



(Photo: F. O'Leary)

Biology

Antarctic Avian Population Studies, 1965-1966

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The antarctic avian population studies aim at understanding the population dynamics and social behavior of the long-lived antarctic seabirds. The interactions of polar communities are simple when compared with communities in the warmer regions; therefore, insight into basic ecological principles may be collected more easily from these populations. Moreover, a better knowledge of their breeding biology is required to formulate good conservation measures.

At the Cape Crozier, Ross Island, study area some 300,000 Adélie penguins, *Pygoscelis adeliae*, interact in specific social groups in one enormous rookery. Their eggs and young are preyed upon by only one species of bird, the south polar skua, *Catharacta maccormicki*, while at sea the leopard seal, *Hydrurga leptonyx*, takes a toll of adults and young alike. The social organization of the avian component of these populations is being studied from individually marked birds.

During the past five seasons, a total of 21,474 Adélie chicks and 1,174 skua chicks has been banded in selected study areas. Each year a different check mark (web-punch) has been used on the chicks as a precaution against band loss and as further evidence of known age. Over 24,500 chicks have been web-punched and/or banded. The chicks leave the rookery at the end of the breeding season to reside in the pack ice, returning to land in later seasons, first as juveniles, then as inexperienced breeders, and finally as established breeders (Sladen, 1958).

No marked birds have been recovered during their first year, but a preliminary analysis of the data shows that approximately seven percent of

each of three age groups (in their second, third, and fourth years) are returning to the rookery of their origin. These figures represent a total of nearly 1,000 recoveries of Adélies of known age, and they are concentrated mainly in the areas where they were originally banded as chicks, giving enough birds to study and compare with the older, established breeders.

Band loss and immigration to other rookeries (a few have been seen at the Beaufort Island, Cape Bird, and Cape Royds rookeries) are estimated as small in comparison with the high mortality to which these young birds must be subjected during their first two years in the pack ice. The only offshore predator is the leopard seal, which takes a heavy toll of chicks when they are leaving the rookery and probably continues to diminish their numbers throughout their first two years.

A few three- and four-year-old Adélie penguins have bred at Crozier, though all but one three-year- and three four-year-olds have lost their eggs or chicks. These successful but inexperienced breeders reared only one chick each instead of the usual two. However, the majority of these juveniles do not breed and have been observed wandering around the rookery individually or in small groups. Their social interactions, which may be detrimental to successful breeding of the older birds, have been the subject of much of the studies.

A food habit study of the Adélie penguin was carried out at Cape Crozier during the austral summers of 1964-1965 and 1965-1966 as part of the overall avian population studies. The objectives of this study were to obtain as complete a record as possible of marine animals taken as food by the Cape Crozier Adélies, to determine what proportion each individual food item made up of the total amount of food being brought in, to determine if the composition of food items found in breeding Adélies changed as the chick-rearing period progressed, and to estimate the amount of food removed from the sea during chick rearing.

During the summer of 1964-1965, three kilograms of food samples were collected, preserved, and shipped to the United States for final analysis. These samples were found to contain 15 identifiable

species of Crustacea (all from the orders Euphausiacea and Amphipoda), at least three species of fish, one species of Cephalopoda, and minor amounts of marine algae, parasites, stones and other debris. By weight, the identifiable food items were in the following proportions: Crustacea, 60 percent; fish remains, 39 percent; and miscellaneous, one percent. The high percentage of fish in the stomachs is surprising, as earlier work done in other parts of the Antarctic usually makes reference only to krill, *Euphausia superba*, in stomachs collected. Not only was the proportion of fish quite high but the common food organism *E. superba*, found in stomachs of Adélie penguins in most other areas studied, was replaced in the Crozier birds by the much smaller *E. crystallorophias*.

This study was continued and expanded during the 1965-1966 season. A technique was devised whereby food could be removed from the stomachs without harming the birds, thus making the collection of a large number of samples possible. Twenty kilograms of samples, collected during the 1965-1966 season, are now being analyzed.

Studies of the south polar skua have continued for four seasons in a study area containing about 115 pairs of breeding birds. Of 205 banded breeders present in 1964-1965, 197 (96 percent) returned in 1965-1966. This figure and data from previous years indicate an annual mortality of breeding adults of 4 to 8 percent, 12 to 18 percent annual breakup of mated pairs, and a high degree of nest-site tenacity.

Totals of 9 two-year-old, 117 three-year-old, and 51 four-year-old skuas were recorded, all banded at Crozier as chicks. None of these was known to breed although three- and four-year-olds have bred in other areas, possibly reflecting a lower mortality of established breeders at Crozier and a stable and undisturbed population.

During a visit to Beaufort Island, 80 kilometers (50 miles) from Cape Crozier, further evidence of the wandering behavior of immature skuas was gathered when a three-year-old, banded originally at Crozier, was observed. This bird was also recorded at Crozier 10 days before and 17 days after the Beaufort sighting. Crozier skuas were observed feeding 80 kilometers (50 miles) away at the McMurdo Station garbage dump early in the season. Evidence of longer travels during winter comes from a one-year-old skua found dead on a beach in southeastern Australia. This is the fourth recovery of a banded skua north of Antarctica and, to our knowledge, the sixth observation of a one-year-old bird after fledging.

The presence of DDT and its residues in Adélie penguins and a crabeater seal, *Lobodon carcin-*

phagus, was reported (Sladen *et al.*, 1966) for the first time in Antarctica from specimens collected in February 1964. This report has been confirmed from analysis made from Adélies, skuas, and one fish, *Rhigophila*, collected in December 1964 and January 1965 (George and Frear, in press). Specimens of muscle and heart collected from Adélies in extremes of physiological conditions during the breeding season have demonstrated the stability of the isozymes of lactate dehydrogenase (Markert and Sladen, 1966).

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Biotelemetry Studies on Penguin Body Temperatures

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The purpose of this program is an investigation of the adaptive mechanisms permitting the emperor, *Aptenodytes forsteri*, and the Adélie, *Pygoscelis adeliae*, penguins to survive the rigorous antarctic environment. Special emphasis is being placed on the physiological and behavioral mechanisms of thermoregulation in these species (Goldsmith and Sladen, 1961; Prévost, 1961). The new techniques of biotelemetry (the means of gaining and transmitting information from an organism to a remote observer) were used for the first time to monitor the body temperature in these species. Previous biotelemetry investigations in Antarctica have involved measuring the incubation temperatures of eggs (Eklund and Charlton, 1959) and tracking the movements of Adélie penguins (Penney, 1965).

This work and related studies on the breeding biology of the emperor penguin began on October 14, 1965, from a temporary field station on the sea ice below the Ross Ice Shelf at the Cape Crozier