Terns carrying multiple fish. Wilson Bull. 85: 233-236.
- Jensen, R.A.C. & Berry, H.H. 1972. The Black Tern *Chlidonias nigra* (L.) in South West Africa. Madoqua ser. 1(5): 53-56.
- Lemmetyinen, R. 1976. Feeding segregation in the Arctic and Common Terns in southern Finland. Auk 93: 636-640.
- Siegfried, W.R., Frost, P.G.H., Cooper, J. & Kemp, A.C. 1976. South African Red Data Book - Aves. South African National Scientific Programmes Report no. 7. C.S.I.R., Pretoria. 108pp.

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