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Relative contribution of the sexes to chick feeding in Roseate and Common terns.—The relative parental contribution of the sexes during the entire chick-rearing period has received very little attention in marine terns. To our knowledge, no published reports exist for Roseate Terns (*Sterna dougallii*) and only one study of the role of sexes throughout the entire chick-rearing period has been completed on Common Terns (*S. hirundo*; Wiggins and Morris 1987). Here we provide some data on this topic.

Methods.—The study area was Cedar Beach, a barrier beach on the south shore of Long Island, New York (Lat. 40°N, Long. 73°W). We trapped, measured, and color marked incubating adult Common Terns in 1984–1987. We trapped and color marked Roseate Terns in 1984 and 1985, but not in 1986 or 1987 because we wanted to reduce disturbance to breeding pairs after the species was proposed for Endangered listing (52 FR 42064). Deliveries of prey to nests of 13 pairs of Roseate Terns and 24 pairs of Common Terns were observed from blinds. We recorded data between 05:00 and 09:00 h EST 3–5 days per week through the chick-rearing period. Longer-billed members of each pair were assumed to be males (see Coulter 1986). Observations of begging corroborated this assumption in four Roseate Tern pairs; we assumed that only females begged from mates (I. Nisbet pers. comm.). Chicks were fenced (as in Safina et al. 1988) to keep them at the nest site. Prey fish length was estimated relative to adult tern bill length (e.g., 1.5 bill-lengths). Data were analyzed using SAS (Ray 1982).

For analysis of prey species composition and prey length, we used data from all pairs in which mates could be differentiated at least part of the time. For these analyses we used 748 nest-h for 13 pairs of Roseate Terns and 1682 nest-h for 24 pairs of Common Terns, 1984–1987.

Analysis of intersexual differences in the number of fish contributed to growing chicks requires that the sexual identity of mates be known for all prey deliveries observed. In 1984, dyes used on both species faded before the end of the chick-rearing period; these individuals were deleted from this analysis. In 1986 and 1987, we did not color mark Roseate Terns. Attempts to identify individual Roseate Tern pair members by other characters (e.g., old bands) were only partially successful during rapid prey exchanges, making the data for most pairs unsuitable for analysis of number of prey delivered. We also deleted from this analysis any pairs which did not raise at least one chick to flying age, because we wished to exclude any parents whose delivery rate may have been abnormal. Consequently, for our analysis of intersexual differences in the number of fish delivered, we were able to use only the 1985 data for Roseate Terns (5 pairs, 305 nest-h) and 1985–1987 data for Common Terns (20 pairs, 1580 nest-h).

Results.—During our 1985 observations, Roseate Tern males delivered 65% ($N = 181$) of the prey to chicks while females delivered 36% ($N = 101$; goodness of fit $\chi^2 = 22.7$, $df = 1$, $P < 0.001$).

During our observations of 1933 Common Tern prey deliveries, males made 45% of 264 prey deliveries in 1985, 51% of 924 prey deliveries in 1986, and 56% of 745 prey deliveries in 1987. Overall, male Common Terns accounted for 51% of prey deliveries observed ($\chi^2 = 2.60$, $df = 2$, ns).

In both species, males brought longer fish than did females (Kruskal-Wallis $\chi^2 = 8.44$, $df = 1$, $P < 0.01$ for Roseate Terns, $\chi^2 = 5.74$, $df = 1$, $P < 0.02$ for Common Terns). For analyses of fish length, we used unconverted bill-length units, not converted mm length estimates; thus our measure of the intersex differences in fish size is conservative, because a male with a fish of 1.5 bill lengths has, in reality, a longer fish than a female with a fish of 1.5 bill lengths. Roseate Tern males (mean culmen = $39.2 \pm .04$ mm [SE]) brought fish

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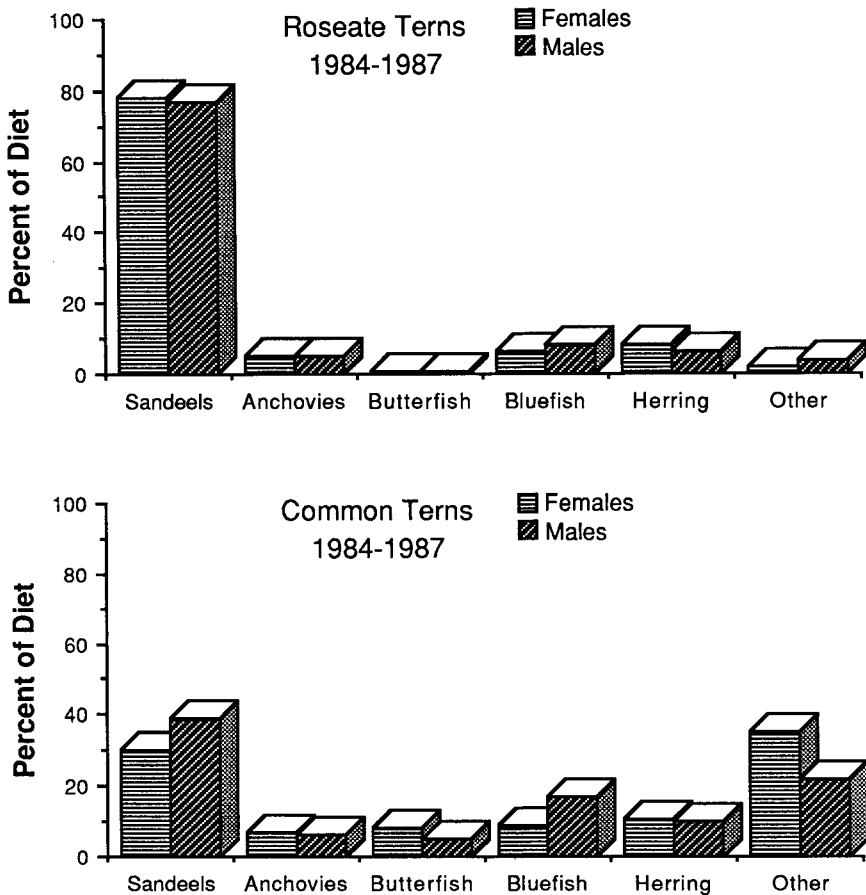


FIG. 1. Inter-sex differences in major prey brought to nests by Roseate and Common terns.

averaging 1.6 bill lengths (ca 63 mm), while females' (mean culmen = $37.3 \pm .04$ mm) fish averaged 1.5 bill lengths (ca 56 mm). Common Tern males (mean culmen = $36.8 \pm .03$ mm) brought fish averaging 1.6 bill lengths (ca 59 mm), while females' (mean culmen = $34.7 \pm .04$ mm) fish averaged 1.5 bill lengths (ca 52 mm).

Roseate Tern males brought longer sandeels (*Ammodytes* sp.), the principle prey, to their chicks than did females, but there was no intersexual difference in the length of sandeels brought by Common Terns (Kruskal-Wallis $\chi^2 = 5.5$, $df = 1$, $P < 0.02$ for Roseate Terns, $\chi^2 = 1.4$, $df = 1$, ns for Common Terns). For other fish species, both Roseate and Common tern males brought longer fish to their chicks than did females (Kruskal-Wallis $\chi^2 = 9.43$, $df = 1$, $P < 0.002$ for Roseate Terns, $\chi^2 = 5.91$, $df = 1$, $P < 0.01$ for Common Terns).

For combined years, species composition of prey brought to chicks did not differ between adult male and female Roseate Terns (Contingency Table $\chi^2 = 2.46$, $df = 1,5$, $P < 0.8$; Fig.

1). In 1985, however, males brought 70 bluefish to nests while females brought only 19 bluefish (goodness of fit $\chi^2 = 29.22$, $df = 1$, $P < 0.0001$).

The species composition of prey delivered by Common Tern adults for combined years differed between sexes ($\chi^2 = 61.56$, $df = 1, 5$, $P < 0.0001$; Fig. 1). For Common Terns, of the major prey species we individually analyzed, males delivered a significantly higher proportion of sandeels (compared to total prey they delivered; Contingency Table $\chi^2 = 16.86$, $df = 1$, $P < 0.0001$), and juvenile bluefish (Contingency Table $\chi^2 = 16.86$, $df = 1$, $P < 0.0001$), while females delivered a higher proportion of pipefish (Contingency Table $\chi^2 = 53.33$, $df = 1$, $P < 0.0001$). There were no significant inter-sex differences in the proportion of total prey composed of herring, anchovies, or butterfish.

Discussion.—In contrast with our results for a marine system, Wiggins and Morris (1987) found that, throughout the chick-rearing period at a freshwater colony, male Common Terns consistently delivered prey at a rate three times higher than that of females. They cite other studies (e.g., Nisbet 1973) which reported that male Common Tern parents fed chicks more than did females in the period immediately after hatching, when females still do much brooding. Like Wiggins and Morris, we studied provisioning throughout the chick period. The differences in results between our study and that of Wiggins and Morris may relate to basic differences between freshwater and marine systems. We suspect that prey distribution is less predictable and is much patchier in marine systems. Marine and freshwater systems differ fundamentally because tides, interactions with pelagic predatory fish, and large-scale schooling and migration greatly influence prey availability in salt water (Safina and Burger 1988).

Pierotti (1981) found that in Western Gulls (*Larus occidentalis*) some aspects of the relative contributions of the sexes to parental care were affected by environmental conditions. This, and the contrast between our results and those of Wiggins and Morris, suggest that generalizations about parental care in a species ought not be inferred from a single study if conditions which might affect such important factors as food availability vary fundamentally with differing habitat types within the species' range.

Prey species composition did not differ between sexes for Roseate Terns, but it did for Common Terns. Greater proportions of sandeels and bluefish delivered by male Common Terns suggest a diet more similar to that of Roseate Terns, which concentrate their foraging in the nearby ocean inlet (Safina, Unpubl. data). This raises the possibility that male and female Common Terns forage in different areas.

Interspecific and intersexual differences in mean prey size, if reflective of differences in the range of prey captured and not simply of differences in selecting which prey to deliver to chicks, suggest subtle differences in feeding ecology. However, we cannot rule out the possibility that birds may differentially select which prey to deliver out of the range of prey captured. Such differential selectivity could relate to bill size, wing loading, and/or distance to the colony.

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Prolonged parental care and foraging of Greater Snow Goose juveniles.—The importance of prolonged parental care in geese and swans (see Kear 1970) in the foraging behavior of juveniles recently has received close attention from researchers. Scott (1984) has shown that Mute Swan (*Cygnus olor*) juveniles still with their parents spend more time feeding in their daily activity budget than do juveniles which have left theirs. Similarly, Gregoire (1985) found that in foraging flocks of Lesser Snow Geese (*Chen caerulescens caerulescens*), lone juveniles fed less and moved more than family juveniles. In foraging flocks of Barnacle Geese (*Branta leucopsis*), family juveniles feed for longer, uninterrupted periods than do juveniles that have been separated from their parents (Black and Owen, in press a). Furthermore, within these flocks, families are more likely to feed in the leading edge of flocks, where the biomass is higher, than do lone juveniles (Black and Owen, in press b). In all instances, these results were related to the lone juveniles' low status in the dominance hierarchy. The purpose of this study was to compare the foraging activities of lone juveniles and those of juveniles belonging to families in Greater Snow Geese (*C. c. atlantica*).

We conducted field observations in the springs of 1985 and 1986 along the south shore of the St. Lawrence river estuary between Montmagny and St-Jean-Port-Joli, Québec. Some 40,000 Greater Snow Geese stage along this stretch of shoreline from late March until about 20 May, when they depart for their high-arctic breeding grounds (Gauthier et al. 1984a, 1984b). Most ten-month-old juveniles are still with their parents at that time of the year. Although the birds have recently turned to feeding in cultivated lands to some extent (Bédard et al. 1986, Gauthier et al. 1988), they still obtain well over half of their energy intake from the tidal marshes (Bédard and Gauthier, in press) where they dig up rhizomes of three-square bulrush (*Scirpus americanus*) (Giroux and Bédard 1988). We studied only geese feeding in marshes. In early April, the ice has just started to disappear, leaving a marsh surface almost totally devoid of aerial vegetation.

We watched (Y.T. and one assistant) the foraging geese from dawn to dusk, from permanent blinds and vehicles located near the edge of the marshes, using 15–45× spotting scopes.