

comprising about one-fifth of the passerines, are considered by some workers to be more primitive than the oscines and by others to be of separate phyletic origin (Feduccia 1977). Except for *Xiphorhynchus*, the metabolic rates of the suboscines we measured fit the prediction based on Passeres quite well.

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EXPERIMENTAL EVIDENCE FOR FACILITATION OF PAIR FORMATION BY BRIGHT COLOR IN WEAVERBIRDS

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Experimental studies of the role of color in displays of male birds have generally emphasized responses of the male, rather than of the female. Smith (1972) painted the red epaulets black on male Red-winged

Blackbirds (*Agelaius phoeniceus*) who then often lost their territories, but were still able to attract females. However, no data were presented on relative numbers of females attracted by normal and painted males which retained territories.

The Village Weaverbird (*Ploceus cucullatus*) is a polygynous African species. In the course of pair formation the male hangs beneath the bottom entrance of the roofed nest he has woven and attempts to attract a female to enter his nest by a special display in which he vigorously flaps his wings, revealing their bright yellow linings. The upper surfaces of the wings are mostly dark. Our object was to see if this flashing display attracted a female to the nest more than it would if the yellow color were not present.

Birds were maintained at Los Angeles in three large outdoor aviaries (9.2 × 5.2 × 5.2 m, 7.9 × 6.1 × 4.0 m, and 9.2 × 4.6 × 4.0 m), in which they had bred each spring and summer for several years previously. Methods of maintaining the birds and details

TABLE 1. Number of permanent acceptances of the nests of seven adult male Village Weaverbirds by females, comparing years in which wings of each male were painted black (b) to years in which his wings were the normal (n), largely yellow coloration. Wilcoxon matched-pairs signed-ranks test, $T = 0$, $P = .01$.

Male	Acceptances per annum						Rank
	Actual numbers			Average numbers			
	1975	1976	1977	Normal n	Black b	Differ- ences (n - b)	
A	21(b)	20(n)	11(b)	20	16	4	3.5
B	2(b)	6(n)	7(b)	6	4.5	1.5	2
C	2(b)	9(n)	14(b)	9	8	1	1
D	7(b)	20(n)	15(n)	17.5	7	10.5	7
E	1(n)	4(b)	15(n)	8	4	4	3.5
F	14(n)	1(b)	0(n)	7	1	6	5
G	4(n)	0(b)	11(n)	7.5	0	7.5	6

of nest building and behavior are given by Collias and Collias (1970). In each of three successive years, the wings were dyed black in some males while other males served as controls. The dye used was Nyanzol-D, and the method of preparation and application of the dye follow Melchior and Iwen (1965). Control males were handled similarly, but their wings were merely swabbed with alcohol-soaked cotton. Each male was painted in no more than two of the three years and in the other year(s) served as a control for his own record of success in attracting females. This experimental design eliminated variables associated with individual differences among the males. Seven males were used in all three years of this experiment. They were all fully adult birds between 10 and 13 years old. They readily obtained and held territories in which they built nests. Eighteen mature females were used, nine of whom were two-year-olds experiencing their first exposure to the wing-painted males and their controls in this experiment. Two groups of two-year-old females were used, one in 1976 and one in 1977. The nine other females were ten or more years old, and were acquainted with the experimental males before this experiment. Total time in the outdoor aviaries available for pairing was comparable each year: 157 days in 1975, 155 in 1976 and 153 in 1977.

If a female accepted a male's nest, she brought soft grass heads or a strip torn from a palm frond and lined the nest with them. Laying eggs signified permanent acceptance of the nest, but sometimes a female shifted to some other nest or male before laying eggs. In such cases the initial acceptance was designated a temporary acceptance only. A few females, after accepting a nest, copulated repeatedly with the male owner but rarely or never laid eggs. Nest acceptance by these females was also considered permanent. Acceptances were recorded for each nest of each male, and results were analyzed statistically. For example, as Table 1 shows, females permanently accepted nests built by Male A 21 times in 1975 when his wings were painted black, 20 times in 1976 when his wings were the normal coloration and 11 times in 1977 when his wings were again painted black. Thus, his score was 20 acceptances in the year his wings were left unpainted versus 16 acceptances for the average of the two years in which his wings were painted black. Results for all seven males were put on a per annum basis in this manner, and the differences were compared for all the males by a

Wilcoxon matched-pairs, signed-rank test (Siegel 1956). Males had fewer permanent acceptances by females in years when their wings were dyed black than in years when they possessed normal coloration (Table 1).

The young females, much more than older females, avoided males whose wings were painted black. During the same periods of time the two-year-old females accepted nests of the black-winged males for only 18% of their 49 permanent acceptances, the older females for 45% of their 85 permanent acceptances. The difference in relative frequency of permanent acceptances of nests of black-winged males between the young and old females was significant ($\chi^2 = 7.8$, $P < .01$). To give more data for these comparisons, a young male, two or three years old, was added to the seven older males and he was present in part of the same experiment. However, this young male was available for only two of the three years of the experiment (unlike the seven males in Table 1), and his wings were painted black in only one of the two years.

Young and old females did not differ significantly in the proportion of acceptances of normally colored males that became permanent ($z = .19$, $P > .05$; Dixon and Massey 1969). This contrasts with the significant difference between the younger and the older females, with reference to the black-winged males ($z = -3.04$, $P = .001$); it indicates that the young females tend to desert such males after temporarily accepting their nests, unlike the older females who also differed in being better acquainted with these males from earlier years. Thus, 50% of the 18 acceptances of black-winged males by the young females became permanent, in comparison with 82% of 121 such acceptances by the older females. For the normally colored males, 65% of 62 acceptances by young females became permanent, little different from the 71% of 96 acceptances by old females that became permanent.

Was the diminished success of males with blackened wings due to some depressing effect of the dye on the frequency of nest-invitational displays given by the male? In previous experiments we had found that those males which displayed their nests most frequently were more successful in obtaining mates (Collias and Victoria 1978). We had also previously determined that a male displays his nest most often to visiting females on the day before it is accepted and on the day of acceptance (Jacobs et al. 1978). In the present series of experiments we made similar counts of bouts of nest-invitational displays by methods described in detail in our earlier reports. When a female visits a male's nest her visit stimulates him to display more frequently. The male and female therefore reciprocally excite each other. We found that the frequency of nest-invitational displays per hour given by the seven males when their wings were painted black averaged 8.4, compared with an average frequency of 11.7 given by the same males when their wings were the normal color. However, this difference was not significant (Wilcoxon matched-pairs, signed-ranks test, $T = 8$, $P > .05$).

In conclusion, our experiments demonstrate that the bright yellow color of the underside of the wings of the male Village Weaver facilitates the effectiveness of his nest-invitational display to females and increases his success in attracting and holding mates.

Interestingly enough, the yellow and black plumage of the male Village Weaver, which is reminiscent of the plumage color of many male New World orioles, may also attract female orioles. During each of the

18 years we have had Village Weaverbirds in outdoor aviaries at Los Angeles during the spring and summer, female Hooded Orioles (*Icterus cucullatus*) and Bullock's Orioles (*I. bullockii*) from the vicinity have repeatedly visited the aviaries, clinging to the wire sidewalls and peering at the birds within. Female Western Tanagers (*Piranga ludoviciana*), whose males are black, yellow and orange, were also attracted. No other local species of wild birds have been similarly attracted.

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THE ASSOCIATION OF MARINE BIRDS AND FEEDING GRAY WHALES

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Feeding associations in which terrestrial birds scavenge from feeding terrestrial mammals are well-known. Examples include the Cattle Egret (*Ardeola ibis*) feeding with the domestic cow (Heatwole 1965), the honey badger (*Mellivora capensis*) with the Greater Honey-guide (*Indicator indicator*) (Skead 1951), and the House Sparrow (*Passer domesticus*) with man. Similar feeding associations between birds and mammals in the marine environment are largely anecdotal (for example, Murphy 1936, Ryder 1957, Wilke and Fiscus 1961), but are perhaps equally frequent. Evidence collected on aerial surveys in the northern Bering Sea (Fig. 1) leads me to conclude that a community of at least nine marine birds are partially supported by an association with feeding gray whales (*Eschrichtius robustus*).

Aerial surveys were flown during the months of June, August, and October 1976 over Bering and Chukchi seas to map populations of marine birds and mammals which may be affected by offshore petroleum development. A modified Grumann Turbo-goose with good forward and lateral visibility was flown at a groundspeed of 200 km/h and an altitude of 180 m (June) and 30 m (August and October). The aircraft was equipped with a Global VLF Navigation System (Karant 1976) which uses the very low frequency radio band and provides a continuous readout of longitude and latitude. Observations of marine birds, gray whales, mud tracks from the whales (Fig. 2), and periodic geographical positions were recorded on a cassette recorder. Birds were identified to the lowest taxon possible, but a large proportion of those seen in June were not identified

to species due to the high altitude of that survey. In the analysis of these observations, gray whales that were too distant for us to detect the simultaneous presence of birds were eliminated. The presence of

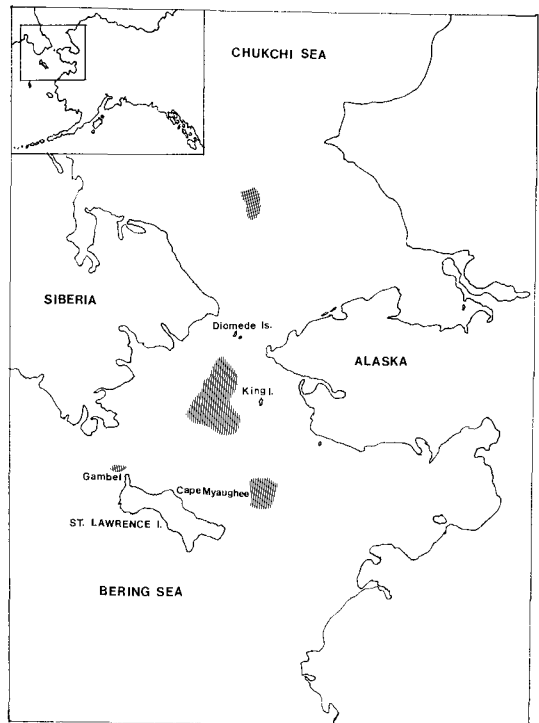


FIGURE 1. Northern Bering Sea, Alaska. Shading depicts areas where birds have been observed feeding in association with surfacing gray whales.