

**The terns of the Dry Tortugas.**—William B. Robertson, Jr. 1964. Bull. Florida State Mus., 8(1): 1-94.—Breeding behavior, annual cycle, and demography of tropical seabirds have in recent years received considerable attention, particularly by N. P. Ashmole (1962, 1963) in relation to Ascension Island in the tropical Atlantic. This subject is of theoretical importance as it allows for studies of correlations of the internal rhythm of birds with the restricted seasonal variations in the tropics of weather, suitability of nest sites, and food supply.

The present paper apparently serves the double purpose of being a faunistic and demographic documentary of seven species of terns reported nesting on the Dry Tortugas since these islands were first visited by Audubon in 1832. The Dry Tortugas, low, atoll-shaped, coral islands about 70 miles west of the nearest Florida Keys, although difficult of access, have been the site of bird-banding operations from 1936 through 1941 (mainly by Jack C. Russell of the Florida Audubon Society) and, more extensively, by a joint effort with the National Park Service, Florida State Museum, from 1959 onwards. Unfortunately, although a not insignificant part of the general discussions is based on the results from thousands of terns banded, details of recoveries are not given (other than incidentally) either in relation to localities or to age classes. This makes it difficult for the reader to check the conclusions, important as a whole, made by the author, who, it may be recalled, is a careful and competent Park Biologist at Everglades National Park and Fort Jefferson National Monument (on Garden Key, Dry Tortugas).

The description of the locations and physiography of the shoals and islands of the atoll provides an impressive history of the actions of currents, waves, and hurricanes upon the presence, shape, and vegetation of the islands and their repercussions on site and size of terneries. The known changes of each island (including their intricate and confusing names) and of the growth and shifts of the colonies of each species of tern are given separately and in chronological sequence. They are described critically, but in the absence of a comparative tabulation, in which also the hurricanes and the introductions and eradications of rats would also have been helpfully entered chronologically, it is not easy for the reader to reach his own conclusions.

Counting the population size of the Sooty Tern (*Sterna fuscata*) and the Brown Noddy (*Anous stolidus*), which are the most abundant bird species of the islands, involves many difficulties. These include the inadequacy of visual estimations of bird flocks numbering tens of thousands of individuals, the need to allow for the presence of non-breeding individuals (if these are visiting the breeding colonies at all), the need to allow for the arrival of late breeders and the departure of early nesters, and the need to estimate the number of birds which have lost their eggs or young. The Sooty Terns, of which the record starts with an uncertain estimation of probably not over 50,000 pairs in Audubon's time (1832), apparently have had their lows at the end of the last and the beginning of this century when commercial egg taking was heavy (an estimated 5,000 adults in 1903). They reached peaks about 1919 (110,000 adults), 1944 (130,000 adults), and 1950 (over 190,000 adults) with lows in between. The present colony is estimated at 80,000 breeding adults.

In contrast to the well known situation on Ascension Island, the Tortuga Sooty Terns definitely have a 12-month cycle, but new breeding birds arrive from April until July and start egg-laying almost immediately. "Commonly hundreds of birds are incubating by the afternoon of the day of landing" (p. 40). First (night) landings are earlier at present than they were 20 years ago (changing from, at the average, 27 April to 14 April or earlier, e.g., 28 March in 1964).

Birds arrive in optimal physical condition and in fresh, unworn plumage. It was thought that they did not visit their breeding site in winter, but recent observations have made it necessary to hold this opinion less rigidly. Other interesting data and their inferences are given by the author in an elaborate discussion. Site tenacity, first arrival of older adults which occupy traditional nesting sites, suitability of nesting grounds (flat, sandy spaces with sparse growth of sea oats), and possible nest-site competition with noddies are discussed with expert knowledge. A comparison with the Sooty Tern colony on Ascension Island is facilitated by a tabulation of data (table 3, p. 51). Particularly, the considerable difference in adult mortality (by feral cats, amounting in Ascension Island to three per cent; insignificant in the Tortugas colonies) and the high (Tortugas) against the very low (Ascension) breeding success of the Sooty Tern are noteworthy. Population size, which, according to Ashmole, is restricted by food supply in Ascension, is in the Tortugas unrestricted by food supply, but rather is restricted by available nesting sites. The termination of the breeding season is fixed by autumnal or late summer storms causing heavy waves and high water and by the passage of migrating hawks, which take the remaining, late, or disabled young. However, no details of this hawk predation (amount? species?) are given, nor are those on the amount of predation by frigatebirds (*Fregata magnificens*).

"Brown Noddies have been banded and recaptured at the Dry Tortugas in much smaller numbers than the Sooty Terns" (p. 58); still, the discussion gives important data on the dependence of these terns on the edges of bay cedar bushes for nesting sites, the devastating effect of hurricanes on the presence and growth of these bushes, and the consequent changes of the number of breeding noddies. Although the noddy was originally estimated to be about as abundant as the Sooty Tern, its present numbers hardly surpass 2,000 adult breeding birds. They must have reached a peak at about 1919 (*ca.* 35,000), after which their original breeding place ("Bird Key") was definitely unsuitable for them through repeated hurricane action.

Faunistically this paper is important, as its results suggest that the total Tortugas breeding population of at least the Sooty Tern does not leave the confines of the Gulf of Mexico, and that a shift of breeding sites in Sooty Terns and Brown Noddies, both individually and as a colony, only rarely occurs. The unpredictable population changes in the other species of terns (Roseate, *Sterna dougallii*; Least, *S. albifrons*; Royal, *Thalasseus maximus*; and Sandwich, *T. sandvicensis*), all occurring in small numbers, are described. These fit well into what is known of these species in their Caribbean ranges. According to the reviewer's experience the breeding places of the Common Tern (*Sterna hirundo*) in the islands of Aruba, Curaçao, and Bonaire in the southern Caribbean do not usually coincide with those of the Roseate Tern. Hence, the author is sufficiently cautious in not yet accepting any definite breeding record of this species in the Tortugas. The Black Noddy (*Anous tenuirostris*), first recorded in the "continental" (*sic*) United States at Bush Key, Dry Tortugas, on 13 July 1960 by the author, has been observed, mist-netted, and photographed on Bush Key in subsequent years, but definite proof of nesting is lacking, though this is strongly suspected.

Robertson's study is an important paper of reference, and probably will be for many years. The reviewer hopes that the numerous banding results will allow a further paper to be prepared on the actual distribution of the members of the Tortuga colonies over the Gulf of Mexico and the Caribbean seas and on the composition of the populations and the life expectancies of Sooty Terns and Brown Noddies according to age classes.—K. H. Voous.