Cannibalism in Herring Gulls

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Plates 85-87

INTRODUCTION

The Herring Gull *Larus argentatus* is a notorious killer during the breeding season. Young chicks are repeatedly struck on the head or often gripped by the neck and worried until dead (plate 85a). Usually, these chicks have trespassed into neighbouring territories, and the strong territorial aggression of the adults may cause a considerable pre-fledging mortality. Chicks may also be eaten, however, by other Herring Gulls and even by their own parents (Moreau 1923, Paynter 1949, Goethe 1956). Few observers who have visited Herring Gull colonies have failed to record such instances of cannibalism. Nevertheless, no quantitative study of this habit appears to have been made. This paper presents an account of the extent and possible effects of cannibalism within a colony breeding on the Isle of May, Fife. On that island the species has increased progressively and spectacularly from a solitary pair in 1907 to over 14,000 pairs in 1968. This investigation was part of a wider study of the breeding biology of that large population during 1966-69.

METHODS

Nests and eggs in selected subcolonies were marked and numbered, and the chicks marked or ringed at hatching. It was therefore possible to differentiate between first-, second- and third-hatched chicks in any brood, and also to know the dates of hatching and the positions of the nests from which the individual chicks came. The rings regurgitated by cannibal gulls gave information concerning the numbers and identity of the chicks that were eaten. A detailed study of cannibalism was carried out during 1968 in a subcolony of 903 nests on a part of the Isle of May called North Ness. Of the 1,722 chicks that hatched in this area, 1,415 were ringed immediately and their fate followed through to fledging. Only four pairs of Great Black-backed Gulls *L. marinus* were nesting on the entire island, and their predation on Herring Gull chicks on the North Ness subcolony was negligible.

MORTALITY DUE TO CANNIBALS

As has already been mentioned, chick mortality caused by adult Herring Gulls may be divided into two main categories. Firstly, chicks may wander into other territories and subsequently be killed. Then they usually lie dead and untouched except for the original fatal wounds around the head (plate 85b). Some of these corpses,

however, and others that have died of disease or exposure, may be eaten by adults or even by larger chicks. The motivation here is merely the scavenging nature of gulls, and the remains of the chicks are normally found in the vicinity of their own nest sites. Secondly, and the main subject of this paper, chicks may be eaten by cannibals that act as predators. These are adult Herring Gulls which leave their own nest sites specifically in search of live chicks as a food source. Chicks are taken from the nest sites, and may be swallowed in flight or carried to the nest of the cannibal before being eaten (plates 86a-87a). Around this nest may be found the regurgitated remains of chicks and rings (plate 87b).

A large proportion of chicks are attacked or eaten by other Herring Gulls. Of samples of 226 and 376 chicks found dead on the island in

Table 1. Fate of 1,415 young Herring Gulls *Larus argentatus* **ringed at hatching on North Ness, Isle of May, in 1968**

	Number of chicks	Proportion of total
Known to have fledged	609	43.0%
Eaten by cannibals	329	23.3%
Dead with head scars	47	3.3%
Dead but no visible injury	256	18.1%
Not accounted for	174	12.3%

1967 and 1968, as many as 56% and 59% respectively were partially or wholly eaten, or appeared to have died from head wounds. On some occasions these injuries may have been inflicted after death. Of the 1,415 chicks ringed on North Ness in 1968, however, cannibal Herring Gulls ate 329 or 23% (table 1). This represents a major proportion of the pre-fledging mortality, and yet just over half of these chicks (167) were eaten by only four cannibals. Thus, each cannibal was killing 2-5% of the chicks that hatched in the subcolony, and similar figures were noted for individual cannibals in other subcolonies in both 1967 and 1968. For these gulls, chicks were the major food item. The density of such cannibals in any subcolony was approximately one per 250 pairs.

Cannibals normally take young chicks as prey. For example, the mean number of days between hatching and death for 55 chicks taken and killed by cannibals was 6.7 days. In the course of their search for these chicks, cannibals ranged over distances of as much as 150 metres from their own nest sites (fig. 1). There was no possibility that the chicks had wandered by chance to the cannibal territories, especially as two of the latter were isolated by sea and steep rocks from

the remainder of the subcolony. Although there was some overlap between their foraging areas, the cannibals studied were not nesting close to one another.

CANNIBALS AS PREDATORS

Predation is an important cause of chick and egg loss, and several authors have discussed the probable anti-predator function of colonial nesting and synchronised laying in seabirds (Kruuk 1964, Patterson

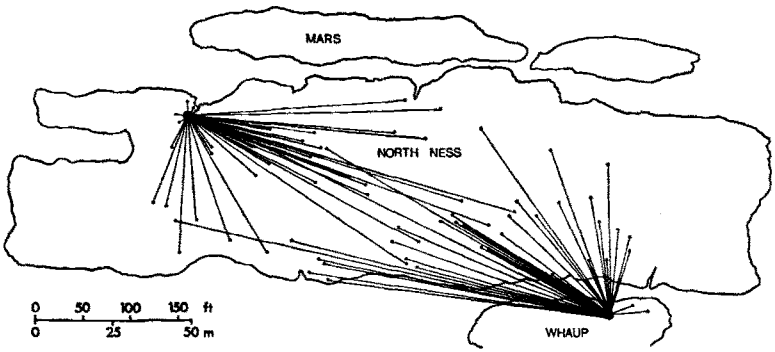

Fig. 1. Scale diagram of North Ness, Isle of May, showing the nests of two cannibal Herring Gulls *Larus argentatus* in 1968 (large black circles) and the nests from which each took chicks (small black circles). The distances flown can be measured against the scale

Table 2. Mean density of 71 nests from which chicks were taken by cannibal Herring Gulls *Larus argentatus* on North Ness, Isle of May, in 1968, compared with that of a random sample of 80 nests selected from a table of random numbers

Density is expressed as the mean number of other nests (standard error in brackets) within three different arbitrary radii of the individual ones concerned. In all three cases, the nests from which chicks were taken were, on average, at a lower density and the significance of the difference between cannibalised and random samples is shown in the last line

	RADIUS IN METRES		
	2.3	3.0	4.5
Cannibalised nests	0.84 (±0.09)	2.07 (±0.14)	4.80 (±0.21)
Random sample of nests	1.12 (±0.09)	2.74 (±0.14)	5.39 (±0.20)
Significance of difference	<0.05	<0.002	<0.05

1965). It was suggested that colonial nesting encourages and enhances the use of behavioural defence mechanisms against predators. The main predator of both eggs and chicks on the Isle of May is the Herring Gull itself, and it was possible to investigate whether these cannibals were selecting nests that were perhaps more isolated or in less dense areas than others.

Nest density was measured by the number of nests within a given radius of a central one. The mean density of nests from which chicks were taken by cannibals was compared with similar data for a random sample of others (the number of each nest site being obtained from a table of random numbers). The results in table 2 show that cannibals selected nests in significantly less dense areas than normal. As such, cannibalism creates a selective pressure against low density breeding, while territorial aggression selects against overcrowding. Indeed, pairs breeding at the most common density were the most successful, both in terms of hatching and fledging success, and the two factors of cannibalism and territorial aggression can explain the significantly poorer success at low and high densities ($P < 0.01$) (Parsons *in preparation*).

The incidence of cannibalism on chicks hatched third in the brood was significantly greater than on those hatched first and second (table 3). Many predators tend to take the weakest members of their prey species (Lack 1954), and it is possible that the third chick is commonly in that position (Parsons 1970). Furthermore, this chick succumbed more frequently to kronism (cannibalism by its parents) than either of the other two, although the samples were too small for statistical treatment: in a study of 747 nests, kronism occurred in 15 cases and caused the deaths of nine third-hatched chicks, compared with two first- and four second-hatched chicks. This differential mortality is typically associated with asynchronous hatching which establishes a nestling hierarchy (Lack 1954). It is possible that the

Table 3. Numbers of chicks hatched first, second or third in brood and eaten by cannibal Herring Gulls *Larus argentatus* on North Ness, Isle of May, in 1968

The significance of the difference between first and third chicks is $P<0.05$

	Chicks ringed	Chicks eaten	Proportion eaten
First chick	611	30	4·9%
Second chick	509	27	5·3%
Third chick	295	26	8.8%

Herring Gull's asynchronous hatching, although slight, and its smaller third egg are adaptations to an unpredictable food supply, so that the brood size is adjusted to the most efficient number of chicks that can be reared in the prevailing conditions. There appears to be ample food available to the Herring Gull during the hatching period, however, and it is believed that this differential mortality is an indication of a breakdown in the behaviour between the adults

and the young rather than a response to a food shortage.

Darling (1938) found that the Great Black-backed Gull and the Heron *Ardea cinerea* took a steady toll of Herring Gull chicks while they were in the down stage and suggested that, if this period were short, the percentage mortality due to predation would be comparatively less than in an extended breeding season. The general effect would be one of swamping the predators with potential prey over a short period of time. Using the data from the four cannibals on North Ness it was possible to examine whether this form of predation created a selective advantage towards a shortened breeding season.

The hatching dates of chicks killed by cannibals were recorded and so the percentage mortality from cannibalism of young hatched in different periods could be calculated (table 4). Early and late chicks suffered a significantly higher mortality from these four cannibals than those hatching in the middle of the season ($P < 0.001$). In fact,

Table 4. Seasonal variation in the numbers of chicks eaten by four cannibal Herring Gulls *Larus argentatus* on North Ness, Isle of May, in 1968

The significance of the seasonal variation is $P<0.001$

	DATE OF HATCHING						
	Before 5 June	5-9 June	10-14 June	15-19 June	20-24 June	25-29 June	After 29 June
Chicks ringed	99	201	289	443	260	84	22
Chicks eaten	22	22	21	34	29	23	7
Proportion eaten	22.2%	11.0%	7.3%	7.7%	11.2%	27.4%	31.8%

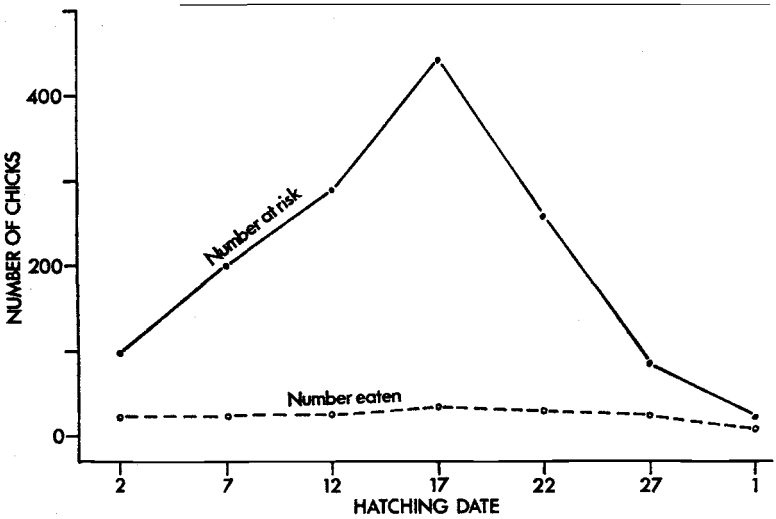

Fig. 2. Seasonal variation in the numbers of ringed chicks of Herring Gulls *Larus argentatus* at risk to predation on North Ness, Isle of May, from 2nd June to 1st July 1968, and the numbers eaten by four cannibal Herring Gulls

the cannibals took a relatively steady number of chicks throughout the season, although the numbers available changed considerably (fig. 2), and this must create a selective advantage for breeding in the middle of a well-defined period. A similar result was obtained for a single cannibal on another part of the island, known as Rona. There the chicks were ringed with different colour rings according to their date of hatching. The proportions of the colour rings regurgitated by the cannibal gave estimates of the percentage mortality for four hatching periods (table 5). Whereas in the middle of the season only

Table 5. Seasonal variation in the numbers of chicks eaten by one cannibal Herring Gull *Larus argentatus* on Rona, Isle of May, in 1968

Various colour rings were used to denote different hatching dates of the chicks. The significance of the difference between the percentage mortality of middle hatching groups and that of early and late ones taken together is $P<0.001$

	COLOUR RING USED AND DATE OF HATCHING			
	Blue Before 9 June (early)	Yellow 9-16 June (middle)	Green 16-22 June (middle)	Black After 22 June (late)
Chicks ringed	40	104	375	113
Chicks eaten	6	3	9	8
Proportion eaten	15.0%	2.9%	2.4%	7.1%

2.4–2.9% of the chicks ringed were killed by this cannibal, significantly higher proportions of early chicks (15%) and late ones (7.1%) were taken by the same bird.

As part of a study into the effects of the season on breeding success, normal breeding was compared with nesting experimentally delayed by the removal of eggs (Parsons *in preparation*). In both control and delayed subcolonies, hatching success was correlated with nest synchronisation rather than time of laying, so that eggs laid during the peak period in any subcolony were the most successful. It is probable that egg predation by Herring Gulls themselves is mainly responsible for this relationship. Likewise, the synchronisation of nesting was the most important factor in determining the pre-fledging success in both control and delayed areas, and much of the lowered survival of early and late chicks within a group was due to cannibalism. Therefore, the Herring Gulls generate a selection against deviation from the main peak of laying, and that selection will tend to maintain the synchrony of breeding irrespective of food availability. Furthermore, late breeding did not appear to be a disadvantage providing that it applied to the group as a whole.

THE CAUSES OF CANNIBALISM

Various ideas have been advanced concerning the type of gull that

becomes a cannibal, and the pressures within a population that may bring about cannibalistic behaviour. Kirkman (1937) believed that many deaths of chicks of Black-headed Gulls *L. ridibundus* were due to 'unmated rogue' individuals which had acquired the habit. Similarly, Tinbergen (1953) suggested that three- and four-year-old sub-adult Herring Gulls hanging around the colony were active predators. The cannibal gulls on the Isle of May retained the habit and ate chicks in successive years: they were not unmated or immatures and, indeed, were no less successful at breeding than the rest of the colony.

There is evidence to suggest that some cannibals find difficulty in separating the drive to feed and care for their own offspring from the urge to kill and eat the young of other Herring Gulls. One adult ate over 40 chicks while incubating a clutch of three eggs. When its own brood hatched, it continued to collect chicks and return with them to its own nest site, but failed to kill them. As a result, over a period of a week, it augmented its own brood by the addition of eight live and healthy chicks. The cannibal even fed this enlarged brood, though two of the eleven chicks (one of which was a captive and the other one of its own) died of exposure in a rain storm. Eventually, eight of the remaining nine (including the other two of its own) were eaten by the same cannibal, but the last chick, which was one of the first captives, duly fledged, having been fed almost exclusively on young Herring Gulls. In this particular case the male was the active predator, but not enough observational results are available to rule out the possibilities that a female or both adults in a pair may eat chicks.

Cannibalism has recently received some attention in the context of population size and regulation. Paludan (1951) suggested that 'an increasing population gives less favourable feeding possibilities and therefore an increased cannibalism'. In these circumstances, cannibals merely exploit an additional source of prey, with individual selection favouring those adults able to make use of this food supply (Ashmole 1963). Alternatively, cannibalism is regarded as a density-dependent brake applied to the rate of recruitment to a population (Wynne-Edwards 1962). Brown (1967) noted that cannibalism was the main cause of chick mortality on Walney Island, Lancashire, although there was no evidence of a food shortage. This somewhat conflicting evidence was explained by the general scavenging nature of gulls and the density of available food. As such, cannibalism was regarded as 'an extension of the normal hunting of young shore-birds and ducklings'.

It is probable that, in a dense breeding colony, chicks are a more accessible and an economical or preferred source of food. Cannibalism need not then indicate a food shortage, nor need it be an adaptation to curb recruitment. Nevertheless, only four cannibals in an area containing over 900 nests were able to reduce the annual fecundity of

the subcolony from a potential 0.80 chicks fledged per pair to an actual 0.67. In static conditions of adult and first-year mortality, this reduced fecundity could lower the known population increase from 13.3% per year to approximately 10% annually over a period of years. However hypothetical this may appear, it does show how any long-term increase in the relative numbers of cannibals can affect the fledging success and ultimately the rate of population change. Unfortunately, there is not enough evidence to relate cannibalism to the density of the colony, although it is obviously impossible for a gull to be a fully active cannibal in a small colony and a minimum number of pairs must be present before this habit can be fully developed.

DISCUSSION

Productivity of the Herring Gull colony on the Isle of May is reduced by cannibalism, even though the percentage of cannibals in the breeding population on the island is relatively small. Whereas many Herring Gulls suffer predation from other species, notably the Great Black-backed Gull (Harris 1964, Kadlec and Drury 1968), the gulls on the Isle of May are free from all but a pair of Carrion Crows *Corvus corone* and four pairs of Great Black-backs. Various aspects of colonial breeding, particularly nest density and synchronisation of laying, have an anti-predator function, and this function appears to be maintained even when the Herring Gull itself is the predator concerned. There is evidence to suggest that this species could breed successfully later in the summer, since delayed breeding does not appear to be particularly disadvantageous (Parsons *in preparation*). Nevertheless, the poorer breeding success suffered by early and late clutches due to egg predation and cannibalism will tend to maintain the present timing of the breeding season, even if food is not limiting. It is probable that a colony must reach a minimal size before cannibalism becomes prevalent, but even then the availability of chicks rather than a shortage of food is likely to be the factor determining the extent of cannibalism.

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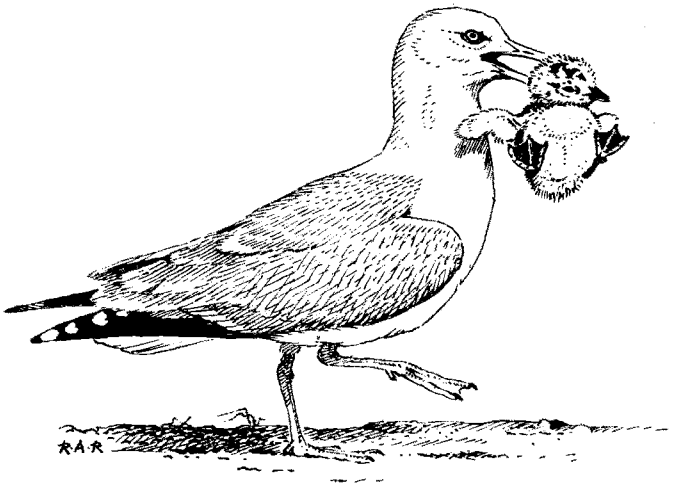
SUMMARY

A considerable proportion of pre-fledging mortality (23%) in a colony of Herring Gulls *Larus argentatus* on the Isle of May, Fife, was attributed to cannibals seeking chicks as a major food source. Nests situated in less dense parts of the colony were selected by these predators, and the chicks hatched third in a brood succumbed

more frequently than those hatched first and second. Within any group, chicks hatching early and late suffered a significantly higher mortality than those hatching in the middle of the season. Therefore, cannibalism tends to select against isolated breeding, while also selecting for nesting synchronisation. Cannibals are probably utilising an available source of food without indicating a general food shortage, but could nevertheless reduce recruitment into the population. At a time when its own brood was hatching, one cannibal was unable to distinguish these from chicks which it had collected, indicating a conflict of behavioural drives.



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