

How antarctic penguins communicate their readiness for nest relief

DIETLAND MÜLLER-SCHWARZE and CHRISTINE MÜLLER-SCHWARZE

Department of Environmental and Forest Biology
College of Environmental Science and Forestry
State University of New York
Syracuse, New York 13210

During the past year, we analyzed data on communication between pygoscelid penguins during nest relief that had been collected on two earlier research stays in Antarctica. Breeding penguins of the genus *Pygoscelis* exchange complex sequences of a number of ritualized displays when one mate returns to the nest and takes over egg incubation or guarding the young while the partner leaves the nest. The goal of our study is to elucidate the kind of information transmitted during the elaborate series of mutual displays.

The genus *Pygoscelis* consists of the Adélie penguin (*P. adeliae*), the chinstrap penguin (*P. antarctica*), and the gentoo penguin (*P. papua*). During nest relief, the more closely related Adélie and chinstrap penguins show the same displays in slightly different forms. These are known as the loud mutual display, with both birds waving their heads back and forth while uttering a loud cackling with open bill; the quiet mutual display, in which both birds also wave their heads, but utter a soft humming sound with closed bill; and circling, in which one bird walks part or all of the way around the rim of the nest while nodding his head.

The displays of the gentoo penguin deviate from those of the other two species. Its loud mutual display lacks the lateral neck movements. In addition, it has a bow-gape-hiss display, in which it bends down to the nest, opens its bill so that the bright red lining shows, and hisses. This display is derived from nest-building, in that pebbles may be deposited in the same way with subsequent hissing.

Functions ascribed to nest relief displays in birds include appeasement (Lorenz, 1938), mate and nest-site recognition, and stimulating the mate into leaving the nest (Armstrong, 1947). The loud mutual display in the Adélie penguin can serve in personal recognition (Penney, 1968), and it is assumed to effect sexual appeasement and reducing aggression (Sladen, 1958; Spurr, 1975), to express hesitancy to locomote (Ainley, 1975), and to be a "greeting ceremony" (Sladen, 1958). Roberts (1940) postulated an appeasement function for the gentoo's bow-gape-hiss display.

Our hypothesis stated that one bird communicates to its mate how ready he is for changing over at the nest by varying the rate of one or several displays. We recorded 100 nest reliefs of Adélie penguins tending chicks at Cape Crozier (77°31'S/169°23'E) and 31 nest reliefs of Adélies incubating eggs on Torgersen Island

(64°46'S/64°05'W). In addition, we recorded 50 nest reliefs for the chinstrap penguin on Nelson Island (62°18'S/59°03'W) and 50 for the gentoo penguin at the same site, both counts being made during the stage of guarding chicks.

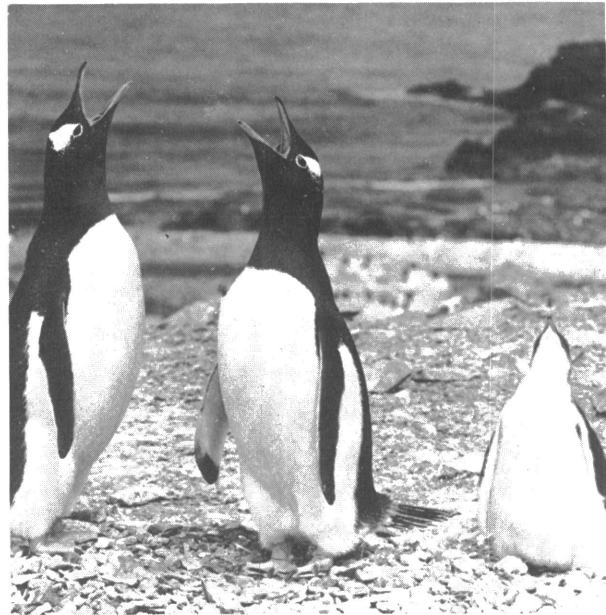
All behaviors of both mates were recorded for 5 minutes beginning at the time each bird returned from the ocean and approached the nest. After the observations, both birds were sexed with a cloacoscope.

It was found that the more displays uttered per time unit, the sooner the birds relieve each other. For instance, if Adélie penguins perform five loud mutual displays per minute, nest relief will take place 1 to 3 minutes after the arrival of the second bird; in contrast, if they perform only one display per minute, nest relief will occur 5 or more minutes later.

The chinstrap penguin uses circling to indicate its eagerness to relieve its partner. The more often the arriving bird circles around the nest, the sooner nest relief occurs.

Among gentoo penguins, a high rate of bow-gape-hiss display by the arriving bird is predictive of a quick changeover at the nest. After four or five displays per minute, the birds change roles within 1 minute or less, whereas 0.5 display per minute is correlated with a relief time of between 2 and over 5 minutes.

These observations constitute the first demonstration of a correlation between the rate of avian display and the time of nest relief. Both birds indicate their readiness to change roles, and possibly stimulate each other, leading to a fine synchronization of the events at the nest. Precisely synchronized nest relief minimizes the time of



Gentoo penguin pair performing the loud mutual display immediately prior to changing roles at the nest. The chick (right) also participates in the display.

exposure of eggs or chicks, which is particularly important in Antarctic penguins for two reasons. First, exposed eggs or chicks may be chilled, and second, they may be preyed upon by south polar skuas (*Catharacta maccormicki*) within a few seconds.

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Status of high antarctic penguin colony in San Diego, California

FRANK S. TODD

*Hubbs/Sea World Research Institute
San Diego, California 92109*

I have described previously the establishment and history of the colony of Adélie penguins (*Pygoscelis adeliae*) and emperor penguins (*Aptenodytes forsteri*) in San Diego, California (Todd, 1977; Todd, 1978). This year we did not alter the maintenance and husbandry techniques used previously. Very few of the adult penguins died (less than 1 percent) and no problems with aspergillosis or "bumblefoot" were encountered. This is considered significant because both of these maladies have been major problems in the past for penguins within a controlled environment.

We again achieved breeding success with the Adélie penguins. In early October, we covered one-third of the freezer facility with nesting rocks. Courtship activity commenced on schedule late in October; 54 pairs of penguins established and defended territories and 49 ultimately produced eggs. To facilitate behavioral research, we installed a television camera with pan, tilt, and zoom capabilities, and we videotaped activities of interest. All penguins were banded with color-coded bands with numbers large enough to be read on the remote television monitor.

Infertility appears to have been the main reason that only 21 of the 96 eggs hatched. The amount of research and other activity carried out in proximity to the penguins may have been a major disturbing factor. By contrast, a small experimental unit in the Orlando (Florida) facility, which is relatively free from disturbance, was successful in fledging 5 young from 6 pairs of adults.



Adélie penguins at Hubbs/Sea World Research Institute, San Diego, California.