ATTENDANCE PATTERNS OF COMMON GUILLEMOTS *URIA AALGE* AND KITTIWAKES *RISSA TRIDACTYLA* AT COLONIES DURING CONTINUOUS DAYLIGHT

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Barrett R.T. 2001. Attendance patterns of Common Guillemots *Uria aalge* and Kittiwakes *Rissa tridactyla* at colonies during continuous daylight. Atlantic Seabirds 3(1): 31-48. *Attendance patterns of adult Common Guillemots* Uria aalge *and Kittiwakes* Rissa tridactyla *at breeding colonies during continuous daylight were studied in arctic Norway. While there were clear diurnal variations in the attendance of Common Guillemots that were similar to those found in colonies further south, those of the Kittiwakes were more diffuse. Seasonal variations were otherwise similar to those of birds breeding further south. Variations in attendance pattern were least during incubation and early chick-rearing for both species, corroborating published recommendations of carrying out census or monitoring counts during these periods.*

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INTRODUCTION

In order to determine when best to census or monitor breeding seabird populations, it is necessary to document short-term diurnal and seasonal changes in attendance patterns of adults in the colony (Nettleship 1976; Evans 1980). This has been done several times at temperate latitudes (e.g. Cullen 1954; Lloyd 1972, 1975; Birkhead 1978; Slater 1980; Richardson *et al.* 1981; Harris *et al.* 1983), but apart from Gaston and Nettleship's (1981, 1982) study of Brünnich's Guillemots *Uria lomvia* and Tschanz's (1983) study of Common Guillemots *U. aalge*, little has been published on the effects of continuous daylight on attendance patterns in the Arctic.

Kittiwake *Rissa tridactyla* and Guillemot monitoring is generally based on counts of apparently occupied nests or individual birds on the breeding shelves within previously determined sample plots. Although nest counts are the basis of most Kittiwake monitoring (Walsh *et al.* 1995), counts of individuals have also been recommended and used as they measure whole populations of breeders and non-breeders (Heubeck *et al.* 1986; Hatch & Hatch 1988). The use of individuals as the counting unit also avoids the problem of the observer's subjective definition of a nest (e.g. Heubeck & Mellor 1994) and results in

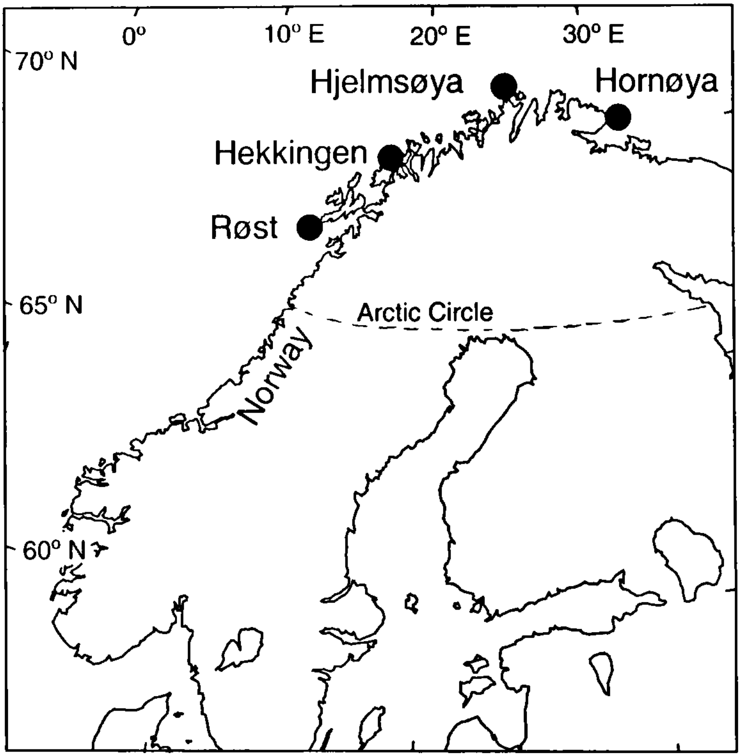


Figure 1. Map showing the location of the seabird colonies mentioned in the text in relation to the Arctic Circle.
Figuur 1. Ligging van de in de tekst genoemde zeevogelkolonies ten opzichte van de poolcirkel.

smaller inter-observer differences in counts than when nests are used as units (Wanless *et al.* 1982). Furthermore, short term counts of adults may be useful indicators of attendance changes which, in turn, may be a result of, for example, fluctuating food availability, predation or human disturbance (Wanless & Harris 1992; Cadiou 1999; Sandvik & Barrett 2001).

In 1979, a national seabird monitoring programme was initiated in Norway, focusing on three species considered representative of Norwegian seabird colonies, the Common Guillemot, the Atlantic Puffin *Fratercula arctica* and the Kittiwake (Røv *et al.* 1984). Counting techniques standardised by the

Seabird Group (Evans 1980; and later Walsh *et al.* 1995) were, and still are used, irrespective of the latitude of the colony in question. Consequently, counts of auks and Kittiwakes were timed according to the recommendation of British studies (Evans 1980; Richardson *et al.* 1981) and assumed that attendance patterns at nest sites within the Arctic Circle were similar to those of more southerly colonies. In Norway, >80% of Norway's cliff-breeding seabirds breed north of the Arctic Circle (Barrett & Vader 1984; Anker-Nilssen *et al.* 2000) and three of the four main monitoring sites have continuous daylight throughout the breeding season (Røst 67° 25' N, Hjelmsøya 71° 07' N and Hornøya 70° 22' N).

This paper reports adult attendance patterns of the Common Guillemot and the Kittiwake at colonies within the Arctic Circle and compares them with data published from colonies further south.

METHODS

The main part of this study was carried out on Hornøya (70°22' N, 31°10' E), an island off the northeastern tip of Norway, in 1980 and 1981 (Fig. 1). Supplementary data are drawn from a study of Kittiwakes (Barrett 1978) on Hekkingen (69°36' N, 17°50' E), *c.* 40 km west of Tromsø. Both islands are 'bathed in midnight sun' during most of the breeding season, from 17 May-26 July (Hornøya) and 20 May-23 July (Hekkingen).

Common Guillemot Seasonal patterns of attendance by adult Common Guillemots were studied by daily counts at 12:00 (Norwegian Summer Time, NST = GMT +2 hr) of birds on a clearly defined monitoring plot on Hornøya. The plot contained *c.* 220-240 pairs or up to 400 birds that could be counted easily using binoculars from a ledge *c.* 40 m from and 10 m above the plot. Counts were made between 14 May and 12 August 1980, and between 13 May and 17 August 1981. Using time-lapse photography in 1980 and direct counts in 1981, diurnal attendance patterns were recorded every 2 or 4 hr throughout a 48 hr period (weather permitting) at *c.* 10 day intervals throughout each field season. In order to correct for possible effects of weather on attendance (Corkhill 1970; Birkhead 1978; Slater 1980), the diurnal counts were restricted to a period of fine, calm weather. Whenever a count series was threatened by deteriorating weather, it was postponed (or suspended when the weather suddenly worsened) until conditions improved.

Data on wind speed, precipitation, temperature and sea state (on a scale of 1-9) at Hornøya were based on observations made at 08:00 and 14:00 NST by the Norwegian Meteorological Institute at Vardø, *c.* 1 km from the colony.

Kittiwake Diurnal patterns of adults at nests were determined by counting adults at nests on photographs taken either directly (Hornøya) or using time-lapse photography (Hekkingen). On Hekkingen, photographs were taken from a hide *c.* 20 m from a group of 57 nests every 45 min over a 24 hr period using a Nikon F2 35 mm camera with automatic aperture control (Nikon DS-1), motor drive (Nikon MD-1) and a battery-driven timer, seven times between 7 May and 29 July 1976. On Hornøya, photographs of *c.* 160 Kittiwake nests surrounding the Guillemot plot were taken manually in 1981 at the same time and from the same site as the Guillemots were counted. Seasonal changes in numbers were based on the means of the diurnal counts made within the given 24 hr periods.

The numbers of birds on nests with eggs or chicks (or, in the pre-laying period, nests in which eggs were later laid) and the numbers on failed nests in the pre-laying, incubation and chick-rearing periods on Hekkingen were determined from daily records of the contents of all the nests.

RESULTS

Common Guillemot Judging from when the first chicks were seen on the monitoring plot (16 June 1980 and 21 June 1981) and using a mean incubation period of 33 days (Gaston & Jones 1998), the daily counts at Hornøya began each year around the start of egg laying. The first chicks fledged from the plot on 10 July 1980 and 17 July 1981, and counts continued until the last adults left.

Despite considerable daily variation in the midday numbers of birds, attendance patterns through the season were essentially the same in 1980 and 1981 (Fig. 2). There were no trends in the numbers present before the first chicks were seen in either year (r^2 = 3.2%, $P > 0.1$ in 1980; r^2 = 7.5% $P > 0.1$ in 1981). However, linear regressions indicated a significant increase in numbers from the day of first hatching to the day the first chicks fledged in 1980 (r^2 = 46.8%, $P < 0.001$), although in 1981 the increase in the same period was not significant (r^2 = 8.9%, $P > 0.1$). In both seasons there was a significant overall increase over both periods until fledging started (r^2 = 52.2%, $P < 0.001$ in 1980; r^2 = 28.9%, $P < 0.001$ in 1981. Once chicks started to leave the colony, the numbers of adults on the plot dropped steadily and within 30 days all had departed.

Significant, positive correlations between wind speed at 14:00 NST and numbers present during the incubation and nestling periods were found in 1980 (r^2 = 11.6%, $P < 0.01$). Although there were no significant correlations between attendance and wind speed measured at 08:00 NST, there were significant, positive correlations with sea state at 08:00 and 14:00 NST (r^2 = 8.2%, $P < 0.05$ and r^2 = 11.6, $P < 0.01$ respectively). In 1981, the correlation between numbers and wind speed at 14:00 NST was weak but significantly negative (r^2 = 8.7%,

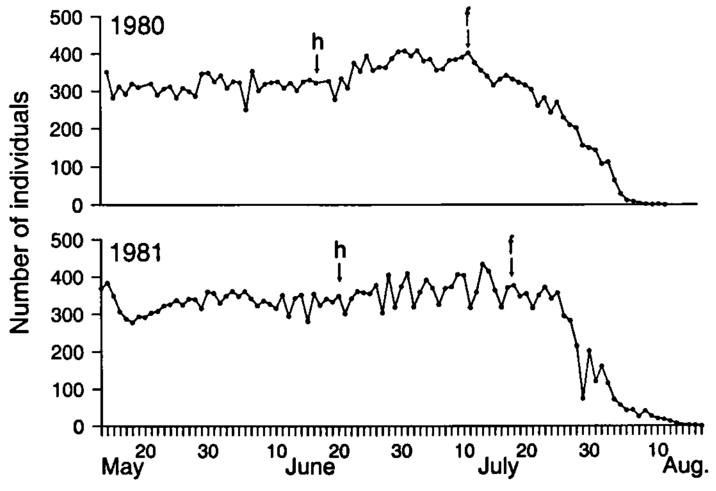
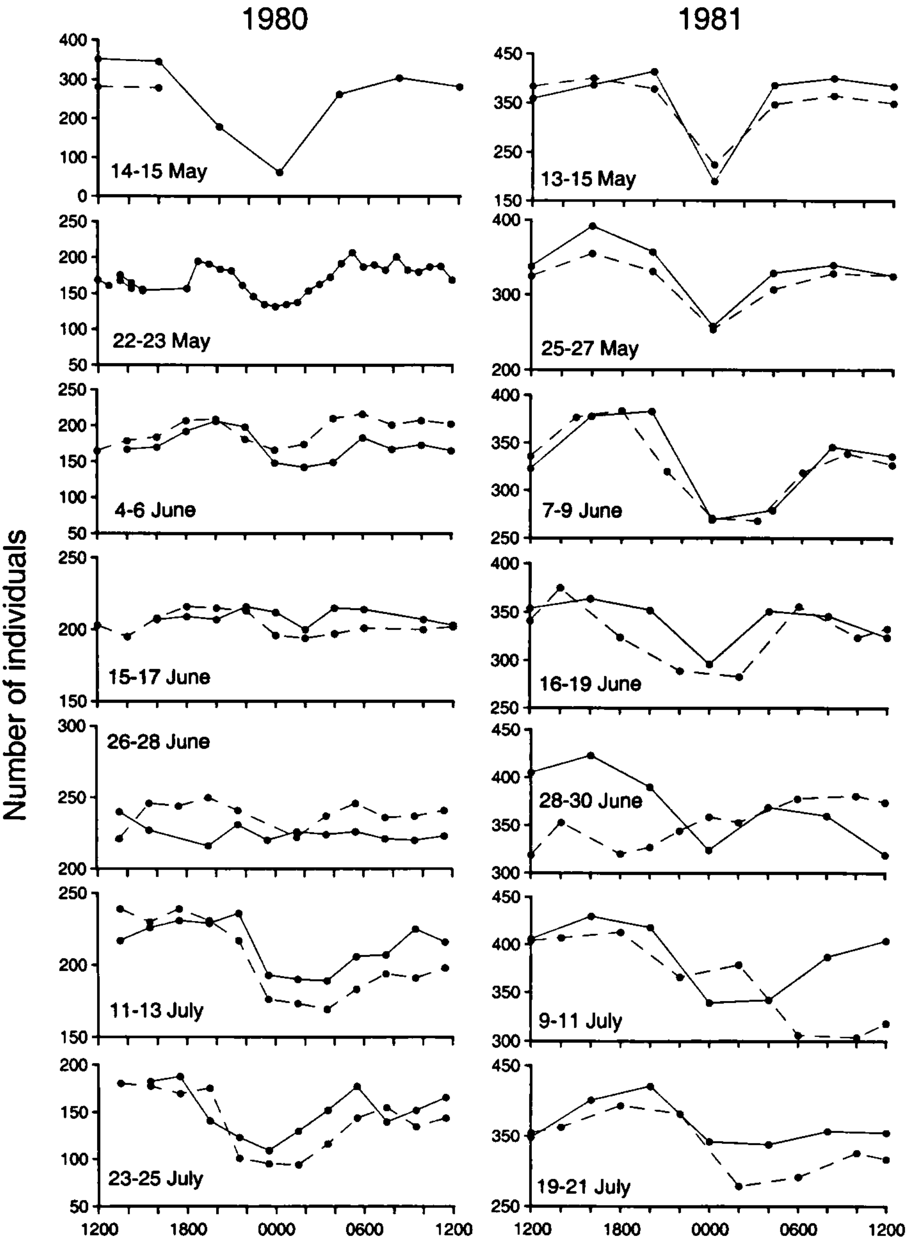


Figure 2. Seasonal variation in the numbers of adult Common Guillemots attending a sample plot at Hornøya, North Norway during the incubation, chick-rearing and fledging periods in 1980 and 1981. Counts were made at midday local time. h = date on which the first chick was seen, f = date on which the first chick was seen on the water below the cliff.

Figuur 2. Variatie in de loop van het seizoen in het aantal volwassen Zeekoeten dat aanwezig was op een steekproefplot op Hornøya, Noord-Noorwegen, tijdens de broedfase, kuikenfase en het uitvliegen in 1980 en 1981. Tellingen werden om 12 uur 's middags lokale tijd uitgevoerd. h = datum dat het eerste kuiken werd gezien, f = datum dat het eerste jong op zee werd gezien.

$P < 0.05$), but there was no correlation between numbers and either wind speed at 08:00 NST or sea state at 08:00 or 14:00 NST. No significant correlations between attendance and other weather variables were found.

There were large fluctuations in the size and coefficients of variation (CV) of the counts of Guillemots made at 2 or 4 hr intervals over 1-2 days on the plot during the pre-laying period (before 15 May both years) and after the chicks begin to leave the cliff (10 July 1980 and 18 July 1981), but smaller fluctuations during the incubation and nestling periods (Figs. 3 and 4). However, there was a clear diurnal pattern of attendance with fewest birds on the plot around midnight and usually most during the evening. Two exceptions to this pattern, during the afternoon of 29 June 1981 and morning of 11 July 1981, coincided with periods of heavy rainfall.


1980
1981
Number of individuals
14-15 May
13-15 May
22-23 May
25-27 May
4-6 June
7-9 June
15-17 June
16-19 June
26-28 June
28-30 June
11-13 July
9-11 July
23-25 July
19-21 July
1200
1800
0000
0600
1200

Opposite page. Figure 3. Diurnal variations in numbers of adult Common Guillemots attending a sample plot at Hornøya, North Norway, 1980 and 1981. x-axis indicates Norwegian Summer Time (GMT+2 hr). The main incubation period and early chick-rearing period fall in June. Solid line = first 24 hours, dotted line = second 24 hours.

Figuur 3. Dagelijkse variatie in het aantal volwassen Zeekoeten dat aanwezig was op een steekproefplot op Hornøya, Noord-Noorwegen, 1980 en 1981. X-as geeft Noorse zomertijd weer (GMT + 2 uur). De hoofdbroedfase en de vroege kuikenfase vallenin juni. Doorgetrokken lijn = eerste 24 uur, onderbroken lijn = tweede 24 uur.

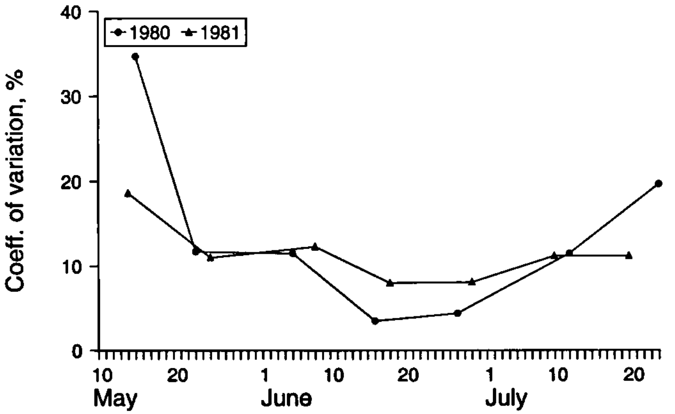


Figure 4. Seasonal variation in the coefficient of variation of the means of the diurnal counts (Fig. 3) of Common Guillemots attending sample plots at Hornøya, North Norway, 1980 and 1981.

Figuur 4. Variatie in de loop van het seizoen in de variatiecoëffiënt van de gemiddelden van de dagelijkse tellingen (Fig. 3) van Zeekoeten die steekproefplots op Hornøya, Noord-Noorwegen, bezochten, 1980 en 1981.

Kittiwake Whereas total numbers of Kittiwakes on the study plot on Hornøya declined through the 1981 season (r^2 = 87.3%, $P < 0.01$), there was no evidence of such a trend on Hekkingen (r^2 = 35.6%, $P > 0.1$; Fig. 5). This pattern also prevailed when attendance only after the start of egg laying (on 20 May) was considered (r^2 = 79.0%, $P < 0.01$ r^2 = 17.6%, $P > 0.1$ respectively). In both seasons, however, numbers stabilised and became less variable when most birds were incubating.

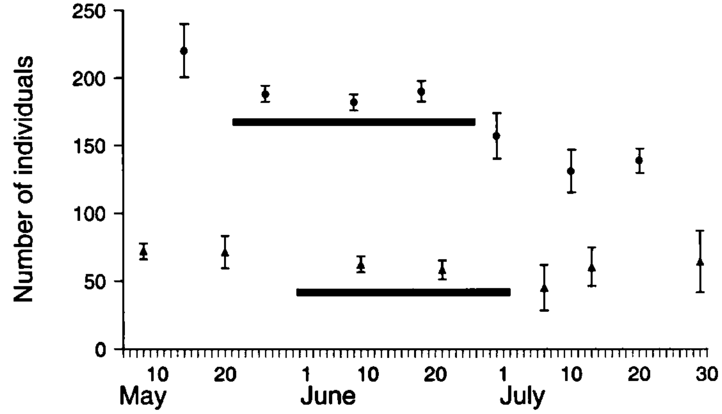


Figure 5. Seasonal variation in the mean numbers of diurnal counts ±SD (Figs. 6 & 7) of adult Kittiwakes attending sample plots at Hekkingen (triangles, 1976, n = 57 nests) and Hornøy (dots, 1981, n = c. 160 nests), North Norway. Shaded bars indicate the main incubation periods.

Figuur 5. Seizoensvariatie in het gemiddelde aantallen van dagelijkse tellingen ±SD (Figs. 6 & 7) van volwassen Drieteenmeeuwen die aanwezig waren in steekproefplots op Hekkingen (driehoekjes, 1976, n = 57 nesten) en Hornøy (rondjes, 1981, n = c. 160 nesten), Noord-Noorwegen. Grijze balken geven de hoofdbroedperiode aan.

There were considerable variations in the diurnal counts on both Hornøya and Hekkingen, often with tendencies towards minima during 'night' and maxima during the morning or afternoon (Figs. 6 and 7). On Hekkingen, there were several episodes of sudden departure from the colony (e.g. at 09:15 on 8 May, 20:50 on 6 July, 13:05 and 22:50 on 12 July, 02:20, 03:50 and 04:30 on 29 July, all times NST; Fig. 7). These were probably identical to mass flights from the colony observed late in the breeding season when all birds would suddenly adopt the pre-flight posture (Paludan 1955) and then simultaneously fly down from the cliff, circle two or three times, and return. This was sometimes repeated several times over a period of 2-3 mins before the birds finally settled on the colony. During 22.5 hrs observation on 12-14 July, such behaviour was recorded 33 times, once being repeated 11 times within 10 mins. These mass flights generally involved only birds with no chicks, but in periods of high agitation even these would leave their nests. However, they returned to their nests almost immediately and did not fly around as long as the failed or non-breeders.

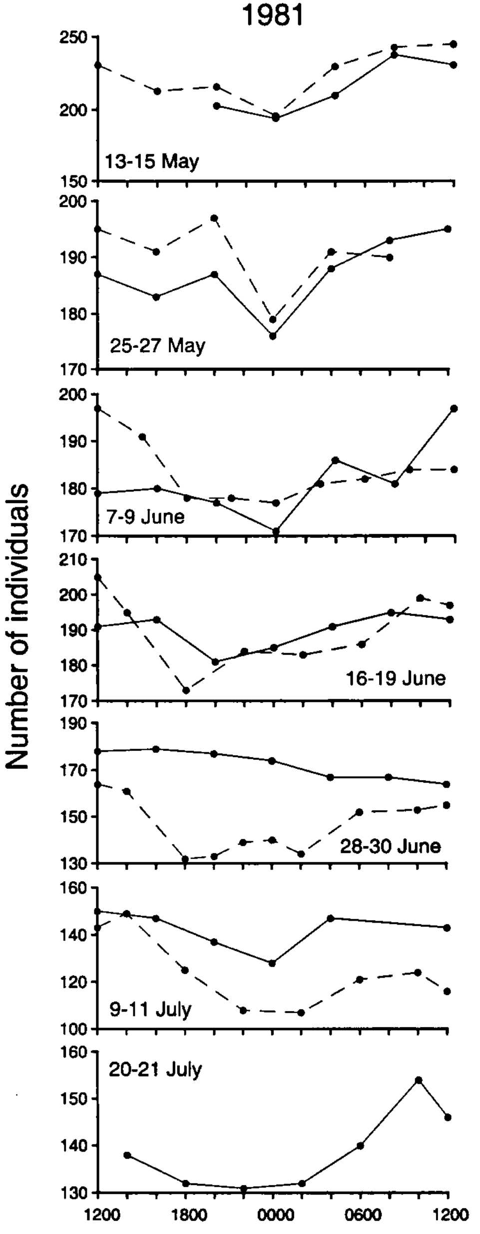
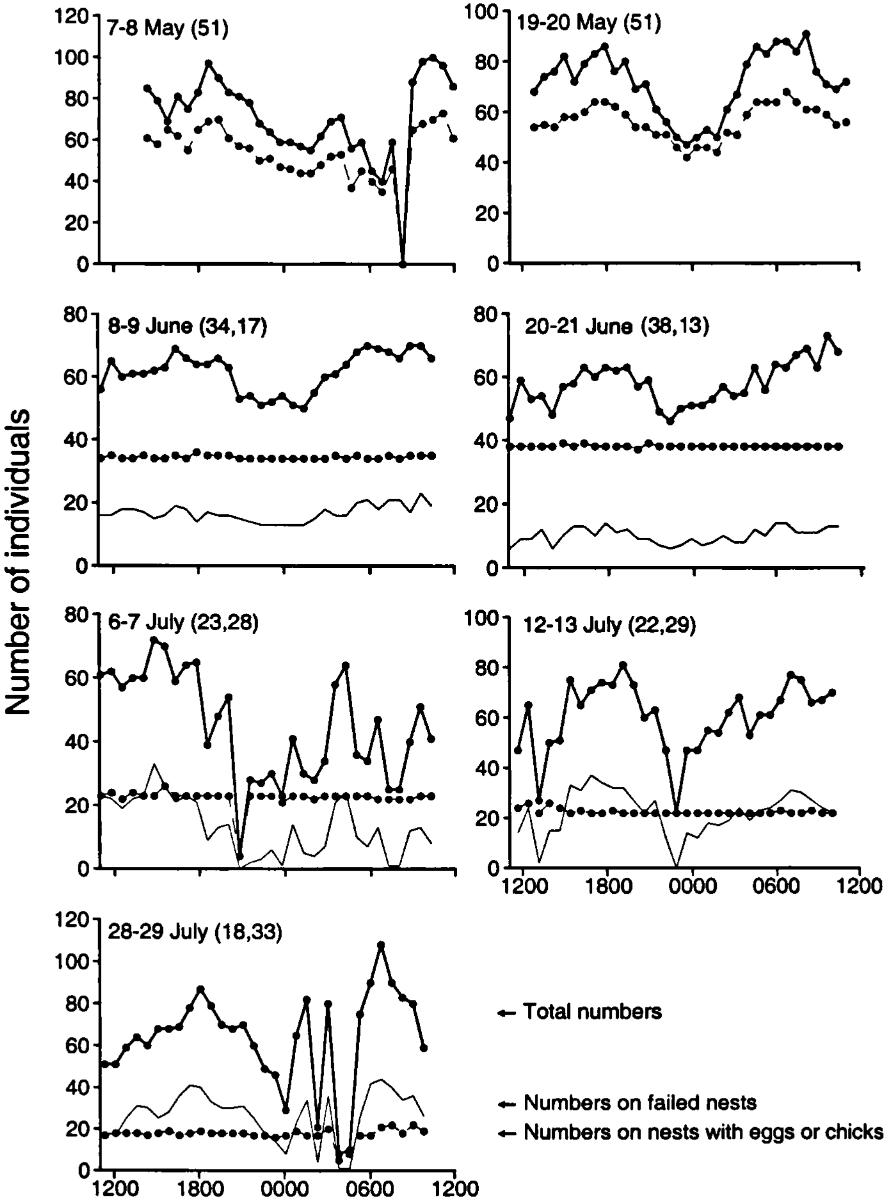


Figure 6. Diurnal variations in numbers of adult Kittiwakes attending a sample plot at Hornøya, North Norway, 1981. X-axis indicates Norwegian Summer Time (GMT+2 hr). The main incubation period falls between 25 May and 30 June Solid line = first 24 hours, dotted line = second 24 hours.

Figuur 6. Dagelijkse variatie in het aantal volwassen Drieteenmeeuwen dat aanwezig was op een steekproefplot op Hornøya, Noord-Noorwegen, 1980 en 1981. X-as geeft de Noorse zomertijd weer (GMT + 2 uur). De hoofdbroedperiode liep van 25 mei t/m 30 juni. Ononderbroken lijn = eerste 24 uur, onderbroken lijn = tweede 24 uur.


Number of individuals
7-8 May (51)
19-20 May (51)
8-9 June (34,17)
20-21 June (38,13)
6-7 July (23,28)
12-13 July (22,29)
28-29 July (18,33)
1200
1800
0000
0600
1200
← Total numbers
← Numbers on failed nests
← Numbers on nests with eggs or chicks

Opposite page. Figure 7. Diurnal variation in numbers of adult Kittiwakes attending a sample plot at Hekkingen, North Norway, 1976. Numbers in brackets indicate number of nests with eggs or chicks, number of failed nests. In May the numbers denote the number of nests that would later contain eggs. Shaded dates indicate the main incubation period.

Figuur 7. Dagelijkse variatie in aantal volwassen Drieteenmeeuwen dat aanwezig was op een steekproefplot op Hornøya, Noord-Noorwegen, 1976. Getallen tussen haakjes geven het aantal nesten met eieren of jongen en het aantal mislukte nesten weer. De mei-getallen geven het aantal nesten weer, waarin eieren werden gelegd. Gearceerde data geven de hoofdbroedperiode aan.

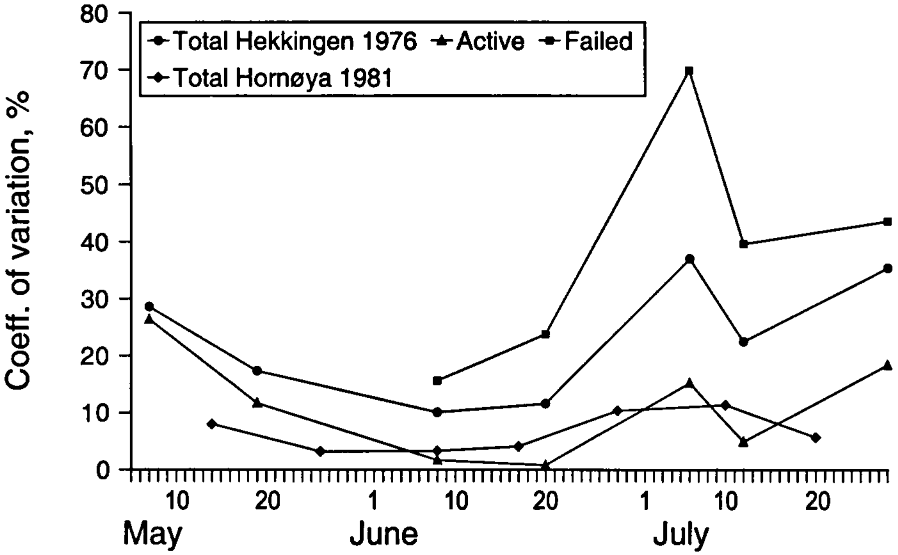


Figure 8. Seasonal variation in the coefficient of variation of the means of the diurnal counts of adult Kittiwakes attending sample plots at Hekkingen, 1976 (Fig. 7) and at Hornøya 1981 (Fig. 6), North Norway.

Figuur 8. Variatie in de loop van het seizoen in de variatiecoëffiënt van de gemiddelden van de dagelijkse tellingen van volwassen Drieteenmeeuwen op steekproefplots op Hekkingen 1976 (Fig. 7) en op Hornøya 1981 (Fig. 6), Noord-Noorwegen.

Eggs were laid in 53 of the 57 nests in the plot on Hekkingen. Before the first eggs were laid, the total numbers of birds on the plot and the numbers attending future active nests fluctuated greatly with a minimum during the early morning (8 May) or near midnight (19-20 May; Fig. 7). Only a small proportion (8-16%) of the nests were unoccupied at any one time during the pre-laying

Table 1. Attendance by adult Kittiwakes at 51 nests with eggs or later failed nests expressed as the mean % ± SD of nests attended by 0, 1 or 2 adults at Hekkingen, North Norway 1976. n = no. of nests.
Tabel 1. Aanwezigheid vanvolwassen Drieteenmeeuwen op 51 nesten met eieren of later mislukte nesten, uitgedrukt als gemiddelde % ± SD van nesten met 0, 1 of 2 volwassen vogels op Hekkingen, Noord-Noorwegen 1976. n = aantal nesten.

	No. of adults at nests with eggs/chicks			
	0	1	2	*n*
May 7-8	16.2±17.6	62.1±14.6	21.7±13.9	51
May 19-20	7.5±4.9	74.9±7.8	17.6±9.5	51
June 8-9	0	98.7±1.6	1.3±1.6	34
June 20-21	0	99.7±0.9	0.3±0.9	38
July 6-7	3.6±14.5	95.7±14.6	0.7±2.5	23
July 12-13	0	97.6±4.4	2.4±4.4	22
July 28-29	6.3±15.6	90.4±15.9	3.3±6.7	18

	No. of adults at failed nests			
	0	1	2	*n*
June 8-9	11.3±5.9	77.6±1.2	11.1±1.1	17
June 20-21	32.5±1.4	57.0±1.3	10.6±0.9	13
July 6-7	58.1±26.8	36.3±22.3	5.6±7.1	28
July 12-13	36.9±22.3	50.9±14.5	12.3±10.8	29
July 28-29	36.1±24.2	46.9±17.0	17.1±13.3	33

period whereas 18-22% were attended by two adults (Table 1); a single bird attended the remaining nests.

During incubation in June, there was very little variation in the numbers of birds attending nests with eggs, and the fluctuations in total numbers were smaller than earlier in the season (Fig. 8). During this period, more than 98% of nests with eggs were attended by single adults, while 11-32% of the failed nests were unoccupied and 10-11% occupied by two adults (Table 1).

Once chicks had hatched in July, variation in total numbers increased much as a consequence of increased variance in the attendance at failed nests (Fig. 8); attendance at nests with chicks remained stable with over 93% being attended by single or two birds at any one time. As during the incubation period, more than 90% were attended by single birds. In contrast, failed breeders abandoned their nests for up to 58% of the time (Table 1).

DISCUSSION

Common Guillemot Seasonal trends in numbers of Common Guillemots on Hornøya were similar to those reported from more southerly regions and for

Brünnich's Guillemots on Prince Leopold Island in the Canadian Arctic (Gaston & Nettleship 1981). Many studies report relatively stable or a gentle increase in numbers during incubation and chick-rearing, after which numbers fall steadily as chicks and adults leave the colony. In the Canadian Arctic, Brünnich's Guillemot numbers peaked ±14 days within the median hatching date, a little earlier than for Common Guillemots in this study, which Gaston and Nettleship (1981) attributed to off-duty site-holding Common Guillemots spending longer time on their sites than off-duty Brünnich's Guillemots.

On Hornøya, day-to-day numbers were most stable when birds were incubating and before the first chicks hatched. In this period, the CVs of the mean number of birds on the plot were 7.1% and 6.5% in 1980 and 1981 respectively, slightly lower than the 12% recorded by Harris *et al.* (1986) during the chick-rearing period on a Scottish colony, and the 17.6% and 12.4% during the incubation and chick-rearing periods respectively on a Welsh colony (Lloyd 1975). However, it is similar to the 5.2-9.4% found during the chick-rearing period of Brünnich's Guillemots on Prince Leopold Island (Gaston & Nettleship 1981). The subsequent slow rise in numbers during the chick-rearing period on Hornøya may have been due to the arrival of non-breeding adults and/or an increase in the proportion of time off-duty birds spent at the colony when rearing chicks (Lloyd 1972; Slater 1980).

While weather conditions may influence attendance patterns, especially early in the breeding period (Corkhill 1970; Birkhead 1978; Slater 1980), the poor association between attendance by birds on Hornøya and wind speed later in the season accords with findings from Orkney, Scotland and Newfoundland (Slater 1980; Harris *et al.* 1983; Piatt & McLagan 1987). The weather on Hornøya was, however, relatively calm in the two seasons of the study, with winds averaging 7-8 knots (*c.* 12-14 kph, Beaufort force 3) and never exceeding 18 knots (*c.* 31 kph, Beaufort force 5). Sea state never exceeded 4 (= 2.5 m waves) on a scale of 0-9 (9 = >14 m waves). These were well short of the 'extreme' conditions Gaston and Nettleship (1981) concluded were necessary to influence attendance patterns of Brünnich's Guillemots.

Although diurnal patterns of guillemot attendance at the colony vary from locality to locality many studies, including this one, indicate that fewest birds are present at night or early morning, and most are present during the morning and afternoon (Birkhead 1978; Slater 1980; Gaston & Nettleship 1981; Tschanz (1983); Hatch & Hatch 1989). One exception to this is a small plot of 21 pairs of Common Guillemots in Alaska where numbers tended to peak at midnight (Watanuki *et al.* 1992). The CVs of the means of the diurnal counts on Hornøya were at a minimum in the second half of June (Fig. 4), i.e. early in the chick-rearing period. This accords with data presented by Gaston and Nettleship (1981) for Brünnich's Guillemots on Prince Leopold Island.

Verspoor *et al.* (1987) and Uttley *et al.* (1994) have shown that food availability can influence Guillemot attendance patterns, low food availability causing adults to spend less time resting in the colony. That Guillemot attendance patterns on Hornøya were very similar in 1980 and 1981 suggests that there was little change in feeding conditions around the island, agreeing with Furness and Barrett's (1985) observation of a superabundance of food in the early 1980s.

Despite a regime of continuous daylight, Guillemots in arctic colonies maintain a diurnal and seasonal rhythm of attendance that is very similar to that found at more southerly latitudes. Furthermore, the best time to monitor the Common Guillemot population on Hornøya was towards the end of the incubation period and early in the chick-rearing period when numbers were most stable both from day to day and from hour to hour, again in accordance with recommendations made for colonies further south (Walsh *et al.* 1995).

Kittiwake The seasonal pattern of nest attendance by Kittiwakes between egg-laying and late in the chick-rearing period seems to vary from colony to colony, and also from year to year. This study recorded a decline in numbers of adults on a plot on Hornøya, while numbers on Hekkingen remained stable (Fig. 5). In a four year study of a colony in Alaska, Hatch and Hatch (1988) recorded one season with an increase in numbers, two with a decrease and one with no change over this period. In Britain, Coulson and White (1956) reported a large influx of prospecting birds that augmented numbers during incubation and chick-rearing.

The large variation in numbers attending the colony before incubation starts, the stabilisation of numbers during incubation and early chick-rearing, and the subsequent increase again in birds attending as chicks near fledging and after fledging starts are characteristic features of all studies. The variability early in the season may be attributed to birds prospecting for, establishing and defending nests, as well as pair formation. Later in the season, the arrival of non-breeding adults occupying nests and sites coincides with birds at sites leaving their nests unguarded or occupying them in pairs more often than birds at nests with eggs or chicks. This, along with reduced attendance of breeding adults during the late chick-rearing period (Coulson 1959; Hodges 1977; Roberts & Hatch 1993; Cadiou *et al.* 1994; Harris & Wanless 1997), results in additional variability in attendance. This was obvious on Hekkingen where the variation in numbers of adults attending failed nests was much higher, and where many more sites were either left unattended or were occupied by two adults, than during the incubation period (Table 1). Furthermore, as also found by Anderson *et al.* (1974) and Hodges (1977), the variation in numbers of birds on failed or empty nests was much greater than on nests with eggs or chicks, a fact that Hodges (1977) attributed to a greater degree of activity co-ordination among breeding birds.

Several studies have shown that nest attendance declines as chicks become older and/or as food availability decreases (Barrett & Runde 1980; Wanless & Harris 1989; Roberts & Hatch 1993; but see Regehr & Montevecchi 1997 for evidence of the converse). The fact that very few nests with chicks on Hekkingen were left unattended accords with Barrett and Runde's (1980) suggestion that feeding conditions in the region were good in the early 1970s. At Hekkingen, however, there was evidence of a third factor, disturbance by mink *Mustela vison,* and this probably affected nest attendance both directly and indirectly. Whereas the indirect effect of increasing the numbers of failed nests through predation of chicks was clearly evident (Barrett & Runde 1980), the sudden, short-term departures from the colony of birds attending failed nests and/or nests with young suggests a more direct response. This was observed in the plot several times late in the breeding season. Although not actually seen, the presence of mink near the colony was the likely cause of this behaviour. Similar behaviour has been observed several times in larger colonies in the region and has coincided with the presence of predators such as Peregrine Falcons *Falco peregrinus* and Gyr Falcons *F. rusticolus* (pers. obs.).

While Guillemots showed a clear diurnal pattern in colony attendance, patterns of total numbers of Kittiwakes at Hornøya and Hekkingen were more diffuse, as was also shown during a one-day count of Kittiwakes in Arctic Greenland (80° N; Falk & Møller 1997). Although attendance patterns varied little, there were nevertheless detectable lulls in activity and calling between *c.* 01:00 and 02:00 NST (pers. obs.), as also reported by Anderson *et al.* (1974). This near lack of diurnal attendance patterns in the Arctic during periods of continuous daylight agrees with Cullen's (1954) findings from Jan Mayen (71° N), Anderson *et al.'s* (1974) observations at Spitsbergen (79° N) and personal and Furness and Barrett's (1985) observations of chick-feeding activity through 24 hours with no evidence of a break at 'night'. Later in the season, however, or throughout the season at more southerly colonies, diurnal variation is more marked with low attendance, longer absences from the nest, no chick-feeding and rare calling activity during the hours of darkness (Wooller 1979; Richardson *et al.* 1981; Galbraith 1983; Wanless & Harris 1992; Coulson & Johnson 1993; Roberts & Hatch 1993).

Thus, while the diurnal attendance patterns of Common Guillemots seem to be similar throughout their breeding range, those of Kittiwakes become less marked as daylight hours increase with latitude. Despite this, it seems that numbers of adult Kittiwakes attending arctic colonies vary least from day to day and from hour to hour during the incubation period, again corroborating the recommendation that Kittiwake populations be monitored during the latter half of the incubation period in colonies further south (Walsh *et al.* 1995).

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PATRONEN IN DE AANWEZIGHEID VAN ZEEKOETEN *URIA AALGE* EN DRIETEENMEEUWEN *RISSA TRIDACTYLA* OP KOLONIES IN GEBIEDEN MET CONTINU DAGLICHT

In 1980 en 1981 is de aanwezigheid van volwassen Zeekoeten Uria aalge *en Drieteenmeeuwen* Rissa tridactyla *in Noord-Noorwegen onderzocht in broedkolonies die 's zomers blootstaan aan voortdurend daglicht. Dit om de beste inventarisatietijd voor beide soorten vast te stellen. De aanwezigheid van volwassen Zeekoeten vertoonde voor de eieren waren uitgekomen geen trend. Daarna namen de aantallen toe tot de eerste jongen "uitvlogen". Vervolgens nam het aantal aanwezige vogels gestaag af (Fig. 2). De aanwezigheid verschilde in de loop van de dag sterk. Het patroon was vergelijkbaar met meer zuidelijk gelegen kolonies waar het 's nachts donker wordt. 's Nachts en in de vroege ochtend waren de aantallen het laagst, het hoogst in de loop van de ochtend en 's middags (Fig. 3). Het seizoenspatroon van de Drieteenmeeuw verschilde enigszins tussen de kolonies. De aanwezige aantallen fluctueerden voor de broedfase begon, gevolgd door een stabilisatie tijdens de broedfase en vroege kuikenfase en een toename toen de jongen bijna vliegvlug of uitgevlogen waren (Fig. 5). De seizoensvariaties verschilden niet wezenlijk van meer zuidelijk gelegen broedplaatsen. De aanwezigheid in de loop van de dag was meer diffuus; 's nachts waren de aantallen over het algemeen het laagst en 's ochtend of in de middag het hoogst (Fig. 6 & 7). Verschillen in aanwezigheid gedurende de dag waren het kleinst tijdens het bebroeden van de eieren en kort na het uitkomen van de jongen. De auteur sluit zich aan bij eerder gepubliceerde suggesties om tellingen van Zeekoeten en Drieteenmeeuwen vooral in deze periode van intensieve broedzorg te concentreren.*

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