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## SEXUAL COLOR AND SIZE VARIATION IN THE SOUTH POLAR SKUA

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In the South Polar Skua (*Catharacta maccormicki*), females average larger than males in both weight and size, a fact known for some time (Falla 1937, Spellerberg 1970). During December, 1982, at Cape Crozier, Ross Island (77°31'S, 169°23'E), we attempted to determine whether a visual comparison of the members of skua pairs could be used as a valid means to determine sex. Thanks to our observations, made during previous years, of bonded pairs engaged in copulation or courtship feeding, a sample of 43 pairs of known-sex skuas was available to us. Without knowing the actual sex of the birds as we moved through the breeding colony, we determined which was the larger in each of the 43 pairs. At the outset, we were surprised to find that the larger bird was almost always paler as well. Consequently, we noted the relative color as well as the relative size between paired birds.

Based on size measurements, we were able to correctly sex 38 pairs (88%; Table 1). We did not find a discernible size difference between members of the five remaining pairs, and thus, we withheld a declaration as to their sex. Based on color alone, we would have been able to correctly sex only 31 pairs. Thus, relative size was a better criterion for determining sex than was relative color. By using both size and color, we were not able to increase the number of pairs correctly sexed; however, we could judge the sex

of birds with more confidence than by using size alone. Thus, when one member of a pair was obviously larger and paler than its mate (in about 72% of pairs at Cape Crozier), we would have been virtually certain to consider that bird a female and its mate a male. In only one pair was the female darker than the male, and in that pair no obvious size difference was discernible (see below).

At Cape Crozier, males tended to be dark regardless of relative color: 26% of males but only 2% of females in the 43 pairs were unequivocally "dark phase" (Table 1). Conversely, females were more likely to be "light phase" but it was more difficult to define the cutoff between the "light" and "intermediate" phases, owing to the intergradation between the two types (see below for a definition of color phases). Among 230 pairs of banded skuas that we were studying during December, 1982, in only one pair were both partners dark-phase birds.

Even in the region of the Antarctic Peninsula, where dark-phase birds predominate (Watson 1975), the use of color and size to determine sex is a valid technique. In 1984, at our request, W. Z. and S. G. Trivelpiece and N. J. Volkman surveyed the population at King George Island. They found that in 12 pairs of South Polar Skuas of known sex, the male was smaller and darker than the female in 10 instances, but in one pair he was the same color, and in another he was the same size as the female. As with our sample, these workers made their comparisons without immediate knowledge of the real sexes of the birds.

To further confirm that skua mates differ in size, we were able to capture and weigh both birds in eight known-sex pairs. In addition, we had weights from two other "pairs" collected by Ainley in the Ross Sea pack ice during January, 1979; in both these cases, the individual that had begged from and received a fish from the other bird proved to be a female and the other bird proved to be a male; in both pairs, the male was darker than the female. In all 10 pairs, the female was heavier than the male. The difference ranged from 30 to 290 g ( $\bar{x} = 126 \pm 79$  g). In eight of the 10 pairs, weight differed by more than 80 g. In the two pairs where the size difference was  $\leq 50$  g, we had visually

TABLE 1. The relative difference in size and color of South Polar Skuas in 43 known-sex pairs; within each cell, the number of males is to the left and the number of females is to the right.<sup>a,b</sup>

|           | Darker | Same color | Lighter |
|-----------|--------|------------|---------|
| Smaller   | 24/0   | 6/0        |         |
| Same size | 2/1    | 2/2        | 1/2     |
| Larger    |        | 0/6        | 0/24    |

<sup>a</sup> Eleven males in the smaller/darker category, and one female in the same size/darker category, were unequivocally dark-phase.

<sup>b</sup> One male in the same size/lighter category, and eight females in the larger/lighter category were extremely pale, light-phase birds.

categorized them earlier as being the same size. One of these pairs was, in fact, the only one in which relative color was reversed, and the other pair was comprised of birds similar in color. We also weighed other known-sex skuas during December, 1982. Including the above 10 pairs, plus an additional six females and 11 males collected in the Ross Sea pack ice during early January, 1978 and late December, 1979, a sample of 23 females averaged  $1,421 \pm 75$  g (range 1,280–1,550 g) and a sample of 26 males averaged  $1,277 \pm 95$  g (range 1,120–1,440). The difference between these averages was 144 g and the overlap in weight range was 37%. The above weights were taken after egg-laying and, thus, the differences did not reflect the potential added weight of eggs developing within females.

While we all noted the relative color between paired birds, Spear also categorized birds according to whether they were of the light, intermediate, or dark color phase. Using the Villalobos color code (Palmer 1962), Spear distinguished the three phases as follows. At rest with wings folded, the body, head, and neck of **dark-phase** birds were dark brownish-olive and virtually concolor with the sepia of the back (wing coverts, scapular, and spinal tracts). The hackles on the head and neck of many of these dark skuas had orange-yellow to buffy brown tips which exhibited a glossy sheen. In **light-phase** birds, the dark back contrasted sharply with the buffy yellow to orange-yellow head and neck, and buffy yellow to pale or smoke gray body plumage. The hackles on most of these individuals exhibited a bright sheen covering a much larger area of each feather than in dark-phase birds. Skuas of **intermediate phase** varied in color between the darkest light-phase bird, and almost the lightest dark-phase bird, and their hackles had a sheen of intermediate intensity. Intermediates were speckled light and dark primarily on their necks and bodies, although this was also found in some light- and some dark-phase skuas. In Spear's sample of 115 breeding adults at Cape Crozier, taken between 10 and 25 December, 58% were light phase, 23% were intermediate phase, and 19% were dark phase.

Color phase ratios at Cape Crozier, as determined according to our definitions, differed from those determined by Spellerberg (1970) at Cape Royds, on the other side of Ross Island. His results were as follows: 20% light or pale, 66% intermediate, and 14% dark phase. Thus, our results differed from his in the proportion of light vs. intermediate

phase birds, but we apparently agreed on what constituted the dark phase. The difference could have been due to several factors: (1) Spellerberg defined light-phase birds more conservatively than did we. If our lightest birds, i.e., those that had pale gray body plumage, fit his definition of light phase (the remainder of our light-phase birds being "intermediate phase"), then color phase ratios at Crozier and Royds were similar; (2) South Polar Skuas tend to become lighter with age, at least during their first three to five years (Wood and Ainley, pers. observ.). While all birds in our sample were breeding adults and, therefore, at least four years of age (but probably much older: Wood 1972), with the majority (58) known to be at least 13 years old, the birds in Spellerberg's sample included many nonbreeding individuals which were likely young (darker) prebreeders; (3) The proportion of light-phase birds could differ from one side of Ross Island to the other, just as it does among Southern Giant-Petrels (*Macronectes giganteus*) breeding on opposite sides of Macquarie Island (Shaughnessy 1971); finally, (4), the definition of light- and intermediate color phase is subjective as we have already noted, and in assigning a skua to one category or the other, one must consider that plumage fades quickly in the intense, continuous light of the Antarctic summer (Watson 1975). Whether or not Spellerberg considered this in assigning his birds is not known. Our sample was collected during a two-week period and, thus, fading plumage would not be a problem.

We point out the above difficulties inherent in recognizing and quantifying the color phases of this species to emphasize that, in using color to support size differences as a means to sex skuas, one must use relative rather than absolute color differences.

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