

# WINTER DENSITIES OF SANDERLING IN COASTAL NORTH CAROLINA

by Jeffrey R. Walters

## INTRODUCTION

The winter range of the Sanderling *Calidris alba* includes much of the world's temperate and tropical coasts. Its ecology during winter has been well studied in two locations, central California (Myers 1980, 1983, Myers *et al.* 1979, Connors *et al.* 1981) and north-east England (Evans *et al.* 1980). In both areas individual birds are strongly faithful to a particular wintering site both within and between years. Overlying this basic site fidelity is considerable within-region mobility, as at least some individuals make frequent visits to sites up to 50 km or more distant from their usual winter home.

The choice of a wintering site has dramatic consequences for an individual Sanderling. All breed in the high Arctic, and therefore the choice of a north temperate versus a tropical or south temperate wintering site results in an enormous difference in migration distance. Wintering areas are also very different ecologically, and this may affect winter survival. In the winter of 1981-1982, I initiated a study of the ecology of Sanderlings wintering in coastal North Carolina to determine the effect of such ecological difference on Sanderling behavior and demography. There are obvious differences between North Carolina and other wintering areas in weather conditions, and there are also differences in habitat. Sanderling habitat in North Carolina is much more continuous than in California or England. In the latter two, habitat consists of discrete areas of tidal flats and sand beaches (associated with estuaries and bays) that interrupt otherwise rocky coastlines. In North Carolina, barrier islands provide miles of uninterrupted sand beach. Tidal flats exist behind the barrier islands and in inlets, but they are typically more diffuse and smaller than those in California and England. Furthermore, their pattern of availability through time is more irregular, being more dependent on wind conditions than the locally weak tidal cycle. This more variable exposure also leads to different types of prey communities than occur in flats with a regular tidal cycle of exposure (Peterson and Peterson 1979).

I report here on preliminary census results from the winter of 1981-1982 and 1982-1983 that indicate that Sanderlings behave very differently in North Carolina than they do in other locations where they have been studied. These results suggest several promising directions for future research.

## CENSUS RESULTS

### Sanderlings

Systematic censusing was restricted to outer beach habitat. Other habitats such as tidal flats, ponds, and marshes were surveyed regularly, but because census results were extremely variable in these habitats, reliable estimates of shorebird numbers could not be generated from my limited sample. This variability was presumably due to the irregular availability and small patch size of these habitats; birds apparently moved between patches frequently rather than remaining at any particular one. In any case, Sanderlings were

observed in habitats other than outer beach infrequently (see below).

Censusing was performed at three study sites, (1) Oregon Inlet (35° 46'N), (2) Beaufort Inlet (34° 43'N), and (3) Fort Fisher just north of Cape Fear (33° 57'N). Birds were counted while walking or driving measured lengths of beach. When possible each stretch of beach was counted twice, once at low tide and once at high tide, during each visit to a study site. Sometimes areas were censused three times, sometimes only once, and some counts were done on rising or falling tides. Estimates of densities are averages of all the counts on all the stretches of beach surveyed during a visit to a particular study site, and are therefore only rough estimates. The preliminary nature of these data can not be overemphasized.

It was possible to average counts over the tidal cycle because of the relative lack of movement off beaches in North Carolina. In California nearly all individuals leave the beach at low tide, and densities are considerably reduced during falling and rising tides compared to high tide (Connors *et al.* 1981). In North Carolina there was no evidence of movement off beaches during rising or falling tides, and densities were not greatly reduced even at low tide. At most perhaps one-third of the individuals left the beach at low tide. This result accounts for my failure to find many Sanderlings in habitats other than outer beach.

The data, although preliminary, are sufficient to indicate some striking seasonal trends in Sanderling density (Table 1). At Fort Fisher

Table 1. Density estimates for Sanderlings on outer beach in North Carolina during winter

Date	Km of beach Censused*	Density of Sanderlings (No/km)
Southern Site**		
Nov 1982	19.7	10-15
Feb 1982	5.8	10-15
Apr 1983	11.2	15-20
Northern Sites***		
Sept 1982	41.8	40-50
Oct 1982	1.4	30-40
Dec 1982	41.4	10-15
Jan 1982	10.6	10-15
Feb 1982	9.4	2-3
Apr 1982	4.8	0-1

\*Total distance covered. Because stretch of beach was counted twice on average, the total length of beach included in a census is roughly half the figure given.

\*\*Fort Fisher.

\*\*\*Oregon Inlet and Beaufort Inlet.

densities were relatively stable throughout the wintering period (September through April), as they are in California or England. Other censuses taken during a migration study in 1983 indicated that numbers increased only slightly at Fort Fisher (to 20-30/km) with the onset of migration in early May. In contrast, densities

at the two northern sites varied considerably over the wintering period. Densities were high in the fall following migration but fell to much lower levels in early winter and to extremely low levels in mid-winter. These low levels persisted until the onset of migration in May when numbers increased to as much as 150-175 birds/km. These census results reflect my general impressions about Sanderlings wintering in coastal North Carolina during the past two winters: birds could be found throughout the winter at fairly low densities in southern areas and early in the season in northern areas but became increasingly infrequent in the latter as winter progressed.

The highest densities I recorded (fall densities in northern sites, Table 1) are only half as large as those recorded in California (Connors et al. 1981). Thus, population densities are considerably lower in North Carolina than at other sites where they have been studied, as well as less stable.

Finally, territorial behavior was conspicuously lacking in birds wintering in North Carolina. Territoriality is readily detected in Sanderlings (see Myers et al. 1979), but no strongly territorial birds were observed at any of the sites from September through April. Only a few individuals were even intermittently aggressive. In contrast, strongly territorial birds were commonly observed at all sites in May 1983, and at the only site visited in August 1983. Thus territoriality appears to be common during migration but absent during winter in North Carolina.

#### Other species

Results for other species found on outer beach were similar to those for Sanderling. Willets *Catoptrophorus semipalmatus* and Black-bellied Plovers *Pluvialis squatarola* were common on the northern beaches in fall but had nearly disappeared by mid-winter, whereas they were present throughout the wintering period on the beaches near Fort Fisher. Because these species moved off the beach regularly as a function of the tidal cycle, my data are not sufficient to estimate their densities accurately. Both species, but particularly Black-bellied Plovers, used outer beach primarily at high tide. Other species characteristic of tidal flats (notably Dunlin *Calidris alpina*) that are rarely observed on outer beach in California, were frequently seen feeding there at high tide in North Carolina.

#### DISCUSSION

##### Significance of Declining Densities

One cannot determine whether the reduction in numbers of shorebirds on outer beach over the winter is due to mortality or movement, without further study employing marked birds. If this decline is a regular occurrence, large scale movement seems likely, but there is no indication that birds leaving the northern locations were absorbed by nearby more southern populations such as that at Fort Fisher. Given the movement capabilities of individuals in stable populations such as those in California and England, large scale movement as a regular wintering strategy is feasible for Sanderlings.

That a change in wintering behavior of Sanderlings should occur from north to south along this particular stretch of coast is intriguing, given the sharp environmental gradients there. For example, isotherms of minimum winter sea surface temperatures are grouped closely in this region (Figure 1). The southern study site is just south of the 50°F

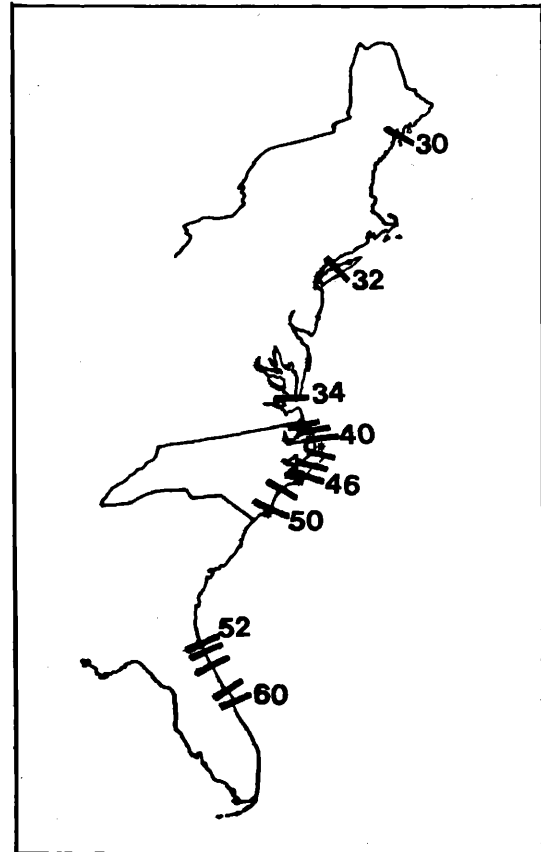


Figure 1. Isotherms of minimum winter sea surface temperatures along the eastern coast of the United States. Isotherms are marked at 2°F (approx. 1°C) intervals. Note the sharp gradient along the North Carolina coast. The state is outlined, and the study sites are indicated by asterisks (Oregon Inlet, Beaufort Inlet, Fort Fisher, from north to south). Note that the two northern sites are within the gradient, whereas the southern site is at the southern end of the gradient. Data are from the *Oceanographic Atlas of the North Atlantic Ocean* (1967).

(10°C) isotherm, that is, just beyond the end of the sharp gradient. The two northern sites are within the gradient, one (Oregon Inlet) near the north end (near 40°F (4°C) isotherm); the other near the southern end (between 46°F (8°C) and 48°F (9°C) isotherms). Minimum sea surface temperatures have little direct effect on Sanderlings, of course, but they are indicative of physical changes in the environment that have dramatic consequences for marine organisms, including those that constitute the winter diet of Sanderlings. The foraging ecology of Sanderlings may therefore change considerably between these study sites, despite their physical proximity and similar climates.

##### Significance of Average Densities

North Carolina clearly does not support the densities of Sanderlings that wintering sites in California or England do. This may be due in part to differences in beach characteristics or weather between sites, but is likely to reflect a difference in use of tidal flats as well. Sanderling in North Carolina are highly dependent on outer beach, whereas tidal flats are used equally extensively at other sites (Connors et al. 1981). Flats in North Carolina

may be less available, less suitable, or both, compared to California or England. This suggests that tidal flats are important in the conservation of this species, although one usually thinks of it as a beach resident.

Lack of territorial behavior suggests that Sanderlings wintering in North Carolina encounter different conditions on the beach than do those wintering in California or other sites. In California, lack of territorial behavior is associated with very low food densities, very high food densities, or presence of predators (Myers et al. 1979, Myers 1980, in press). The first possibility seems most likely for North Carolina. The birds did not show other behavioral features associated with the presence of predators such as tight flocking (Myers in press), and there were no other indications that food was abundant. The difference between North Carolina and California need not be in absolute prey abundance, of course, but may lie in availability of prey relative to required prey intake.

#### Future Research

These preliminary results suggest several promising directions for further research. North Carolina seems a difficult place to winter for Sanderlings, as its position near the northern limit of the east coast wintering range implies. Indeed, Sanderlings may not be able to remain throughout the entire winter over much of the state. One goal in future research should be to determine survival rates for birds wintering in North Carolina, and relate survival to climate, periods of severe weather, food supply, and other variables. Studies of movement and time and energy budgets will be necessary to interpret survival data. Comparison of such data to similar data collected from other wintering sites will enable us to determine the relative costs of wintering in different areas in terms of winter survival. Benefits could be measured in terms of reduction in migration mortality as evidenced by return rates. Thus the consequences of wintering in different regions can be evaluated to achieve a better understanding of the evolution of sanderling migration patterns. Comparisons between North Carolina and Peru, where J.P. Myers has initiated studies of wintering Sanderlings, seem especially promising as individuals from these populations may have a similar breeding range (Myers in prep.).

## THE AFRICAN SEABIRD GROUP

The African Seabird Group has as its primary interest all seabirds (coastal and pelagic) occurring in the Afrotropical region, and on islands in the Atlantic, Indian and Southern Oceans between 20°W, 80°E and south of 20°N. Waders or shorebirds (Charadrii) are not considered to be seabirds, with the exception of Phalaropes (Phalaropodidae). Essentially inland species of primarily marine groups are included (e.g. the Grey-headed Gull *Larus cirrocephalus* and the *Chlidonias* terns).

The African Seabird Group exists to increase communication between those interested in seabirds, especially of the region described above; to organise regular patrols of the region described above; and to publish its journal, *The Cormorant*, which is issued in two parts a year, normally June and December.

Interested persons are invited to submit observations on African seabirds for consideration for publication in *The Cormorant*. Authors do not have to be members of the Group. Material may take the form of papers, notes, progress reports, letters or reviews. Manuscripts should be typed in double spacing

#### ACKNOWLEDGEMENTS

I thank personnel of the Cape Hatteras National Seashore, Cape Lookout National Seashore, Pea Island National Wildlife Refuge, North Carolina Marine Resource Center at Manteo, North Carolina Marine Resource Center at Fort Fisher, and the National Marine Fisheries Laboratory for assistance in the field and access to study sites. Special thanks are due to D.Colby, S.Nunnally, J.Parnell, and R.White. F.McLamb and E.Schoelkopf assisted in preparing the manuscript, and S.Zeveloff suggested several helpful revisions. This is paper No. 9027 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh, NC 27650.

#### REFERENCES

- Connors, P.G., Myers, J.P., Connors, C.C. & Pitelka, F.A. 1981. Interhabitat movements by sanderlings in relation to foraging profitability and the tidal cycle. *Auk* 98: 49-64.
- Evans, P.R., Brearey, D.M. & Goodyer, L.R. 1980. Studies on Sanderling at Teesmouth, NE England. *Wader Study Group Bull.* 30: 18-20.
- Myers, J.P. 1980. Sanderlings *Calidris alba* at Bodega Bay: facts, inferences, and shameless speculations. *Wader Study Group Bull.* 30: 26-32.
- Myers, J.P. 1981. Cross-seasonal interactions in the evolution of sandpiper social systems. *Behav. Ecol. Sociobiol.* 8: 195-202.
- Myers, J.P. 1983. Space, time and the pattern of individual associations in a group-living species: sanderlings have no friends. *Behav. Ecol. Sociobiol.* 12: 129-134.
- Myers, J.P. in press. Spacing behavior of nonbreeding shorebirds. In *Behavior of Marine Animals: V. Shorebirds. Breeding Biology* (eds. J.Burger and B.L.Olla). Plenum Press, New York.
- Myers, J.P., Connors, P.G. & Pitelka, F.A. 1979. Territory size in wintering sanderlings: the effects of prey abundance and intruder presence. *Auk* 96: 551-561.
- Oceanographic Atlas of the North Atlantic Ocean.* 1967. Washington, U.S. Naval Oceanographic Office.
- Peterson, C.H. & Peterson, N.M. 1979. *The Ecology of Intertidal Flats of North Carolina: a Community Profile.* U.S. Fish and Wildlife Service, Office of Biological Services. FWB/OBS-79/39.

J.R. Walters, Department of Zoology, North Carolina State University, Box 5577, Raleigh, NC 27650, U.S.A.

and submitted in duplicate. All submitted material is considered by at least one referee. Figures should be prepared in the size of final production, or they may be reduced photographically.

Membership of the African Seabird Group is R5-00 per year, and members receive *The Cormorant* free. Institutions may subscribe to *The Cormorant* for the same amount. All back numbers are presently available at R2-50 each. The first seven numbers were issued as bulletins of the Southern African Seabird Group. Write to the Treasurer for further information.

#### OFFICE BEARERS

Chairman & Editor: J. Cooper, Fitzpatrick Institute, University of Cape Town, Rondebosch 7700, South Africa.

Secretary: Dr. P.A.R. Hockey, Fitzpatrick Institute, University of Cape Town, Rondebosch 7700, South Africa.

Treasurer: R.K. Brooke, Fitzpatrick Institute, University of Cape Town, Rondebosch 7700, South Africa.