ACTIVITY PATTERNS OF GULL CHICKS IN RELATION TO FEEDING BY PARENTS: THEIR POTENTIAL SIGNIFICANCE FOR DENSITY-DEPENDENT MORTALITY

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THIS study compares the activity of Glaucous-winged Gull (*Larus glaucescens*) chicks after unsuccessful begging for food with their activity after having been fed. We wished to test the hypothesis that differences might exist in the behavior of hungry and well-fed chicks that would result in the hungry chicks wandering from their territories and thus being exposed to more frequent attacks by neighboring adult gulls. If hunger resulted in inappropriate behaviors by chicks, we could then link chick survival with the availability of food to foraging adults.

METHODS

We studied young Glaucous-winged Gulls from 12 families on Mandarte Island, British Columbia, from 23 June through 12 July 1973. Observations of 1.5 to 3.0 h duration were made from blinds at various times of day between 0600 and 2100 h for 13 periods in June and 16 periods in July. During each period three chicks were watched, each belonging to a different pair of parents. Ages of the chicks ranged from 2 to 32 days over the course of the study. The activity of the chicks and their distance from their nearest parent present on the territory were recorded at 1-min intervals.

Five categories of behavior were noted: (1) Resting: The chick was inactive and in some cases may have been hiding. (2) Active I: The chick was less than 4 feet from its parent and was moving about. (3) Active II: The chick was moving about 4 or more feet from its closest parent. (4) Begging: The chick was soliciting food from its parent (see Tinbergen 1960 for a description of begging). (5) Feeding: The chick was obtaining food from its parent.

June and July results were similar, and are combined in this presentation.

RESULTS

Intervals between a chick's feeding and its subsequent initiation of begging were longer during periods in which no parent returned to the territory than when begging followed the return of the parent. When begging was not preceded within an arbitrary 6-min period by the return of a parent, chicks initiated begging an average of 43 $\pm$ 24 min after their last feeding ($N = 61$). When a parental return was followed by begging within 6 min, the interval between the previous feeding and that begging was 31 $\pm$ 16 min ($N = 16$). This difference was statistically significant ($t = 2.05$, $P < 0.05$).

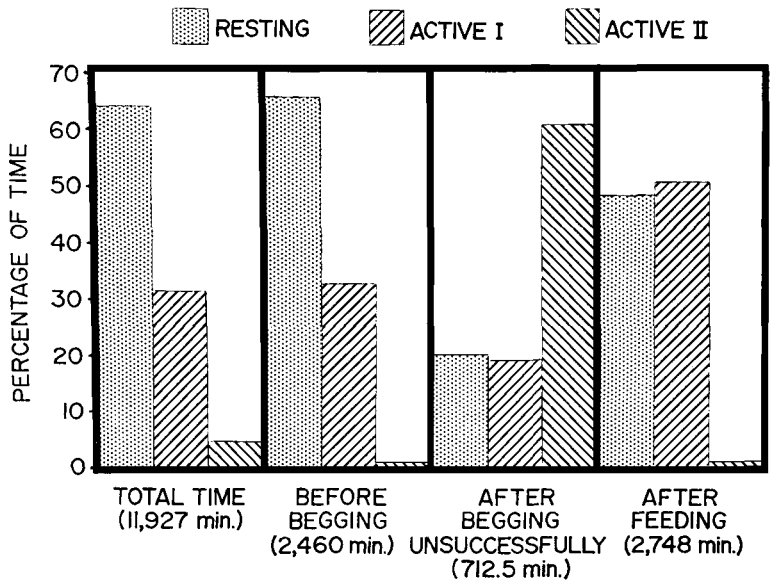

Fig. 1. Activity patterns of chicks during the 20 min prior to begging and the 20 min after begging unsuccessfully or feeding. Active I = moving about within 4 feet of its closest parent. Active II = moving about 4 or more feet from its closest parent.

The return of a parent to the territory was frequently followed by the initiation of begging by the chick. Of 71 parental returns watched, 65% were followed within 6 min by begging. The observed frequency of begging in the 6-min intervals following returns was 0.022. The expected frequency of begging following a parental return based on their joint probability was 0.0018 per 6-min interval, indicating that the return of parent probably stimulates a chick to beg.

Activity patterns were different before and after begging (Fig. 1). Before begging, resting predominated. If feeding followed begging, activity I close to the parent increased in proportion to resting while activity II remained at the same low level as before begging. When chicks obtained no food, begging was followed by an increase in activity II at distances greater than 4 feet from the nearest parent (Fig. 1). In some cases, especially after prolonged begging, the parent moved away from the chick; in other cases the chick moved away from the parent after ceasing to beg.

The average distances of chicks from their closest parent are presented in Fig. 2. Before begging and after feeding, chicks were usually within 2 feet of their parents (Fig. 2). After unsuccessful begging this

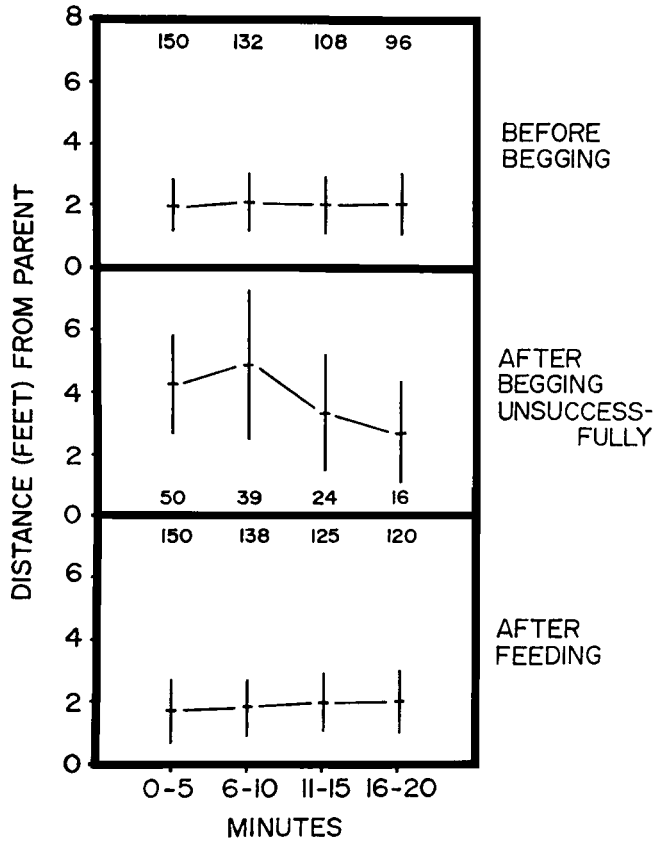

Fig. 2. Mean and standard deviation of the distance of chicks from their closest parent in the 20 min before begging and the 20 min after begging unsuccessfully or feeding. The number of observations in each time category are given.

distance increased to 4 to 5 feet from the parent. Only after 10 or more minutes did the average distance between the chick and its parent begin to return to a distance similar to that of a chick that had fed successfully.

Nine attacks on chicks by neighboring adult gulls occurred when chicks were at or beyond their territory boundaries. Eight of these attacks came after chicks were unable to obtain food from their parents subsequent to begging ($P = 0.02$, Binomial Test). The ninth attack was on a chick active (II) more than 4 feet from its parent after a successful feeding. The preponderance of attacks against chicks after they failed to obtain food is particularly striking. The total time in this category was only 26% as great as the total time of observation subsequent to

successful feeding (Fig. 1). All nine attacks occurred when the chicks were active (II) 4 or more feet from their parents; chicks were noted in this category only 4% of the total time (Fig. 1).

DISCUSSION

Chicks were more active following begging (active II) and feeding (active I) than prior to begging (Fig. 1). Distances between the active chick and its parent were larger after unsuccessful begging than after feeding (Fig. 2), and resulted in increased exposure of the chick to attack by neighboring pairs.

These results may explain why, in several species of gulls, chicks with relatively low growth rates have higher mortality rates than chicks with higher growth rates (Kadlec et al. 1969, Hunt 1972, Ward 1973, Hunt and Hunt 1975, Hunt and Hunt MS). Death from starvation is usually not the result of these low growth rates (Ward 1973, Hunt and Hunt MS). In one study chicks killed by neighboring gulls had significantly lower growth rates than chicks that survived (Hunt and Hunt MS). Being underweight may lower the resistance of a chick to adverse weather, disease and attacks by adult gulls (Harris and Plumb 1965, Ward 1973). Our studies provide an explanation of why the underweight chick (i.e. those fed less often) may be more subject to attack in the first place.

Fordham (1970) found that killing of chicks by adult Dominican Gulls (*L. dominicanus*) increased when the food supply to the colony decreased. Although he provided no data on growth rates, our findings support Fordham's suggestion that this increase in chick mortality was related to an increase in the chicks' wandering.

A similar explanation is useful for understanding the results of Ward (1973). In comparing reproductive success of Glaucous-winged Gulls in colonies with differing access to food resources, he found lower growth rates and lower fledging rates on Mandarte Island where food was less available than on other islands. On Mandarte a larger percentage of the chick mortality was due to killing by other gulls, and we suggest that increased activity on the part of underfed chicks may have been partially responsible for these differences. This explanation may also account in part for the lower success of supernormal broods on Mandarte Island (Ward 1973).

The return of a parent to the territory often stimulates its chicks to beg. Exposure of chicks to neighbors resulting from activity after begging may be minimized if parents time their returns to a frequency no less than the period between the feeding of a chick and its next spontaneous begging (about 45 min in this study). Frequent shorter

trips by a parent, as well as failure to provide food to a begging chick, may result in increased chick activity.

Our results provide a link between food availability and density-dependent chick mortality without recourse to explanations dependent upon starvation. Decline in food availability will be reflected in the ability of parent gulls to provide begging chicks with food. When chicks fail to receive food, their increased activity will raise the probability of their being killed by neighbors. This probability of being killed is in turn a function of territory size (Hunt and Hunt MS) and should be greater in dense colonies (see also Ashmole 1963 for a similar argument concerning terns). Thus food will have two density-dependent actions, one related to the availability of food per individual, and the other related to the size of nesting territories and the chick activity discussed in this paper.

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