EXPERIMENTAL CROSS-FOSTERING OF HERRING GULL AND GREAT BLACK-BACKED GULL CHICKS

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THE objective of the study reported here was to determine whether foster parentage in two species of gulls (*Larcus argentatus* and *L. marinus*) significantly alters (1) hatch success and (2) chick survival until fledging. I divided 30 Herring Gull (HG) nests and 30 Great Black-backed Gull (GBbG) nests, each containing 3 eggs, into three treatment classes yielding a total of 6 species/treatment groups. In one treatment class 10 3-egg clutches from each species were exchanged interspecifically. A second treatment class involved an equal intraspecific exchange of eggs. The third treatment class served as a control group with no egg exchanges. In a similar experiment over a 4-year period, Harris (1970) interspecificially cross-fostered 496 HG chicks and 389 Lesser Black-backed Gull (*L. fuscus*) chicks. He found that growth and survival were similar to those of normally fostered young. The cross-fostered young, especially females, later tended to mate with the foster parent species and rear hybrid offspring.

METHODS

During May 1971 I staked out 30 HG and 30 GBbG nests on First Point, Coatue Beach, Nantucket, Massachusetts. Each contained three eggs. Nests of the two species were distinguished primarily by egg size. Differential measures of length and breadth were tested for significant differences. After eggs had been exchanged the nests were checked at least every other day to determine egg losses and hatch dates.

On Nantucket GBbGs begin to lay about 2 weeks before HGs. Thus an interspecific exchange of eggs lengthened incubation time for GBbGs and shortened it for HGs. The incubation period for the HGs was simply the period of overlap. It began when they laid their eggs and ended when the GBbGs eggs hatched. The incubation period for the GBbGs was the disjunction of the GBbG incubation period and the HG incubation period. Its length was the sum of the two full incubation periods minus the length of the overlap. A similar nesting cycle asynchronism occurs within each species. An intraspecific exchange of eggs lengthened the incubation time for one pair of gulls (the earlier layers) and shortened it for the other pair (the later layers). It was important to determine the extent of this alteration of incubation times because of its possible bearing on hatching and fledging success.

To standardize data an incubation period of 26 days was selected on the basis of studies by Bent (1921), Moreau (1946), Lack (1968), Baerends and Drent (1970), and Weaver (1970). For each exchanged clutch of eggs the mean hatch date was calculated disregarding eggs that did not hatch. The interval between the mean hatch dates of each pair of exchanged clutches was then added to or subtracted from the standard incubation period. This provided the total incubation time for each nest containing exchanged eggs, i.e. the time each pair of gulls incubated its own clutch of eggs plus the time it incubated its foster clutch of eggs.

Hatching success for each nest was calculated according to species and treatment class and the results arranged in a 2 × 3 species/treatment table. Chi-square analysis tested whether the different species or treatments had a significant effect on the results of hatching (Siegel 1956). Nestlings were leg banded with butt-end type aluminum bands adapted with special temporary collars (Firth 1971). Subsequent identification was made by recapturing with a hand net. Chicks were later color-banded to provide additional visual identification.

To estimate chick survival, the vicinity of each experimental nest was searched for banded chicks at least every second day. As time progressed these chicks became harder to find because of their increased mobility and the rapid growth of ground cover, and some disappeared permanently. This led to the calculation of a survival index based on the date that a chick was last identified. To estimate survival at the time of fledging, a survival index was calculated based on 5, 6, and 7 weeks of chick life. This covers the period when chicks fledge, though GBbGs may lag somewhat behind HGs.

All chicks that lived more than a week were ordered according to days of survival up to a maximum of 7 weeks. These were divided into three groups: (i) chicks known to have lived 1 to 5 weeks, (ii) chicks known to have survived 5 to 6 weeks, (iii) chicks known to have survived 6 to 7 weeks. The maximum number of days that a chick may be known to have survived and still be included in a group are as follows: (i) 35, (ii) 42, (iii) 49. Three survival ratios were calculated for each chick using these numbers as denominators and the maximum known days of survival as the numerator. The maximum survival ratio score for a count period was 1/1 = 100. Example #1: a chick was last seen 28 days after hatching. Using a base of 5 weeks (35 days) of chick life, its *chance of surviving unnoticed by me* for that period was rated 28/35 or 0.800. On the basis of the 6-week count, this same chick was rated at 0.667. For the 7-week (49-day) count, this same chick was rated at 0.571. Example #2: a chick was last seen 45 days after hatching. Based on a 5-week count the ratio 45/35 was reduced to 1.00, the maximum allowable survival ratio. Based on a 6-week count this chick again scored 1.00. For the 7-week count the score was 0.918, representing the high probability that it survived until day 49, 4 days after last seen. As disappearance rates were particularly high during the first week of chick life, chicks not known to have survived at least 7 days were dropped from the calculations.

Three sums were calculated for each of the six species/treatment groups. For each group the survival ratios for all chicks as determined by the count period of 35 days were summed; then the corresponding six sums were calculated for the count period of 42 days and again for 49 days. These 18 sums were tabulated by count period resulting in 3 (2 × 3) species treatment tables. Each was tested by Chi-square to determine if the different species or treatments had any significant effects on the results of survival for any one of the count periods.

RESULTS

1. GBbG eggs were significantly larger in both length and breadth than HG eggs (Student's *t*-test, $P \cdot Ho \cdot < 0.001$, Runyon and Haber 1967).

2. Table 1 summarizes measurements of incubation time, calculated as described, for nests with exchanged eggs.

TABLE 1

SUMMARY OF INCUBATION TIME OF EXPERIMENTAL CLUTCHES

Foster parent	Incubation time (days) Mean	Range
(a) Interspecific exchange		
Herring Gull	15.7	10–24
Great Black-backed Gull	36.5	28–42
(b) Intraspecific exchange		
Herring Gull		
(earlier layers)	30.0	27–32
(later layers)	22.0	20–25
Great Black-backed Gull		
(earlier layers)	32.0	27–41
(later layers)	20.0	11–25

3. The results of hatch success were tabulated according to species and treatment class. No significant species or treatment difference was found ($\chi^2 = 1.0792$, $P > 0.05$; Table 2).

4. Results based on survival through 5-, 6-, and 7-week periods of chick life are given in Table 2. Again no significant species or treatment difference was found (5-week count: $\chi^2 = 1.4598$, $P > 0.05$; 6-week count: $\chi^2 = 1.6164$, $P > 0.05$; 7-week count: $\chi^2 = 1.7884$, $P > 0.05$).

DISCUSSION

Because experimental egg exchanges might be expected to affect hatching success and subsequent chick survival to the time of fledgling, it is important to compare my results with those of previous studies.

Eggs and incubation.—Beer (1961) stated that the Black-headed Gull (*L. ridibundus*) prefers to sit large eggs rather than normal sized eggs.

TABLE 2

SUMMARY OF HATCHING SUCCESS AND ESTIMATED SURVIVAL[1]

					Estimated survival					
			Hatch success		35-day count		42-day count		49-day count	
Group No.	Exchange	Egg/chick species	No.	%	No.	%	No.	%	No.	%
HG 1	Interspecific	GBbG	26	87	13.3	44	12.6	42	11.8	39
GBbG1	Interspecific	HG	22	73	11.3	38	9.7	32	8.4	28
HG 2	Intraspecific	HG	18	60	8.9	30	7.9	26	6.8	23
GBbG 2	Intraspecific	GBbG	23	77	14.7	49	12.9	43	11.2	37
HG 3	None	HG	29	97	10.0	33	9.1	30	8.0	27
GBbG 3	None	GBbG	26	87	9.3	31	8.1	27	6.8	22

[1] Hatch success and estimated survival for each group based on sample of 10 nests (30 eggs).

Similar results for the HG were described by Baerends (1959) and Tinbergen (1961). By interspecifically exchanging eggs, I gave some GBbGs and some HGs significantly smaller and larger eggs respectively. This caused no apparent behavioral differences in acceptance, incubation, or hatch success. Furthermore the end of incubation for some foster parents was advanced or postponed by as much as 16 days with the hatching of chicks. This change, likewise, did not affect hatch success as measured in relation to the entire experimental sample.

Hatching success.—GBbG and HG eggs in control nests (class 3) had a hatch success of 87% and 97% respectively. Based on a relatively small sample size (20 nests, 60 eggs), these data were significant only in terms of the homogeneity of the entire sample (60 nests, 180 eggs). In order to increase sample size for comparative purposes, the six groups were arranged by biological or foster parent species and by species of the eggs/chicks. The results are similar. HG parents had a hatch success of 79%. The hatch success for HG chicks (groups: GBbG, 1, HG 2, HG 3) was 76% and for GBbG chicks (groups: HG 1, GBbG 3) 83%. The results of hatch success for HG adults and chicks fall within the range of Erwin's (1971) classification of "experimental" HGs—"those nesting in proximity to Black-backs" (67%), and "control" HGs—"those nesting at a considerable distance from Black-backs" (82%). Kadlec and Drury (1968) tabulated the hatch success of HGs on Coatue with similar results.

Estimated survival at fledging.—For the HG, Paynter (1949) reported that the average chick is 43 days old at first flight. He found that on the basis of eggs laid, 36% of the chicks survived to fledge, and that of hatched chicks, 51.5% survived to fledge. In my study 30% of HG eggs (groups: GBbG 1, HG 2, and HG 3) hatched and produced chicks that survived through day 42. Of hatched chicks, 39% survived through day 42. The average number of HG chicks per nest (3-egg clutches) to survive day 42 was 0.89. From their work on Coatue and Sandy Point, Kadlec and Drury (1968) recorded HG fledge success at 1.06 per nest. Kadlec et al. (1969) reported an average HG fledging age of 51 days with the youngest fledging at 35–44 days and the oldest fledging at 56–61 days.

For the GBbG, Lack (1968) listed a fledging period of 56 days (citing Harris 1963 and Heinroth 1922). I suspect that the average number of days until fledging for GBbGs in my sample was probably about a week less. Assuming that "disappearance" rates for older chicks have the same significance for both species, there is no marked difference in chick life to indicate that GBbGs took longer to fledge.

The survival index technique employed produced results of estimated survival at the time of fledging similar to the reported results of fledge success from other studies. Furthermore, as all species/treatment groups were treated in the same way, I conclude that no species or treatment difference significantly affected the survival at the time of fledging of any group as measured in terms of the entire study sample.

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