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Responses of Herring Gulls *Larus argentatus* and Common Gulls *L. canus* to warm years: early migration and early breeding

Mikael Kilpi

Kilpi, M., Department of Zoology, University of Helsinki, P. Rautatiekatu 13, SF-00100 Helsinki, Finland

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Monitoring of two breeding colonies in 1983–1991 indicated that both Herring Gulls and Common Gulls altered their migration schedule and time of breeding in very early springs (1989 to 1991). The date of the ice break-up dates varied during the study period, the maximum difference between dates being 96 days. There was a trend towards an earlier break-up in 1983–1991, and the break-up dates correlated with the maximum ice-cover in the Baltic, reflecting the general severity of the winter. The Herring Gulls occupied the breeding colony up to 54 days earlier in the earliest spring (1990) than in late springs, the Common Gulls 26 days earlier. Early arrival was followed by early breeding. The maximum difference between years in the initiation of the first nest was 23 days in the Herring Gull and 11 days in the Common Gull. The response to a warm year is more pronounced with regard to the timing of migration and colony occupancy, than with regard to the timing of laying. As only one group of breeding birds was monitored for each species, the data suggest that individual adults are able to alter their migration behaviour from year to year. The Herring Gulls were behaviourally more plastic than the Common Gulls. This may be due to the wintering strategy; Herring Gulls stay chiefly within the Baltic and are probably able to monitor the meteorological conditions more readily than Common Gulls which migrate outside the Baltic area.

1. Introduction

The timing of annual events, such as breeding and migration, is an issue of perennial interest to avian ecologists (Lack 1968, Perrins 1970, Drent & Daan 1980). If early breeding was always favourable (Daan et al. 1988), there should be a positive connection between early arrival and the onset of breeding.

Alerstam & Högstedt (1980) suggested that short-range migrants benefit from wintering within the same climatic region as their breeding region. Such short-range migrants should be able to note oscillations in the environment and time their annual behaviour so as to start migration and breeding as early as possible. Long-range migrants cannot be expected to predict the weather on the breeding grounds from their winter quarters, and consequently, should not be able to respond to climatic variation in the breeding area. Generally, phenologic data (e.g. Hildén et al. 1979) seem to suggest that short-range migrants do show higher year-to-year variation in arrival dates than do long-range migrants. However, Pienkowski & Evans (1985) stated that the evidence runs counter to the prediction that, at least, individual shorebirds will vary the timing of their migration from year to year.

In this paper, I will provide data on arrival dates for a short-range migrant, the Herring Gull (*Larus argentatus*), and for the Common Gull (*L. canus*) which migrates outside the Baltic area. I will also present data on the onset of breeding for these two species. From the arguments presented above, I predict that (a) Herring Gulls should be able to arrive earlier in early springs, and (b) should show a more pronounced response to early spring than Common Gulls. I further predict that (c) both species should be able to start breeding earlier in warm springs, and that (d) Herring Gulls should start breeding still earlier than the Common Gull.

2. Material and methods

The observations used in this paper were gathered off Hanko (60°N 23°E) in 1983–1991.

I used only one breeding colony of each species. This has certain implications for the results. Since the species are long-lived and highly philopatric when once established in a breeding colony (Kilpi & Saurola 1983, 1985), I probably at least in part monitored the same pairs in all years, and thus the observations should partly reflect changes in individual behaviour, though this cannot be quantified.

In spring, I recorded occupancy of the Herring Gull colony checking the islands in every 10 days in January–February, and weekly from March onwards. The first group recorded in the colony showing display behaviour was entered as the first observation of colony occupancy. This procedure is not entirely satisfactory, and the arrival dates should thus not be treated as absolute, since I may have missed the initial arrival (but not by more than a week). Common Gulls were monitored from late March at 3-day intervalls.

I monitored the onset of breeding by checking the colony at 2–3 day intervalls, ice conditions permitting. Here I will use chiefly the first dates for laying.

I used the ice conditions as indicators of the weather during winter and spring. This is because ice is the ultimate factor preventing these species from foraging. Mälkki & Tamsalu (1985) have shown that the ice conditions in the Baltic generally reflect the severity of the winter and the onset of spring. I used two data sets, one reflecting the actual situation around the study colonies, gathered by me in 1983–1991, the other reflecting the situation in the entire Baltic and the general area, from Hanko to the Hitis archipelago (1966–85, Anon. 1971, 1982, Kalliosaari & Seinä 1987). In the latter area, the ice breaks up a few days earlier.

The general migration pattern of the species is known for the populations on the Finnish coast. Herring Gulls migrate to the southern part of the Baltic and the Danish Straits (Kilpi & Saurola 1984) often staying on the Finnish coast in some numbers as long as the sea is free of ice. Common Gulls migrate to areas southwest of Denmark, including the British Isles (Kilpi & Saurola 1985).

3. Results

3.1. Ice conditions

During the study period, the date of ice break-up around the study colonies broke up between 1 February (1990) and 4 May (1987, Table 1), the mean date being 7 April (SD = 32 days, n = 9 years). There was a significant trend towards an earlier break-up in the period 1983–1991 ($r = -0.67$, $df = 7$ $P = 0.05$, $n = 9$ years).

Generally, when the Baltic had an extensive ice cover, the break-up date at Hanko was late ($r = 0.76$, $P = 0.002$, $n = 20$ years 1966–85). The maximum area of ice in the Baltic thus reflects the general severity of the winter, and early break-up dates indicate that the winter and spring have been mild.

There was no significant trend towards a progressively earlier break-up in the period 1966–1990 ($r = 0.27$, $P = 0.19$, $n = 25$ years). For the period 1966–1985, the mean date for the break-up was 8 April (SD = 66 days, n = 20, range 1 January to 12 May). The mean was heavily influenced by two virtually iceless years. The fre-

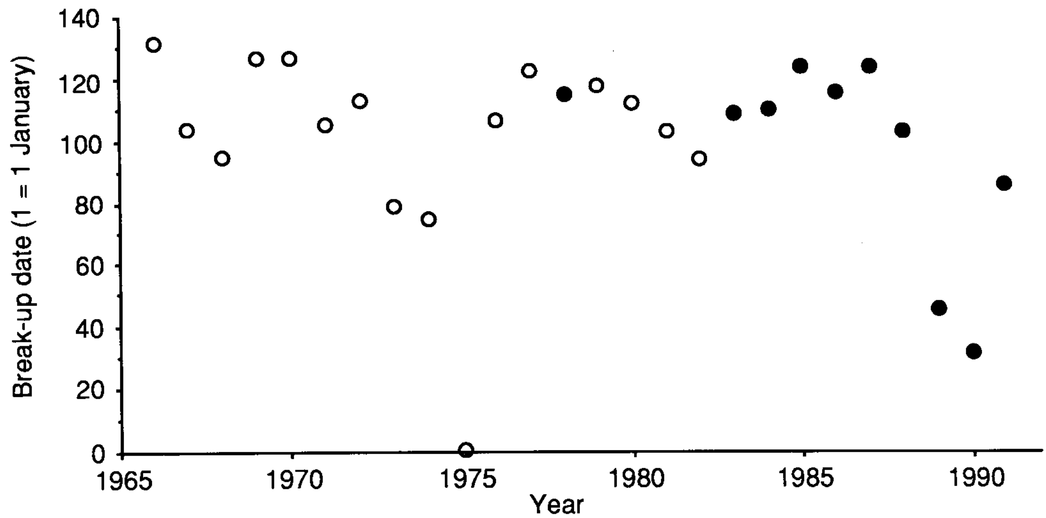

Fig. 1. Break-up dates of the ice outside Hanko during 1960–1991. Open symbols are data obtained from published records, closed symbols refer to dates observed

quency of early break-ups (by 1 April) was 20%, that of average (by 1 May) 45% and that of late break-ups (later than 1 May) 25%. In 1966–1985, two successive iceless years did not occur, but the data do suggest (Fig. 1) that an iceless year is preceded by one or two winters with an earlier than average ice break-up.

3.2. Colony occupancy

I found no significant consistent trend towards earlier colony occupancy during 1983–1991 in the Herring Gull ($r = -0.43$, $df = 7$, $P = 0.25$). Herring Gulls occupied the colony island considerably earlier in 1989, 90 and 1991 than in the other years, the difference between extreme years (1987 versus 1990) being 54 days. In 1983–1988 arrival varied between 15 March and 31 March (Table 1), but the colony site was already occupied in February in 1989–1991 (20th, 6th and 11th respectively). Herring Gulls occupied the colony before the ice disappeared in all years except in 1990. Occupancy correlates with the date the ice disappears ($r = 0.77$, $df = 7$, $P = 0.02$, see also Kilpi 1990).

Table 1. Break-up of the ice, initial date of colony occupancy, and date of first laying for the two species. HG = Herring Gull, CG = Common Gull. – = no data. Difference = maximum difference between years (days).

Year	Break-up	Occupancy HG	Occupancy CG	Lay HG	Lay CG
1983	19 April	15 March	–	18 April	4 May
1984	20 April	20 March	–	19 April	4 May
1985	4 May	17 March	26 April	29 April	2 May
1986	26 April	17 March	20 April	24 April	4 May
1987	4 May	23 March	25 April	28 April	4 May
1988	13 April	31 March	24 April	24 April	4 May
1989	1 March	20 February	13 April	10 April	26 April
1990	1 February	6 February	30 March	6 April	23 April
1991	26 March	11 February	30 March	12 April	30 April
Difference	92	54	26	23	11

Common Gulls occupied the colony site after 20 April in 1985–1988, but in 1990 and 1991 the colony was occupied already by 30 March, about three weeks earlier than in colder years. Colony occupancy in the Common Gull correlates with the ice break-up date, ($r = 0.77$, $df = 5$, $P = 0.04$, Table 1); occupancy is thus earlier in warm springs. In the Common Gull occupancy also became earlier during the study period ($r = -0.87$, $df = 5$, $P = 0.009$, 1985–91).

3.3. Laying

Laying of the first clutch in the Herring Gull colony is correlated with the ice break-up, an early break-up resulting in early laying ($r= 0.91$, $df = 7$, $P = 0.0006$). The colony occupancy date correlated significantly with the laying date ($r = 0.79$, $df = 7$, $P = 0.01$), the time lag from occupation to first laying varying from 30 days (1984) to 60 days (1990). The earliest first clutch was laid on 6 April (1990) and the latest on 29 April (1985), the maximum difference between years during this period thus being 23 days. The date of first laying was significantly correlated with the median date of laying ($r = 0.98$, $df = 7$, $P < 0.0001$). The median dates varied by maximally 16 days, from 18 April (1990) to 4 May (1985). There was no indication that the first laying date became progressively earlier over the sequence of years ($r = -0.57$, $df = 7$, $P = 0.11$).

In most years, the Common Gulls started laying in the first week of May, the range being from 23 April (1990) to 4 May (six years, see Table 1) with a maximum difference of 11 days. The break-up date correlated significantly with the date of first laying ($r = 0.92$, $df = 7$, $P = 0.0004$). Occupancy time prior to laying varied between 7 days in 1985 and 24 days in 1990. In Common Gulls, early occupancy is also significantly connected with early breeding ($r = 0.80$, $df = 5$, $P = 0.03$). The date of first laying was significantly correlated to the median date of laying ($r = 0.89$, $df = 7$. $P = 0.001$), and there was a significant trend towards earlier laying over the years ($r = -0.68$, $df = 7$, $P = 0.04$). The maximum difference between the median laying dates was 14 days (from 1 May in 1990 to 14 May in 1985).

4. Discussion

It is not known to what extent the severity of the winter, reflected by the ice-conditions, affects the yearly winter distribution of migrant Herring Gulls or Common Gulls from the southern Finnish coast. According to ring recoveries (Kilpi & Saurola 1984, 1985), Herring Gulls tend to winter close to the January 0°C isotherm which runs roughly through the Danish Straits, while Common Gulls tend to winter to the southwest of it. During winter, Herring Gulls often appear and disappear along the southern coast of Finland in accordance with the weather ("Pendelzug" see Schuz 1971), while such movements seem absent in Common Gulls (own obs.), though possibly occurring in more southern areas. There is only circumstantial evidence for movements back and forth in Herring Gulls. In the winter of 1990/91, the sea off Hanko was open very late and the temperatures in January were generally >0°C. The Herring Gull numbers were high well into late January (>1 000 individuals on several occasions) but their origin is not known. In 1991, the first Herring Gulls had settled in the study colony off Hanko on 11 February, after an influx of gulls in late January. This indicates that the spring return had started, since the colony island is never used as a roosting site by wintering Herring Gulls. However, the sea froze over for the first time during this winter during the same week, and all the gulls had left by 16 February, returning ten days later when the weather became warmer. Short movements back and forth would provide an effective means of checking the possibility of survival and early settling in the breeding area.

Common Gulls migrate from the Finnish coast in late July – early August, while Herring Gulls migrate from October onwards. Thus Common Gulls seem to be more rigidly tied to other areas than Herring Gulls. Due to their larger size, Herring Gulls are probably better equipped for wintering closer to the breeding grounds.

However, both species settled earlier in early years (prediction a), possibly due to a flexible strategy with regard to the migration distance (also possibly involving lingering, i.e. delayed migration, Haila et al. 1986), or to earlier migration from a fixed wintering location in spring. Herring Gulls probably have a more flexible area use in winter than do Common Gulls.

The response of the Herring Gulls to an overall warmer winter and iceless conditions is more pronounced than the response of the Common Gulls in my data, the maximum difference in occupancy date being 54 days in Herring Gulls and 26 days in Common Gulls. This is in accordance with prediction (b). As the birds monitored in both species were most probably at least to some extent the same over a number of years, the data indicate that individual adult birds may alter their migratory behaviour in accordance with detectable changes in the environment (see Baker 1978). Herring Gulls wintering roughly within the Baltic seem able to alter their time schedule to a greater degree than Common Gulls wintering outside the Baltic, which agrees with the general idea of Alerstam & Högstedt (1980).

In both species, laying was earlier in early than in late years in both species (prediction c). In the Herring Gull, the maximum difference is striking; in 1990 the first nest was initiated 23 days earlier than in 1985. In Common Gulls the maximum difference is smaller (11 days). In this connection it is worth noting that these differences do not apply only to the study colonies, but generally to all colonies in the area, though these have not been monitored quantitatively.

Early occupancy clearly allows for early breeding in both species. An early arrival has also been found to correlate with early breeding in the Kittiwake (*Rissa tridactyla*, Coulson 1985) The data suggest that the proximate decisive factor involved in the Herring Gull could be the ice break-up. For Common Gulls, the break-up seems to determine when the colony is occupied possibly by influencing arrival, but not the date of laying, since in most years the ice breaks up well in advance of laying.

As predicted (d) it seems that the shift to an earlier breeding date can be greater in Herring Gulls than in Common Gulls. This shift is accomplished inspite of the fact that they seem to need a considerably longer pre-laying period in the colony (minimum 30 days in this data) than do Common Gulls (minimum 7 days). Early breeding in the Herring Gull may be aided by better physiological adaptations to coping with cold environments, which allows them to arrive early, and subsequently adjust breeding to the ice break-up (CV for date of laying the first egg 42% for 9 yrs). The proximate trigger in Herring Gulls seems to be disappearance of the ice cover (see also Kilpi 1990), while the proximate environmental trigger in the Common Gull is unknown. Hario et al. (1991) have shown that Herring Gulls rely partly on endogenous reserves during pre-laying and laying, arriving in good condition and carrying endogenous reserves. The immediate intake during courtship feeding is also important (Hario et al.1991), and Herring Gulls seem able to obtain sufficient food very early in spring if provided access to the sea.

Arriving Common Gulls, on the other hand, seem to have a very short pre-laying period in the colony, maybe because of an even more pronounced use of endogenous reserves with a minimum of immediate intake during the courtship feeding phase. Common Gulls are possibly tied to another type of feeding environment which prevents a very early arrival. The seasonality of the breeding environment seems on the whole to be more pronounced for Common Gulls, which appear to have a "tight" schedule compared with Herring Gulls (CV for laying date 13% for 9 yrs). The constraints operating in this context are unknown.

The data presented here suggest that there are considerable possibilities for behavioural plasticity with regard to both timing of migration and timing of breeding, especially in short-range migrants. The Herring Gull seems to be the more plastic of the two species considered here.

If warm winters and early springs prevail in the Baltic for a longer period, the effect upon the breeding species may be pronounced. As early species become earlier still and late species (long-range migrants) show a less pronounced response, the asynchrony between species will increase. The consequences of this scenario are difficult to foresee.

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Sammanfattning: **Gråtrutar och fiskmåsar svarar på tidig vår och varm vinter med att både flytta och häcka tidigt**

Under vårarna 1989–91 var islossningen mycket tidig på Hangö Västra Fjärd jämfört med perioden 1983–88. Skillanden mellan de mest extrema vårarna (1987 och 1990) var hela 96 dagar, så att havet svallade fritt den första februari år 1990. Gråtrutarna i den koloni som undersöktes återvände till häckskäret mycket tidigare under de varma vårarna — år 1990 var kolonin bemannad redan den 6 februari, då den under "normala" vårar vanligen ockuperas i medlet av mars. Skillnaden mellan de mest extrema vårarna i detta fall uppgick till 54 dagar. Fiskmåsarna i den koloni som studerades anländer vanligen omkring den 20 april, men 1990 och 1991 var de på plats redan dryga tre veckor tidigare.

Gråtrutarna inledde också sin häckning mycket tidigare de varma vårarna, skillnaden uppgick till dryga tre veckor jämfört med de kallaste åren. Samma skillnad hos fiskmåsarna var 11 dagar. Observationerna visar att (a) flyttfåglar kan justera sin tidtabell i förhållande till aktuella omständigheter, och att (b) arter som flyttar kortare sträckor (gråtrut) lättare kan justera sitt beteende. Detta gäller både flyttning och häckning. Eftersom bara en koloni av bägge arterna observerades, verkar det som om fullvuxna individer vore kapabla att justera sitt beteende från år till år. Gråtruten som är bättre anpassad till kallare förhållanden och nordligare områden kan tack vare detta svarar snabbare på en förändrad miljö än fiskmåsen. Ifall varma vårar kommer att bli en fortbestående företeelse, kommer detta att leda till att arternas inbördes tidtabeller i vår skärgård förskjutes, med oanade följder.

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