Breeding biology of the Whimbrel *Numenius phaeopus* in eastern Finnish Lapland

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Received 3 December 1991, accepted 23 November 1992

Introduction

The breeding biology of the Whimbrel *Numenius phaeopus* is not yet intimately known (see Glutz von Blotzheim et al. 1977, Kumari 1977, Cramp & Simmons 1983, Grant 1991a, 1991b, and see Skeel 1983 for data on the nearctic race *N. phaeopus hudsonicus*). The Whimbrel is one of the most characteristic waders in the Värriötunturi fell area (67°44′N, 29°37′E), together with the Dotterel *Charadrius morinellus* and the Golden Plover *Pluvialis apricaria*. The breeding biology of the latter two species is characterized by a low nest mortality (Pulliainen & Saari 1992, 1993a) and in the case of the Dotterel by a small egg size for this species (Pulliainen & Saari 1993b), which agrees with the general geographical trend found in waders (see Väisänen 1977). We are therefore interested in determining whether the breeding biology of the Whimbrel resembles that of the two other species. The main emphasis in this report is on the breeding density, clutch size, egg size and breeding success of the Whimbrel, but other relevant aspects of the breeding biology are also briefly described.

Material and methods

Data on the breeding biology of the Whimbrel were collected by the staff of the Värriö Subarctic Research Station in 1968–1990, most intensively in 1968–1974, when much time was devoted to Dotterel research (see Pulliainen & Saari 1992). The main study area and the main study methods have been described by Pulliainen & Peiponen (1981) and Pulliainen & Saari (1989, 1993a). A total of 32 nests were found, including a few outside the main area. Only limited data are available on some of the nests, but others have been observed quite intensively and thus some information can be provided on behaviour as well.

Whimbrel densities were obtained in the censuses of the bird fauna in eastern Lapland by the line transect method in 1985–1987 (943 km censused in 17 different habitats, E. Pulliainen & O. Hildén, unpublished). The method used is described in detail by Koskimies & Väisänen (1991). The median length of the 70 individual transect lines was 5 km and all, except three, were censused in all three study years by a few

experienced ornithologists. The transects were usually drawn as straight lines through uniform habitats (at least the main belt, i.e. within 25 m of the observer), and the transects were well dispersed over several bird atlas squares (10×10 km). Thus the chances of recording the same pairs on different transects are minimal.

Results

Arrival and departure: The mean date of the first arrival in the area was 14 May (SD = 3.1 days, range 9–20 May, n = 18). In spring the Whimbrels are usually seen in flocks of 1–3 birds and probably at least some of the birds have already paired up before arrival. No big spring flocks have been recorded; at most 10 birds have been seen on the northernmost summit of the Värriötunturi fells (Värriö I). The latest probable spring migrants have been recorded on 10 June. After their arrival, the Whimbrels feed on berries (*Empetrum nigrum* coll., *Arctostaphylos alpina*) of the previous year's crop.

Flocks of 5–35 birds have been observed from late June to early July, and are often seen flying in southerly directions. These flocks probably consist of non-breeders, failed breeders and females leaving their broods a few days after hatching. No large flocks have been recorded after the first few days of July. In August very few Whimbrels have been seen, the last one on 22 August. Thus we do not know how and when the males and young depart, as no flocking has been recorded around fledging time in late July – early August it may be that the survival of the chicks is low, that the birds leave individually or in small flocks, or that they gather somewhere outside the study area.

Breeding densities: The highest densities were found in clear-cut areas and ploughed clear-cut areas (2.3 and 7.6 pairs/km^2, respectively), while the densities in natural open habitats, on alpine heaths and mires, were 1.1–1.7 pairs/km^2 (Table 1). In addition, Whimbrels were recorded breeding in seedling stands of different ages, mixed forests and the treeless strips of strip-cut forests. The population in the Värriötunturi fell area apparently decreased during the period examined, as 18 nests were found at or near Värriötunturi in 1968–1975 (annual mean 2.3 ± 1.3, SD, n = 8, range 1–4), 7 in 1976–1980 (mean 1.4 ± 1.1, n = 5, range 0–3) and only one in 1981–1990 (mean 0.1 ± 0.3, n = 10, range 0–1). The last nest record on the Värriötunturi fell itself was made in 1975, since then all the nest records in the main area come from either the smaller hills next to Värriötunturi or a nearby mire. We believe that this change of habitat is real, since no appreciable changes occurred in the search for nests on the fells.

No systematic counts of the breeding population of the approximately 15 km long Värriötunturi fell chain and its surroundings are available, but 10 pairs were counted on the fell itself on daily visits to different parts of the study area from late May to early August during the summer of 1970, three pairs on the nearby smaller hills, two pairs on nearby mires, and two pairs on the neighbouring Sautunturi fell. The breeding pairs seem to be well spaced, as usually only one pair (exceptionally two) was breeding at any one time on the 58 ha alpine heath of Värriö I. On the other summits the density appeared similar, corresponding well to the line transect densities (see Table 1).

Nests: Of the 32 nests found, 37% were on alpine heaths, 25% in mountain birch forest, 22% on dry heaths (mostly near the Lokka reservoir) and

Table 1. Whimbrel densities in different habitats in eastern Finnish Lapland. Only the main belt observations (within 25 m of the observer) included (E. Pulliainen & O. Hildén, unpublished). The size of the area surveyed in each habitat (km^2), the number of pairs recorded in these and the density (pairs/km^2) are given.

Habitat	Area	N	Density
Ploughed clear-cut	3.15	24	7.6
Clear-cut	3.00	7	2.3
Pine-peat bog	2.86	5	1.7
Alpine heath	3.00	4	1.3
Seedling stand, 50 yrs	3.22	4	1.2
Flark fen	2.67	3	1.1
Seedling stand, 20–30 yrs	4.08	3	0.7
Mixed forest	2.95	1	0.3
Strip-cut forest, treeless strip	3.21	1	0 3

16% on mires. Of 28 completed clutches, 86% comprised 4 eggs whilst the remainder comprised 3 eggs, giving a mean clutch size of 3.86 ± 0.36. The clutches were considered completed when the clutch size did not change between two consecutive visits about one day apart (in theory this interpretation may be wrong, but the questionable cases are only three c/4).

Assuming 5 days for laying 4 eggs and an incubation period of 26 days, laying commenced on average on 29 May ± 5 days (range 22 May – 7 June, n = 21) (according to M.C. Grant, pers. comm., the mean period between successive eggs is 1.25 days and the mean incubation period 26 days for Whimbrel in Shetland; in the only case recorded at Värriö, the interval between the 3rd and 4th egg was about two days).

Five nests were destroyed during the incubation period. These were identified by the remains of egg-shells or disappearance of eggs before the time of hatching. One nest was probably raided by a red fox *Vulpes vulpes* (eggs eaten in the nest), one was deserted and the rest were taken by unknown predators. Whimbrels were observed chasing Ravens *Corvus corax* in the air and a stoat *Mustela erminea* was seen at one nest, but was unable to attack it. Unfavourable weather may cause nest losses, but the Whimbrel seems to be quite well adapted to this; in the midst of a heavy summer snowfall in 1977 (see Pulliainen 1978) the incubating bird was almost totally covered by snow, but in spite of this all the eggs eventually hatched.

Of 18 successful clutches, 61% comprised 4 chicks and the remainder consisted of 3 chicks, giving a mean brood size of 3.61 ± 0.50 (the overall hatching success was 2.83 ± 1.59, n = 23, including the unsuccessful nests). Calculated by the Mayfield (1975) method, 64% of the nests survived the laying and incubation periods (Table 2; assuming equivalent daily survival rates during both these periods). Partial losses of eggs amounted to 6%, i.e. 4 out of 69. One egg was broken, one infertile and two young died at hatching. In addition a few chicks died soon after leaving the nest, but the sample sizes are too small for a meaningful analysis. Of all the eggs laid 60% hatched, according to the Mayfield estimate of nest survival. There seemed to be some differences in breeding success between the habitats (Table 2), all the nests surviving on alpine heaths, but only 22% on dry heaths with scattered pines (two nests destroyed by predators near the Lokka reservoir). The difference in breeding success was significant only when the alpine heath was compared with the other habitats combined ($t = 2.31$, $df = 27$, two-tailed $P < 0.05$; calculated according to Mayfield 1975, Johnson 1979, Tiainen 1988). The difference between the fells (alpine heath and mountain birch forest) and lowland habitats (mires and dry heath) was almost significant ($t = 1.74$, $df = 27$, two-tailed $P < 0.10$).

The incubation period was once 23 days (4th egg laid on 31 May, last chick hatched on 23 June), once no more than 25 days, and once at least 24 and 26 days. Often the hatching of the chicks was spread over two days, but occurred within 24 h. The longest hatching period was probably about 50 h (27 June 23.00 hrs 3 eggs 1 young – 30 June ca. 01.00 hrs 1 young). The hatching date was recorded exactly in 20 cases.

Table 2. Survival of Whimbrel nests during incubation in different habitats in eastern Finnish Lapland (Mayfield's 1975 method). The overall nest survival was calculated by assuming equivalent survival rates during the incubation (26 days) and laying (4 days) periods. SD was calculated according to Johnson (1979).

Habitat	Nests observed	Nest losses	Nest days	Survival of nests	
				Daily rate ± SD	Overall nest survival
Alpine heath	10	0	119	1.000 ± 0	1.000
Mountain birch forest	8	1	112	0.991 ± 0.0089	0.762
Mire	5	2	70	0.971 ± 0.0199	0.414
Dry heath	6	2	40	0.950 ± 0.0345	0.215
Total	29	5	341	0.985 ± 0.0065	0.635

If hatching was spread over two or more days, the day when the last chick hatched was considered. The mean hatching date was 28 June ± 5 days (range from 20 June to 7 July).

Behaviour at the nest: The incubation rhythm was studied at one nest for nearly two days in 1969, and the probable female of this pair was ringed (wing 247 mm, mass 380 g; Table 3) The nest was almost continuously occupied, the unringed bird being present for 1743 min. (63.5%) and the ringed bird for 950 min. (34.6%). The nest was unattended for 52 min. (1.9%). Once the absence lasted only 10 sec.; otherwise it was 1–14 min. (mean 5.8 ± 4.6 min., n = 9). There were two other nests in which the presumed male (the smaller one of the pair) incubated somewhat more than the presumed female (61 ± 10 and 56 ± 16%, n = 18 and 9, respectively).

Eggs and young: A total of 46 eggs (12 clutches) were measured. The average egg size (length × breadth) was 56.28 ± 2.10 × 39.93 ± 1.32 mm, the minima being 51.7 × 39.8 and 52.1 × 37.4 mm and the maxima 60.1 × 39.2 and 58.0 × 42.15 mm. The clutch averages were in the range 53.58–57.99 × 38.24–42.07. Egg volume was calculated according to the formula of Grant (1991a): $V = 0.445\ LB^2 + 0.347$ (V = egg volume in cm^3, L = egg length in cm, B = egg breadth in cm). The mean was 40.39±3.05 cm^3 (n = 12 clutches), the range 35.21–45.46 and the 99% confidence limits 38.12–42.66. The egg volume was the smallest recorded for this species so far (Table 4), and did not appear to change during the breeding season. The annual figures ranged between 37.54 (1969) and 43.79 (1971), but the sample size was small.

In nine nests at least one chick was weighed soon after hatching (including one chick hatch-

Table 3. Incubation rhythm of a pair of Whimbrels at Värriö in 1969. The sexes are identified tentatively, assuming the smaller bird to be the male.

From	19 June 19.45 hrs		to	20 June 18.00 hrs
	♂:	19.45–01.22		♀: 01.23-06.10
		06.24–11.38		11.40–11.41
				11.45–16.20
		16.28–		
From	21 June 19.00 hrs		to	22 June 18.30 hrs
	♂:	19.00–00.52		♀: 00.52–04.32
		04.33–15.20		
		15.29–15.30		15.40–18.18
				18.21–

Table 4. Egg volume ($V = 0.445\ LB^2 + 0.347$, Grant 1991a) in different parts of the range of the Whimbrel. Calculated from the data presented in Skeel (1976), Glutz von Blotzheim et al. (1977), Grant (1991a), and this study: N = individual eggs, except for Shetland, where N is the number of clutches.

	Egg volume (cm^3)	N	Reference
Shetland	48.03	119	Grant 1991a
Iceland	47.19	83	Glutz von Blotzheim et al. 1977
Scotland-Faeroes	45.43	100	Glutz von Blotzheim et al. 1977
Sweden	44.27	189	Glutz von Blotzheim et al. 1977
Finland	42.26	125	Glutz von Blotzheim et al. 1977
White Sea	41.83	40	Glutz von Blotzheim et al. 1977
Norway	41.72	74	Glutz von Blotzheim et al. 1977
Canada	41.72	223	Skeel 1976
Värriötunturi	40.28	46	This study

ing from an egg transferred to another nest). The mean chick mass was 30.96 ± 3.06 g (range 24.5–35.0 g, n = 29). Seven adult birds (not all sexed) caught at the nest weighed 362 ± 24 g, i.e. the hatching mass was 8.6% of that of an adult. The brood means ranged between 25.75 and 34.33 g, and the annual figures between 28.16 (1969) and 33.25 g (1973).

Discussion

The Whimbrel densities were appreciably higher on clear-cuts than in natural open habitats (2.3–7.6 vs. 1.1–1.7 pairs/km^2). It thus seems that the Whimbrel has not suffered from forest management in northern Finland. Ploughed clear-cut areas may be especially advantageous because of the visual protection these offer for the incubating birds. Despite the fact that the extensive clear-cut areas in Lapland have provided new breeding grounds for the Whimbrel, the population seems to be declining, as the population indices for northern Finland for 1941–1949, 1952–1963 and 1973–1977 were 190, 140 and 100, respectively (Väisänen 1983). This means that the population has been halved since the 1940s. The densities in northern Finland are much lower than those in Shetland where Grant (1991b) recorded densities between 11 and 21 pairs/km^2 and the population is increasing. Hunting has been suggested as a possible factor in the decline of Fenno-Scandian Curlews *Numenius arquata*, and it may also be responsible for the decrease of the Whimbrels, although hunting probably has a much smaller impact on this species (for details, see Meltofte 1986).

Another possible reason for the decline on Värriötunturi itself is that a pair of Gyrfalcons *Falco rusticolus* have bred nearby since 1973, although not annually. The diet of the Gyrfalcon was studied during six breeding seasons between 1973 and 1991 (E. Pulliainen & K. Huhtala, unpublished). Of 506 prey items, the most important were Willow Grouse *Lagopus lagopus* (51.4%), Whimbrel (12.1%) and Golden Plover (5.9%). Of the 66 Whimbrels eaten, only two were identified as juveniles. The behaviour of the Whimbrel is conspicuous and aerial and perhaps because of this it easily falls prey to the Gyrfalcon.

The egg volume in the Värriötunturi population was the smallest recorded so far. The highest figures are those obtained in the Atlantic populations from Scotland to Iceland, where the means were higher than our maximum. Statistical testing was generally impossible, however, since only population means were available. Only the recent material of Grant (1991a) from Shetland makes testing possible, and here the egg volume (clutch means) varied annually between 47.65 (S.E. = 0.47, n = 34) and 48.55 cm^3 (S.E. = 0.43, n = 45), the difference between the smallest annual mean and the Värriö clutch mean being very highly significant ($t = 12.71$, $df = 44$, $P < 0.001$).

Of the waders studied so far in Europe, the Whimbrel shows the greatest geographical differences in egg size: the smallest population mean is 83.9% of the largest (see Table 4). In the other species studied, the range was between 84.5 and 93.0% (Väisänen 1977, Pulliainen & Saari 1993b). For the Dotterel this figure was 89.0%, the smallest egg size being recorded in the northeasternmost populations (Värriö and Waigatsch; Pulliainen & Saari 1993b). The Whimbrel thus conforms to the trend documented earlier (see Väisänen 1977). The small egg size at Värriö is probably mainly a consequence of the small mean body mass of adult birds. This was only 85.0% of those weighed in Shetland (mean for males and females combined 426 g, M.C. Grant, pers. comm.), although the harsh environment may also play a role.

The handbooks (e.g. Glutz von Blotzheim et al. 1977, Cramp & Simmons 1983) give an incubation period of 27–28 days, and reports of 24 days are not considered reliable. However, this result is based on data from only three nests in the Faeroes and Iceland. The recent data from Shetland indicate a somewhat shorter incubation period: 26.02 ± 0.17 (S.E., n = 23, range 25–28) days (M.C. Grant, pers. comm.). The incubation period in the present material was once only 23 days, and Skeel (1983) reports an average of 24 days in Canada. Thus it is possible that the incubation period is longer in the Atlantic populations,

where the egg volume is largest and the birds are biggest (have longer wings, see Cramp & Simmons 1983). The nearctic race *hudsonicus* is generally somewhat smaller than the nominate *phaeopus*, but the northeasternmost populations of *phaeopus* have wing lengths similar to those of *hudsonicus* (see Cramp & Simmons 1983). In fact, the birds captured at the nest at Värriö were lighter (mean mass 362 g) than those in Canada (mean of all birds weighed 380 g; Skeel 1982). As the volume of the individual eggs at Värriö is only 83.9% of those in Shetland (see Table 4), a shorter incubation period is possible, but more data are needed to confirm this. The chicks hatched at Värriö weighed only 77.7% of those in Shetland (calculated from Grant 1991a), further emphasizing the differences.

The overall daily survival rate during incubation at Värriö was 0.985. With a laying period of 4 days, an incubation period of 26 days and hatching success of 94%, this means that 60% of the eggs hatched. The corresponding value for Shetland was 74% (Grant 1991b). The nearctic race *hudsonicus* had an overall daily survival rate of 0.986 and 71% nest survival with a 24 day incubation period (67% including a 4-day laying period; calculated from Skeel 1983). As in the present area, there were differences in the survival rates of nests in different habitats. Here no nest losses were recorded on alpine heaths and only one nest was lost in the mountain birch forest (the nest was deserted, but it is not known whether this was because of disturbance). In lowland habitats several nests suffered predation, but owing to the small sample sizes the differences were seldom significant. In Canada the nest success was 86% in a hummock-bog habitat and 54% in both a sedge-meadow and a heath-tundra habitat. The losses were mainly due to predators (Skeel 1983). Few Dotterel and no Golden Plover nests were raided on the Värriötunturi fell (see Pulliainen & Saari 1992, 1993a), which indicates that the predation pressure on nests is low in the alpine environment at Värriö.

Acknowledgements. Murray C. Grant, Hannu Pietiäinen, Paavo S. Tunkkari and Risto A. Väisänen read the manuscript and made many suggestions for its improvement, which are gratefully acknowledged. This paper constitutes Report No. 205 from the Värriö Subarctic Research Station, University of Helsinki.

Selostus: **Pikkukuovin pesimäbiologiasta Itä-Lapissa**

Vuosina 1968–1990 löydettiin Itä-Lapissa, etupäässä Värriötunturin maastossa, 32 pikkukuovin pesää. Tutkimusalueellemme pikkukuovit saapuivat keskimäärin 14.5. ja muninta alkoi 29.5. (vaihteluväli 22.5.–7.6.). Pesyekoko oli 3.86 ± 0.36 (n = 28). Pesistä 64% säilyi muninta- ja haudonta-ajan yli (Mayfieldin menetelmä). Onnistuneissa pesinnöissä kuoriutui 3.61 ± 0.50 (n = 18) poikasta. Haudonta-ajaksi saatiin kerran 23 vrk. Itä-Lapissa pikkukuovin munat olivat selvästi pienempiä kuin esim. Shetlannissa. Pieni munakoko johtunee ensisijaisesti emolintujen pienemmästä ruumiinpainosta.

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