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DEFENSE AS A FACTOR IN BILL-TUCKING

LYNDA L. CUTTS

1028 Fiedler Lane, Madison Wisconsin 53713

Abstract.—Bill-tucking, the insertion of a bird's bill beneath the back feathers, was investigated in shorebird flocks in Florida. The birds tended to tuck their bills outward and toward the side of greatest potential disturbance. The findings suggest that one function of bill-tucking is defense.

Bill-tucking, the insertion of the bill under the scapular feathers, is a posture often associated with a resting or sleeping bird (Lendrem 1983, Ball et al. 1984, Amlaner and McFarland 1981). Halkin (1983) observed that birds in a flock tended to tuck to the side nearest the periphery, possibly as a defensive measure. In this note I analyze bill-tucking behavior in three flocks of resting birds.

Bill-tucking may have several functions. It decreases muscular work (Worden 1956: 7) and may conserve heat as well. Deighton and Hutchinson (1940) attributed a 12% decline in metabolic rate for cockerels in bill-tucked posture to lowered heat loss or deeper sleep. Bill-tucking has also been described in non-resting situations where it has been interpreted as a "displacement activity" (citations in Edwards et al. 1948, Cornwell and Bartonex 1963). Defense from predators may also be a factor in the way birds tuck their bills (Halkin 1983). If this be so, a bird in a flock should tuck its bill toward the outside of the group. In addition, just as a wagon train in a circle will fortify itself most heavily in the direction of expected attack, a flock with a high probability of disturbance from one direction should show a greater proportion of individuals tucking toward that side.

METHODS

I defined a flock as an aggregate of resting birds, the long-body axes of which were mostly oriented in the same direction. The flock was arbitrarily divided into four sections (Fig. 1): Front, Rear, Middle-Left (ML), and Middle-Right (MR). Spotting scopes (20x and 30x) and a pair of 7 x 35 binoculars were used for all observations. The tucking (or non-tucking) posture of each bird and its position in the flock were recorded by a second observer as I called them out. It was possible that an occasional bird was recorded twice or not at all because of movements within the flock during observations. The data from tucking Middle birds were analyzed using Chi-square (2 x 2) tests and binomial tests (Siegel 1956).

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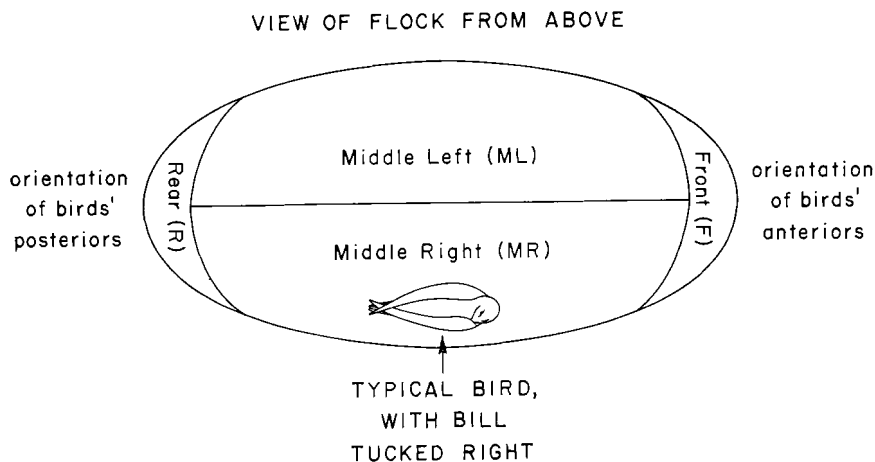


Figure 1. Schematic view of a flock from above showing arbitrary divisions into Front, Back, Middle-Left (ML) and Middle-Right (MR). The latter two divisions were surveyed to see on which sides the birds tucked their bills while at rest.

RESULTS AND DISCUSSION

Flock 1 was observed on 15 March 1984 at St. George Island, Franklin Co., Florida, at 1630 EST. Approximately 90% of the birds were Ring-billed Gulls (*Larus delawarensis*); Laughing Gulls (*L. atricilla*) and Herring Gulls (*L. argentatus*) composed the remainder. The group was oriented into a light westerly breeze on a sandy beach with water to its left and a small sand dune to the right. From a position on the sand dune near the front of the flock I recorded the position and bill-tucking posture of about 70% of the birds. Flock 2 consisted primarily of Willets (*Catoptrophorus semipalmatus*), with a few scattered Whimbrels (*Numenius phaeopus*) and one Great Blue Heron (*Ardea herodias*). The flock was in a marsh south of Lighthouse Road in St. Marks National Wildlife Refuge, Wakulla Co., Florida, on 16 March 1984 at 1330 EST. The tightly-grouped oval flock oriented into a light southerly breeze under warm and sunny skies. I collected data from an observation tower to the right of the flock. One bird was excluded from analysis because its body was oriented opposite to the rest of the group. I observed a predominantly Black Skimmer (*Rynchops niger*) flock (Flock 3) from the left across a narrow boat channel on a concrete dock at the Gulf Coast Ranger Station at Everglades City, Collier

Co., Florida, on 25 March 1984 at 1545 EST. A lumber pile was to the right and buildings and docking area were to the rear of the flock. A tour boat passed through the channel very close to the flock before and during the observation period but the birds did not noticeably alter their behavior. The group was oriented toward the water, slightly to the left of a 15 km/h southwesterly wind (measured with a Dwyer wind meter). The front of the group was more dispersed than the rear and was composed mainly of Ring-billed Gulls and Laughing Gulls, although these birds made up less than 5% of the total flock. Several birds were lying prone; one prone skimmer was tucking at the time of notation.

I found no relationship between position in the group and tucking direction ($df = 1$, $\chi^2 = 0.06$, $P > 0.80$) for Flock 1 (Table 1). A Chi-square test indicated that the Willets in Flock 2 exhibited a strong tendency to tuck their bills to the outside of the flock ($df = 1$, $\chi^2 = 11.90$, $P < 0.001$). A two-tailed binomial test (Siegel 1956) revealed no overall preference to tuck to a particular side ($z = -1.53$, $p = 0.13$). In Flock 3 I also found a significant outward bias in bill-tucking ($df = 1$, $\chi^2 = 4.55$, $P < 0.05$) although this was due mainly to the ML birds (65% tucked left); the MR birds were evenly divided in tucking direction. Although binomial analysis disclosed no overall tucking preference ($z = -1.81$, $p = 0.07$), the results remain suggestive of a left-side bias.

There was obviously greater disruption from the left in the skimmer flock I observed (Flock 3). The birds may have been responding as indicated by the greater proportion of left-tucking birds in the MR than would be expected for a flock with an even distribution of disturbance around it. The Willets (Flock 2) were in a fairly uniform environment, being located in the middle of a quiet marsh with a good view all around. No direction seemed to me to be more "dangerous" than any other. The birds tucked outward but did not show an overall flock preference for one side (the p -value is, however, small enough to be suggestive). The gulls (Flock 1) may have exhibited random tucking because of the smaller percentage of conspecifics or because the flock was more scattered and active than were the other two flocks.

Halkin's (1983) bill-tucking observations on Black Skimmers were made in the same location as mine and demonstrated the same general orientation. Sampling the left side of the flock, she found the birds tucked significantly more to the left. Halkin also "disturbed" the flock from the right, compared before and after results

Table 1. Number of birds tucking bill left or right in relation to position in flock.

Direction of Bill-tuck	Ring-billed Gull Flock 1			Willet Flock 2			Black Skimmer Flock 3		
	ML ¹	MR ²	Total	ML	MR	Total	ML	MR	Total
Left	8	14	22	45	26	71	59	49	108
Right	8	12	20	17	36	53	32	50	82

¹ML = Middle-Left portion of flock.

²MR = Middle-Right portion of flock.

from a small proportion of the flock and found that more birds tucked to the side of the disturbance, although this difference was not statistically significant.

Many studies have investigated the relationships between flocking and predator defense. Pulliam (1973) presented a mathematical model showing that the probability of detecting a predator increases with flock size. Barnard (1980) found, as did Bertram (1980), that individuals became less vigilant (scanned less) with increasing flock size and that the flock as a whole was unable to spot predators any sooner in a large group than a small one. Mallard (*Anas platyrhynchos*) vigilance ("peeking" rate) is not much affected by flock size per se, although it decreases with increasing number of conspecifics between the focal bird and the most exposed side of the group (Lendrem 1983). Metcalfe (1984a) discovered that shorebirds share vigilance with both conspecifics and other species of similar size as long as they are within sight. Lendrem believed that an individual's vigilance decreases with a greater number of more-vigilant companions. Male Mallards in conspicuous nuptial plumage had higher peeking rates than either females or males in eclipse coloration. Female peeking rates declined as the proportion of nuptial males increased but were unaffected by eclipse males. Ostriches (*Struthio camelus*) showed increased vigilance in the presence of conspecifics (Bertram 1980).

Several authors have noted increased vigilance in higher-risk situations (Underwood 1982, Metcalfe 1984b, Barnard 1980, Amlaner and McFarland 1981). Underwood (1982) and Inglis and Lazarus (1981) have shown further that animals on the periph-

ery of a group are more vigilant than those in the center. Finally, Ball et al. (1984), Lendrem (1983) and Amlaner and McFarland (1981) have described vigilance in tucking birds. When tucked Herring Gulls are disturbed they often maintain their tucking posture, perhaps in a wait-and-see attitude (Amlaner and McFarland 1981). But although tucked gulls allowed an investigator nearer than did resting birds before changing posture, they took flight at the same time (Ball et al. 1984).

Many opposing and interrelated factors in addition to defense probably influence bill-tucking behavior. These factors undoubtedly differ among species in type and importance. My findings suggest that, among some Charadriiformes at least, one important function of bill-tucking is defense. I interpret my results to suggest that birds in a flock tend to tuck their bills outward, and that the flock as a whole will tuck more to the side of greatest possible disruption.

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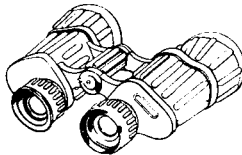
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