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Diet of Herring Gulls *Larus argentatus* during chick rearing in the Gulf of Finland

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We studied the diet of 40 focal pairs of Herring Gulls (*Larus argentatus*) in a colony off Hanko, western Gulf of Finland, during the 1993 breeding season. During 161 feedings, fish was regurgitated in 70% of all cases (mostly *Clupea harengus* or *C. sprattus,* when the fish could be identified). Fish was brought to all territories at least once (mean number of feeding observations per pair was 4.3), and only 9 pairs fed Eider (*Somateria mollissima*) chicks to their offspring, together 11% of all feedings observed. Garbage and offal occurred in 10% of the feedings. Most pairs thus used fish. Fish is the best available food for chicks, since it has a high nutritive value and is easy to handle.

1. Introduction

Sibly and McCleery (1983) state that "the most characteristic feature of the feeding ecology of the Herring Gull (*Larus argentatus*) is the diversity of foods they are prepared to exploit; they can be described as opportunistic omnivores". This ability has been seen as the key factor in the success of the Herring Gull in NW-Europe and the Baltic (Kilpi 1988). Flexibility in feeding allowed the Herring Gull to heavily exploit increased amounts of artificial foods provided by man, probably enhancing both breeding success and overwinter survival (Lloyd et al. 1991).

The colonially breeding coastal population in the Gulf of Finland was initially considered totally dependent on anthropogenic waste (Bergman et al. 1940) during breeding. There is also some evidence suggesting that this dependence on waste also was true outside the breeding season (Kilpi & Saurola 1983). Later, Bergman (1965) suggested that Herring Gulls were adopting more diverse feeding habits during breeding, gradually establishing the reputation of the species as an omnivore pest feeding on eggs and young of various other birds, notably Eiders (*Somateria mollissima*), and on a variety of other items (see Hilden & Hario 1993).

The feeding ecology of the Herring Gull during breeding is, perhaps somewhat surprisingly, not well studied on the southern coast of Finland (Bergman 1982, see also Götmark 1984 for a review up to 1984). In the Gulf of Finland, Hario (1985), Hario & Selin (1989) and Hario (1990), has made an effort to study the cannibalistic and predatory habits of breeding Herring

Gulls. The results of these studies show that only a small fraction of the gulls act as predators on birds (Hario 1994), and thus there is a need for information on feeding in the bulk of the breeding population. This paper is a further contribution to the breeding ecology of the Herring Gull in the northern Baltic, reporting the results on direct observations on feeding in a breeding colony.

2. Study colony and methods

This study was carried out at the colony of Storsundsharun, off the Hanko Peninsula (60°N 23°E). Storsundsharun is a barren granite island, on which 140 pairs of Herring Gulls bred during the 1993 breeding season.

In 1993, we observed Herring Gulls from two hides (one on Storsundsharun, one on a small islet close nearby) with binoculars (8×) and telescopes (30×) throughout the chick rearing season. Observations on feedings were made from May 15 to June 30 (25 observation days, totalling 34 hours of observations), on 40 different pairs. For each feeding we tried to identify the item offered to the chicks. The regurgitate was taken as the unit, even though this tends to underestimate the importance of fish, which could number up to 5–8 in one load. This routine was adopted primarily because the number of fish in regurgitates in more advanced states of decomposition were difficult to establish. We made between 1 and 11 observations (mean 4.3 ± 2.8, n = 161) on individual pairs.

The Baltic is an area poor in fish species. Clupeoid fish taken by Herring Gulls in the area are either Baltic herring (*Clupea harengus*) or sprat (*C. sprattus*) with herring dominating, and generally easily distinguished from cyprinid species with red fins, such as roach (*Rutilus rutilus*) and ide (*Leuciscus idus*) and from perch (*Perca fluviatilis*). As fish primarily was regurgitated in fresh condition, identification in most cases was straightforward, and in many cases the number of fish in a regurgitate could be established. This may be unique to our study colony, and is probably indicative of short feeding trips.

3. Results

Breeding Herring Gulls on Storsundsharun fed on a diverse array of items, but predominantly on fish (Table 1). Fish was brought to all 40 territories at least once. Of the identified fish, clupeoids (sprat or herring) dominated, followed by Cyprinid species (most were likely roach, and perch. Herring, sprat and roach were occasionally found intact on the territories as well. A large proportion of the unidentified fishes were likely

Table 1. Food items fed to chicks of all ages on 40 territories monitored at Storsundsharun. One feed is used as the unit, though in some cases several fish were regurgitated at the same time. Clupeoids (1) refer to either Baltic herring, or sprat, cyprinids (2) to unidentified cyprinid species, while the category miscellaneous (3) refers to small garbage-like items fed occasionally between main feedings.

Item	Number of times fed (%, n = 161 feeds)		Number of territories (%, n = 40)	
Clupeoid (1)	44	(27.5)	28	(70.0)
Cyprinid (2)	8	(5.0)	7	(17.5)
Perch (*Perca fluviatilis*)	3	(1.9)	3	(7.5)
Stickleback (*Gasterosteus aculeatus*)	1		1	(2.5)
Unidentified fish	56	(35.0)	24	(60.0)
Eider	18	(11.2)	9	(22.5)
Garbage	11	(6.9)	7	(17.5)
Offal	3	(1.9)	3	(7.5)
Earthworms	1		1	(2.5)
Mussel (*Mytilus edulis*)	1		1	(2.5)
Miscellaneous (3)	15	(9.4)	11	(27.5)

clupeoids. Clupeoids were fed on 70% of all territories, unidentified fish on 60% of the territories. Together, fish of all species made up 70% (by frequency) of all meals offered to chicks. The clupeoids were all between 10 and 15 cm in length (the Herring Gull beak as reference), all cyprinids about 20 cm in length.

Eider ducklings (small, age < 10 days) were brought to 9 (22%) of the territories, and constituted 11% of the feedings by frequency. Garbage and offal also occurred as items on some territories, accounting together for about 10% of the feedings by frequency. Of course it can be argued that since the number of observations varies between pairs, the chances for seeing an Eider duckling being brought in would increase with an increase in observation intensity. However, we also checked the territories with regular intervals, searching for remains of both ducklings and garbage. Eider ducklings often end up as a pair of legs on the territory together with non-digestable waste. We do not claim that we have seen all duckling taken, but there were certainly no more territories into which ducklings were regularily brought than the ones we have identified.

The category miscellaneous in Table 1 refers to small items fed mainly between main meals, usually by the parent standing on guard in the territory. These could not be identified.

Fig. 1 gives the distribution of hatching of the first chick in the 40 broods studied (in five-day periods), as well as the temporal distribution of fish regurgitates (clupeoids and unidentified combined) and Eider ducklings brought to the colony. Fish was brought in throughout the period, while most Eiders were seen in late May and early June. This coincides with the hatching peak of Eiders based on our qualitative observations. The few late Eider ducklings were taken from very late broods.

On the basis of frequency of different items, we tentatively divided a number of pairs (those for which we had at least 5 observed and identified feedings on different days) into specialists on either eiders or fish (> 50% of feedings either fish or Eider), and generalists with no clear preferences (Table 2). Thus, most pairs (11, 52%, n = 21 pairs classified) seemed to feed on fish, some (3, 14%) on fish and varied items (but no Eiders),

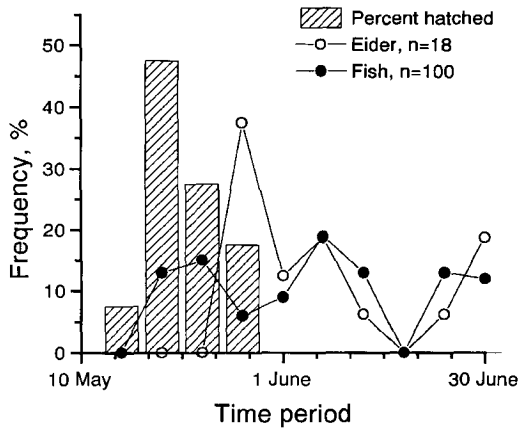

Fig. 1. Frequency of nests hatched (n = 40, histogram) in five day periods (period 1 = May 11 to May 16), and the proportion of all Eiders (n = 18, open symbols) and the proportion of Clupeoids and unidentified fish (n = 100) per five day periods at Storsundsharun 1993.

a few (4, 19%) on varied items including the occasional Eider, and only 3 pairs (14%) seemed to be specialized to some extent on Eiders, though none lived exclusively on them. No Herring Gull in the colony could live exclusively on Eiders, since small ducklings were not available over the entire chick-rearing period, so specialization here should be seen as a tendency to identify and use a certain type of food item when it comes available. Clearly, all Herring Gulls did not use ducklings, even if they were available, and clearly only few feed on waste, eventhough it is available throughout the season.

Table 2. Categorization of pairs (n = 21) based on diet (at least 5 feedings per pair, >50% of one item in feedings if specialist) at Storsundsharun in 1993. Given is also the frequency of Eiders (group A), and fish (group B) in the feedings.

Pair category		
A: Eider in diet	Eider / other item	% Eider
Eider specialist (3 pairs)	10 / 5	67%
Eider generalist (4 pairs)	6 / 23	26%
B: Fish in diet	Fish / other item	% Fish
Specialist (11 pairs)	60 / 17	78%
Generalist (3 pairs)	6 / 12	33%

Table 3 shows the frequency of items brought to small (up to 10 days old) and large (11–30 days of age) chicks. The combined category consisting of waste (garbage, scraps and offal) seems to increase, fish decreases and ducklings remain about equally frequent ($\chi^2 = 7.1$, df = 2, P = 0.03). Pairs raising their offspring on diets including eiders (8 pairs hatching 3 chicks), succeeded in fledging an average of 2.0 ± 0.9 young, 25% fledging three. Those with mostly fish, and no Eiders in their diets, fledged an average of 2.4 ± 0.8 chicks, 60% of the pairs (n = 10 hatching 3) raising all three. This difference in proportions is, however, not significant (Fishers's Exact test, P = 0.18).

4. Discussion

Few studies have in any detail dealt with the use of food in brood rearing Herring Gulls in the Baltic (see Götmark 1984 for review). This is surprising, since food availability is the key to the high reproductive success of the species in the Baltic (Kilpi 1990), and also because the species status as a pest especially in the Finnish archipelagoes is founded on the notion of extensive use of Eider ducklings and young of other species as well (see Bergman 1982).

In one of the few studies, Hario (1990) found remains of spawning Herring in 63% of 67 gizzards (garbage in 15%) of young inspected by him at Söderskär in the central part of the Gulf of Finland. Hario & Selin (1989) detailed the contents of 54 gizzards, and found 61% containing only fish, 20% mainly garbage, and the rest a mixture of garbage and fish on territories with no remains of Eider ducklings at Söderskär. During three years of study, Hario & Selin (1989) found Eider ducklings on 14%, 27% and 15% of all territories (179, 127 and 231), and they concluded that only some individuals (or pairs) had specialized on Eiders. Finally, Hario (1985), found that a few pairs (2–3 annually) of the Herring Gulls breeding at Söderskär were specialized on preying on chicks of other gulls, Lesser Black-backs *L. fuscus*, and Common Gulls *L. canus*, and also on terns, mainly Arctic Terns, *Sterna paradisaea*. The few studies done using pellet analysis (Bergman et al. 1940, Götmark 1984, Lemmetyinen 1963) differ from the above results, probably because the pellets are biased against soft-bodied items, such as cyprinids (see Hario 1990). The absence of Eider ducklings from pellets (and chick regurgitates) may partly be explained by the fact that Herring Gull chicks less than 10 days of age generally cannot easily swallow a dead Eider duckling.

Table 3. Frequency of fish (clupeoids and unidentified from Table (1) combined), Eider, and garbage, offal and scraps combined fed to small (<10 days old) and older chicks.

Item	Frequency by small chicks (69 feedings)	Frequency by large chicks (78 feedings)
Fish	77.0% (53)	60.2% (47)
Eiders	11.5% (8)	10.3% (8)
Garbage	11.5% (8)	29.5% (23)
No. territories	34	26

Our data from Hanko conforms to the same basic pattern indicated above. Most pairs raised their young on fish, mostly on sprat or herring, a few brought in a few Eider ducklings, some managed on a mixture of garbage and fish, varied with a few eiders as well. Qualitatively, we know that none of the pairs at Storsundsharun in 1993 had specialized in taking gull (conspecifics or others) chicks, though one pair killed and consumed at least 7 conspecific chicks from within the colony. No pair probably utilized Eiders as the main source of food over the entire rearing season. In most years both Herring Gulls and Eiders hatch their young at about the same time in our study area (own obs.), and since only small ducklings are taken, their availability rapidly drops well before the Herring Gull young leave the colony at an age of about 60 days. Small Eider ducklings may in most years be available for a period of 2–3 weeks only.

Herring Gulls in the Gulf of Finland appear thus to be generalists during chick rearing, in the sense that almost all possible sources of food are utilized, but individuals differ in their preferences (see also Pierotti & Annett 1991, Sibly & McCleery 1983). We do not, however, know how the different types of food utlized are available in exact terms. Garbage is probably available

during the whole season, while small size-classes of Eider ducklings are available during a limited time. The spawning of herring begins in early May, and gradually advances through the archipelago towards the open sea in July (Oulasvirta et al. 1985), so herring is available through most of the season. There has been a dramatic increase in the herring population over a number of years (Hario 1990). Since the feedings we observed took place during the day-time, Herring Gulls seem quite capable of exploiting clupeoids even outside the dark hours, during which, for istance, Lesser black-backs seem to hunt for herring (Hario 1990). In our study area, Arctic Terns also extensively prey on herring and sprat during the day-time (Wuorinen 1992), which leads us to believe that the Herring Gulls were not relying on commercial fish-traps, which can be important in some areas (M. v. Numers, pers.comm.). As the Baltic has no tide, and is generally poor in invertebrate species (Bonsdorff et al. 1990), the littoral zone, so extensively used on the coast of the Atlantic, is unavailable.

Pierotti & Annet (1987) and Annett & Pierotti (1989) have shown a diet switch in Herring Gulls and Western Gulls *L. occidentalis*, following the hatching of chicks. Herring Gulls in Newfoundland show individual specialization during the incubation period on either mussels, garbage, or petrels, but all switch to a diet of small capelin *Mallotus villosus* once the chicks have hatched (Pierotti & Annet 1989). We do not know wether such a switch occurs in our colony. However, herring and sprat in particular, are very profitable food from the chicks point of view, being both high in calories and fat (Massias & Becker 1990), and extremely easy to handle. Both species are soft-bodied with small bones, and disintegrate rapidly, and are consquently very easy to swallow when offered in the size-range of 10–15 cm. Eiders, on the other hand, are extremely hard to handle especially for small chicks, and most offering of Eiders that we saw, ended with one parent eating the Eider after fruitless attempts to swallow it by the chicks. The feeding parent may try to tear the dead duckling into parts for more easy consumption, but this process renders the feeding situation prone to kleptoparasitism by other gulls (Kilpi et al. in prep.). Therefore, difficulties in handling makes Eider ducklings an inferior type of food compared with fish. Feeding the chicks with fish, clearly reduces the risk for kleptoparasitism since the exchange of item between parent and offspring is rapid, and it reduces also intra-brood competition for food, since the regurgitate is easy to partition among chicks, which enhances the success of the third chick in particular (Kilpi et al. in prep.). Garbage is also of generally lower nutritional quality and often difficult to handle (Hunt 1972). So, even if we have no data to verify a switch, most gulls do feed their young with fish, thereby possibly actively selecting an item which is very beneficial for the chicks. On the basis of our observations, we suggest, that a diet of only garbage or only chicks of other birds would have serious effects on breeding success. Our results showed however, no significant effect of diet on reproductive success. Comparisions between colonies subject to different availability of food items would shed more light on this aspect.

Our data also suggests that waste, garbage and offal, were offered more often when the chicks were larger. Qualitatively this was also seen as an accumulation of garbage items in the colony over time. Such an increase in the proportion of garbage in the diet with increasing chick age was also observed by Annett & Pierotti (1989) in the Western Gull.

In conclusion, the Herring Gulls in our study colony seemed to forage mostly on fish, eventhough other types of food also were available. Data cited above, and arguments based on the ease of handling of food items offered to chicks suggest that fish is the most profitable food during breeding. In the Gulf of Finland, Herring Gulls studied produce their offspring on a fish-dominated diet. Some of these pairs seem to occasionally prey on Eiders and other birds (see Hario 1994, Hario & Selin 1989, Hario & Jokinen 1993). These pairs, be they cannibals or predators, can locally be a severe problem (Hario 1985, 1990, 1994, Parsons 1971), when they seem to specialize on preying upon young of other species. We call for more detailed studies on the feeding of Herring Gulls, so that the basis of it's existance in the northern Baltic, and it's impact on other species can be understood properly. We do not *per se* question the role played by anthropogenic waste outside the breeding season

(Kilpi & Saurola 1983) for being a part of the success of the species, but during breeding the Herring Gulls so far studied seem to rely on natural foods, primarily fish.

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Sammanfattning: **Häckningstida födoval hos gråtrutar i Finska Viken**

Vi undersökte födovalet hos gråtrutar utanför Tvärminne, Hangö Udd, sommaren 1993. Materialet insamlades via direkta observationer av matningar från gömslen på 40 par mellan den 15 maj och 30 juni. Vi identifierade innehållet i 161 uppspydda måltider. Hela 70% av alla måltider bestod av fisk, mest strömming och vassbuk, eller mörtfiskar, i de fall då bestämning kunde göras. Fisk matades på alla territorier minst en gång. Små ejderungar bjöds åt trutungarna i 11% av fallen, och avfall eller andra rester från soptippar eller komposter bjöds likaledes ut i 10% av fallen. Ejder matades på bara 9 territorier totalt. På basen av observationerna utsåg vi de flesta paren av 21 detaljobserverade till fiskspecialiser (11), några få (3) till ejderätare, och resten (7) hankade sig fram på en blandning av fisk, avfall och någon ejderunge. Par som åt ejder producerade i medeltal 2 flygga ungar (8 par med 3 ungar kläckta), medan fiskmatande föräldrar (10 med tre kläckta ungar) födde upp 2.4 ungar i medeltal, men skillanden är inte signifikant. Vi påstår att det inte är möjligt för gråtrutar i västra Finska Viken att föda upp ungar på en diet av ejderungar och avfall, eller att det åtminstone inte går lika bra som på en diet av fisk. Detta beror antagligen på att ejderungar (a) inte finns tillbuds hela säsongen, och att (b) både ejderungar och avfall är sämre mat än fisk. Detta beror mest på att både avfall och ejderungar är besvärlig mat att fördela och svår för ungarna att svälja, förutom att det näringsmässiga värdet är lägre än hos fisk, framförallt jämfört med strömming och vassbuk. Vi tycker att det vore av värde att jämföra mer noggrant häckningsresultatet mellan fiskätare och ejder/avfallsätare, och att på större skala se efter vad gråtrutarna i egentligen äter, och vilken roll som predatorer på skärgårdsfåglar de i själva verket spelar.

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