Breeding biology of the Dotterel *Charadrius morinellus* in eastern Finnish Lapland

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Introduction

The Dotterel *Charadrius morinellus* is a bird of the arctic tundra and arctic–alpine zone. Due to its exceptional tameness and its reversed sexual roles, it has received considerable attention in recent decades (for summaries see Nethersole–Thompson 1973, Glutz von Blotzheim et al. 1975, Cramp & Simmons 1983, and for recent papers Kålås & Byrkjedal 1984a, 1984b, Byrkjedal & Kålås 1985, Kålås 1986, 1988, Kålås & Løfaldli 1987, Byrkjedal 1987, 1989a, 1989b and Watson 1989). Even so, since it is a bird of the remote fells, the data on its breeding biology are still somewhat fragmentary.

Dotterels were studied at Värriö Subarctic Research Station (67°44'N, 29°37'E) in 1968-90. The field research was most intensive in 1968-74, but the northernmost summit of the Värriötunturi chain has also been visited regularly since then. So far only two preliminary papers on the Dotterel have appeared (Pulliainen 1970, 1971). We present here some basic data on its breeding biology.

Material and methods

The material consists of 119 commenced clutches (111 at Värriötunturi and eight on other fells in eastern Lapland), and 58 additional broods observed on the Värriötunturi fells in 1968-76. The annual number of nests and broods found on the Värriötunturi fells ranged between zero (1982, 1989, 1990) and 29 (1971). The main area studied, the northernmost hill of the Värriötunturi chain (Värriö I), has been described by Pulliainen (1970). The treeless tundra summit (*regio alpina*) is 58 ha in area and is surrounded by a well-defined mountain birch zone (*regio subalpina*). The other hills of the fell chain are similar in appearance.

Most of the nests found in 1968–74 were checked systematically until the chicks hatched. Some were observed continuously from a nearby hide, others were visited every 15 minutes and some additional nests were visited several times a day in the laying period. Thus the laying and hatching intervals were determined very accurately in most cases. Since 1974 the breeding biology of the whole local bird fauna has been studied systematically (see Pulliainen & Saari 1989), which has meant that a somewhat less intensive (but more or less constant) research effort has been devoted to the Dotterel since 1975. Extensive line transects surveyed in 1985–87 (E. Pulliainen & O. Hildén, unpublished) gave a current density estimate for the Dotterel on alpine heaths in eastern Finnish Lapland. On 17 June 1990, the number of Dotterel was checked

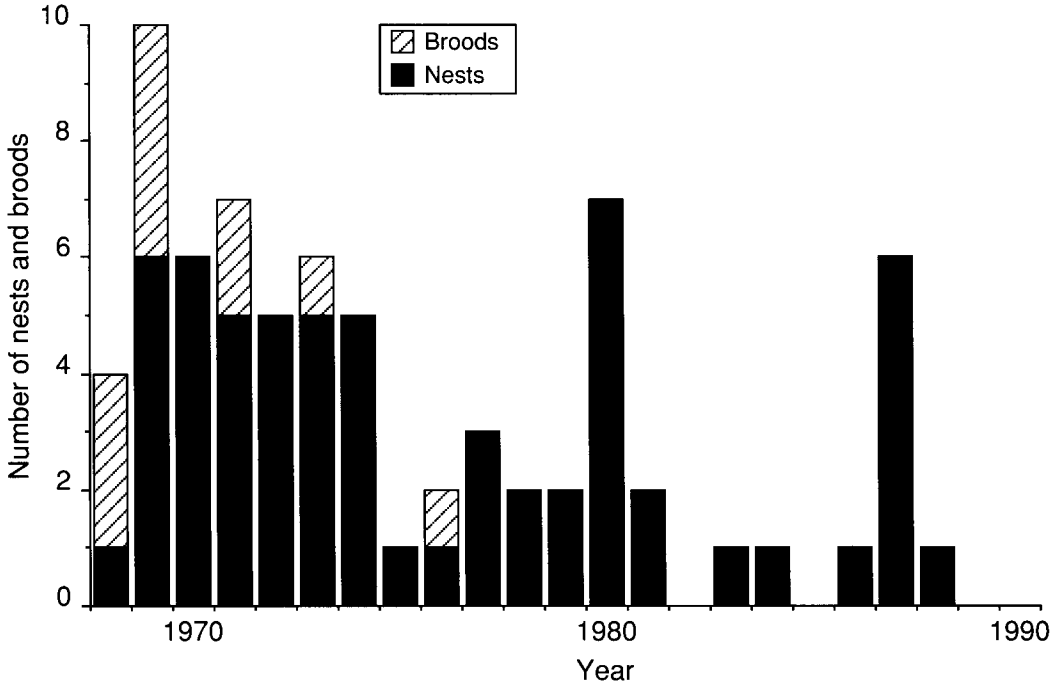

Fig. 1. Number of Dotterel nests and broods on the alpine heath (58 ha) of Värriö I in 1968–90. One nest (in 1986) is included that was not assigned to any particular hill of the Värriötunturi chain. One repeat clutch by the same pair in 1970 is omitted.

by a chain of five observers walking in lines 30 m apart through the whole Värriötunturi range.

Results

Adult numbers

Five to seven nests were found annually in good years on the well-studied northernmost hill, Värriö I (Fig. 1). If the broods are added to these figures, up to 10 breeding pairs have been recorded (i.e. 17.2 pairs/km^2). In bad years no Dotterel nests were found. It is obvious that the Dotterel has been declining in the area since the early 1970s. The reduced research effort since 1975 is expressed more in the quality of the nest records (less data collected at the nests) than in the number of records themselves on Värriö I. Only twice during the last 16 years (1975-90) has the breeding population reached the level typical of earlier years.

Summing the maximum number of nests and broods on the different hills in different years gives a total of 43 pairs, but this is of doubtful value as a population estimate. The maximum number of pairs starting to breed on Värriötunturi is probably 30–40 in peak years. The survey of the whole fell chain on 17 June 1990 revealed only three pairs and two lone birds, none of these on Värriö I.

Line transects (main belt observations only, i.e. ± 25 m from the observer) gave a density of 1.7 pairs/km^2 on alpine heath in eastern Lapland in 1985-87 (59.9 km censused, E. Pulliainen & O. Hildén, unpublished). Line transects are not a good method for counting Dotterels, however (see Kålås & Byrkjedal 1984b). In 1971 two Dotterel pairs (one nest) were recorded on a 58 ha plot on Vongoiva in the Saariselkä fell area. No Dotterels were seen on the isolated Naltiotunturi fell (Saari 1973). In addition to these fells, breeding has been confirmed on Sautunturi, Pulkkatunturi, Saapakoiva and Talkkunapää, and is probable on Korvatunturi and Nuorttitunturi.

Egg laying

Egg laying took place at any time of the day. If the day is divided into six four–hour periods, the peak in laying was recorded before noon (08-12 hrs Finnish solar time: 23 % of a total of 35 records) and the lowest activity before midnight (20–24 hrs: 9 %). Sixty per cent of the eggs were laid between midnight and noon. The laying interval between the first and second egg in the clutch was 32.8 ± 6.0 h (n = 6), that between the second and third 35.4 ± 5.7 h (n=12) and for all eggs combined 34.5 ± 5.8 h (n=18). The range of the intervals between subsequent eggs in the same clutch was 22 h 50 min–48 h 40 min.

A colour-ringed female started to lay a repeat clutch of three eggs 44 h 30 min after laying the first (abandoned) egg of the first clutch, and a second clutch with a new male was commenced 4 days 17 h 45 min after the laying of the final egg in the initial clutch (both clutches contained three eggs).

The first eggs in the clutches were laid in late May in a few cases. The earliest start was recorded in 1973, when a c/3 was found on 30 May (laying had started not later than 27 May). The latest (possibly a repeat) nest was started on 5 July. The mean date of clutch commencement was calculated for the nests where either the laying or hatching dates were known (28 days subtracted from the hatching date, assuming an incubation period of 25 days and a 3 day period from laying the first egg to the third). The mean obtained was 7 June (± 1.2 days, log–transformed data, n=80).

Clutch size

All 93 clutches judged to be completed contained three eggs (Table 1). The few clutches with one or two eggs were probably still at the laying stage and one nest contained one egg and one chick. Only one four-egg clutch was reported (Talkkunapää, Sodankylä, June 1967).

Incubation and hatching

The incubation period, recorded at 15 nests, ranged between 23 and 29 days, mean 25.7 ± 1.5 days. These figures include an incubation period of less than 25 days and two of at least 27 days.

Hatching dates were ascertained with fair accuracy in the case of 71 nests. In most cases the date is fairly exact; in six nests it was estimated from the cracks in the egg-shells and for one early clutch the date is the latest possible hatching date. The hatching dates ranged between 25 June and 1 August, median 4 July (Fig. 2).

Hatching dates were fairly uniform in the different years. The median hatching date is useful for comparing years, since possible repeat clutches do not inflate the average. Hatching started between 25 June and 12 July in 15 years; in June in eight years, and in July in seven (Table 2). The median date varied between 29 June (in 1980) and 11 July (in 1987), and in most of the cases the median fell between 1 and 7 July (only years with at least four dates included). The annual variation is remarkably small for a species nesting at these latitudes. However, the annual

Table 1. Clutch and newly hatched brood size in the Dotterel in eastern Finnish Lapland. Brood size is calculated only from completed clutches, omitting cases where failure was caused by the observers.

Clutch/brood size	Clutches		Chicks hatched in	
	completed	all	successful hatchings	all nests
0	0	0	0	9
1	0	2	0	0
2	0	3	11	11
3	93	113	58	58
4	0	1	0	0
Mean ± SD	3.00 ± 0	2.95 ± 0.31	2.84 ± 0.37	2.51 ± 0.98
N	93	119	69	78

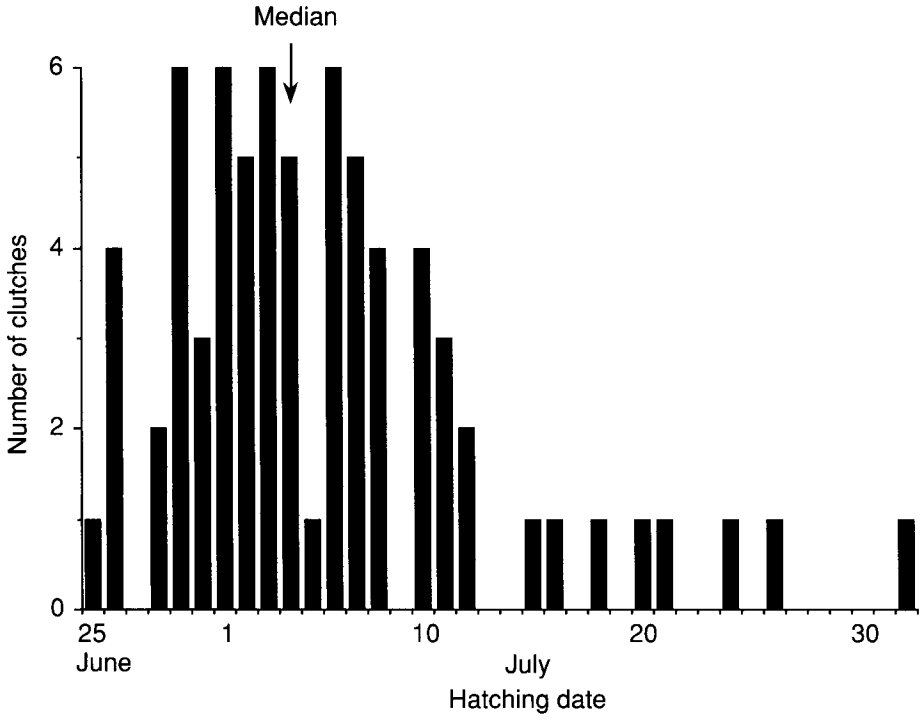

Fig. 2. Hatching dates of Dotterel clutches in eastern Finnish Lapland.

medians differed significantly in 1969–74 (omitting 1970 with only four dates; Kruskal and Wallis test, $H = 10.66$, $df = 4$, $P < 0.05$).

There were eight nests in which the time of hatching of all three eggs was observed. The interval between the first and second chick averaged 4.6 ± 3.0 h (range 1 h 03 min–10 h 39 min), and that between the second and third 7.0 ± 3.9 h (range 2 h 12 min–13 h 20 min). Hatching was completed within 11.6 ± 4.9 h (range 5 h 16 min–19 h 30 min). In seven instances the exact time when the young left the nest was recorded.

Table 2. Dotterel hatching dates (days after 31 May) in 1968-87. Years not given had no data.

1968	38
1969	36 36 36 38 38 41
1970	29 32 32 33
1971	30 31 31 32 32 33 34 34 35 36 37 38 40 41 41 45 46 56 62
1972	26 28 29 33 34 48
1973	29 29 31 31 32 54
1974	36 36 37 37 37 37 40 40
1976	42 50
1978	33 34
1979	31
1980	25 26 29 29 30 33 34
1981	30 33
1983	28
1984	26 26
1987	31 40 42 51

This was 11.0 ± 4.4 h after the last chick had hatched (range 4 h 13 min–15 h 19 min). The young left the nest between 05.12 and 15.16 hrs, i.e. in the morning or early afternoon.

Nesting success

Nine nests failed and 69 were successful (omitting cases where the final number of chicks hatched could not be determined or where losses were due to the research workers). Hatching success in the successful nests was 95%. If total failures are included in the calculations, it may be said that 84% of the eggs hatched (Table 1). According to the method of Mayfield (1975), 86% of the nests survived the incubation period (9 nests destroyed in 1459.5 nesting days, incubation period assumed to be 25 days). Multiplying this figure by the hatching success (95%), we get an overall success of 81% up to the time the young left the nest. The nests completely destroyed were either deserted (6 cases, one after being partially trampled on) or visited by predators (3 cases, twice by the Raven *Corvus corax*). These desertions were probably not caused by the observers. Twice an individual egg disappeared from the nest, one egg was broken and eight failed to hatch (often the embryo died near or at hatching). Of the ten years with at least 50 nesting days (see Mayfield 1975), all nests were successful in five, and nesting success in the others was 65–77% (Table 3).

Discussion

According to the Finnish line transect censuses, the Dotterel population declined significantly between the 1940s and the 1970s (Väisänen 1983), and the data from the present area indicate a continuing decrease. The peak years at Värriötunturi were in the late 1960s–early 1970s, and only occasionally since then have the numbers reached this level. The research effort has admittedly been somewhat smaller since the late 1970s, but this is not a sufficient explanation for the decline on Värriö I.

The population trend on Zirbitzkogel in the Austrian Alps in 1969–90 was similar to that on Värriö I (see p. 200 in Hable & Präsent 1990), which indicates that the reasons for the decline are mainly to be found in the migration phase or winter quarters. According to Hable & Präsent (1990), the Dotterel is heavily persecuted in its overwintering grounds in North Africa, where pesticides used against locust swarms pose an additional threat.

Since Värriötunturi lies at the southern limit of the Finnish range of the Dotterel, the recent amelioration of the climate (June has become gradually warmer during this century, Järvinen & Väisänen 1979) may also play some role in the decline. The

Table 3. Survival rates of Dotterel clutches in different years (Mayfield's 1975 method). Only the years with at least 50 nest days are included. The incubation period was assumed to be 25 days. Figures in brackets after "nest days" give the number of nests destroyed; N gives the number of nests under observation.

Year	Nest days		N	Survival of nests	
				Daily rate	Over the incubation period (%)
1969	108	(0)	5	1.000	100.0
1970	134	(2)	6	0.985	68.7
1971	373	(0)	23	1.000	100.0
1972	119	(0)	6	1.000	100.0
1973	145	(2)	8	0.986	70.7
1974	201	(0)	10	1.000	100.0
1976	59	(1)	4	0.983	65.2
1980	94	(1)	8	0.989	76.5
1981	50	(0)	2	1.000	100.0
1987	68.5	(1)	5	0.985	69.2

Dotterel bred in high numbers again in 1987, for instance, when the summer was exceptionally cold. Thus in cold springs the Dotterel may cut short their migration journey and settle to breed in more southerly areas than normal. Nethersole–Thompson (1973) suggests that cooling of the climate increases the breeding population in Britain, but the increase alluded to, in 1969–71, coincided closely with the first detailed work on Dotterel numbers in Britain and no statistical analysis of the relation between these and the climate has yet been carried out (Watson & Rae 1987). It is also possible, although not probable, that acid rain, mainly from the Kola Peninsula in the USSR, may play a part in the decline at Värriö.

The peak density on Värriö I, 17.2 pairs/km^2, is the highest ever recorded. Nethersole–Thompson (1973) reported 5 nests within 40 ha in Scotland, and elsewhere the maxima have been 8–10 pairs/km^2 (Cramp & Simmons 1983).

According to Glutz von Blotzheim et al. (1975), laying takes place mostly in the afternoon, but not at night. In the present area, where the sun is continuously above the horizon during the laying period for the Dotterel, laying might take place at any time of day, although in practice it occurs most often before noon.

Nethersole–Thompson (1973) reports that the egg–laying interval is usually 24–30 hours, but occasionally 48 hours or more. Our data indicate that the interval is somewhat longer, usually between 30 and 36 hours. Kålås & Byrkjedal (1984a) reported an average of 30.8 hours. Egg–laying on Värriötunturi reached its peak in the first third of June, with occasional commencement dates in May. These dates were not much later than those in the Cairngorms, Scotland, where the annual average for the first clutch commencement was 27 May (Nethersole–Thompson 1973). It appears that Dotterels tend to commence breeding as soon as possible after their arrival on the breeding grounds, thus following a pattern typical of arctic migratory birds (see Irving 1972).

The mean incubation period of 25.7 days corresponds well with the figures reported by Nethersole–Thompson (1973) and Kålås & Byrkjedal (1984a): 26.1 and 24.6 days, respectively. According to Nethersole–Thompson (1973), the chicks usually hatch out in less than 12 hours, Kålås & Byrkjedal (1984a) gave a mean of 24.3 hours, while our mean was close to 12 hours. Nesting success at Värriö was much higher than at Hardangervidda, Norway, where 47.4% of the nests were robbed (annually 22–67%, Mayfield's 1975 method, Kålås & Byrkjedal 1984a, Byrkjedal 1987). Hatching success (95%) was about the same as in Scotland (91%, Nethersole–Thompson 1973).

Two interesting points arise from the record of a female commencing laying her second clutch with a new male 4 days 17 h 45 min after laying the final egg of the first clutch. Firstly, growth of the oocytes in the Dotterel seems to require about 5 days, as in the passerine birds (see the recent review by von Haartman 1990). Secondly, the decision to produce a new clutch with another male can be made immediately after laying the final egg of the first clutch if a "free" male is available. It must be remembered in this context that it is usually the males that incubate and take care of the precocial chicks (Pulliainen 1971, Nethersole-Thompson 1973).

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Selostus: **Keräkurmitsan *Charadrius morinellus* pesinnästä Itä-Lapissa**

Keräkurmitsaa on Värriön tutkimusasemalla (67°45'N, 29°37'E) tutkittu vuosina 1968–90, perusteellisimmin 1970-luvun alkupuolella. Tiedossamme on kaikkiaan 119 pesälöytöä. Tässä kirjoituksessa keskitymme kuvailemaan joitakin keskeisiä piirteitä keräkurmitsan pesimisbiologiassa. Kaikissa täysilukuiseksi tulkituissa pesissä munamäärä oli 3 (n = 93). Yksi 4-munainen pesä on tiedossamme. Poikasia onnistuneissa pesissä kuoriutui keskimäärin 2.8 (n = 69), kaikissa pesissä keskimäärin 2.5 (n = 78). Näissä luvuissa eivät ole mukana ne pesät, joissa tuhoutumisen syynä selvästi oli häirintä, esim. pesät, jotka hylättiin heti emolinnun rengastuksen jälkeen. Mayfieldin (1975) menetelmällä laskien pesistä selvisi yli haudonta-ajan 86%. Huomioimalla kuoriutumisprosentti (95) saatiin tulokseksi, että 81% munituista munista tuotti poikasen.

Ensimmäiset munat voivat ilmestyä pesiin jo toukokuun lopussa ja myöhäisin pesye on munittu heinäkuun alussa. Valtaosassa pesiä muninta alkaa kesäkuun ensimmäisellä kolmanneksella. Munintaväli on hieman alle 1.5 vrk. Hautomisaika on vajaa 26 vrk ja poikaset kuoriutuvat keskimäärin vajaan 12 tunnin sisällä. Keskimäärin 11 tunnin kuluttua viimeisen poikasen kuoriutumisesta poikue jättää pesänsä. Pesästä lähdettiin joko aamulla tai varhain iltapäivällä, mutta ei yötä vasten.

Värriötunturin keräkurmitsakanta oli runsas vuosina 1969–74, tämän jälkeen huippuvuosia on ollut harvoin (1980, 1987). Enimmillään pesiä ja poikueita on Värriötunturilla laskettu vuonna 1971: 29. Laskemalla yhteen eri huipuilla eri vuosina tavatut suurimmat pesä- ja poikuemäärät saadaan enimmäiskannaksi 43 paria. Todellisuudessa parimäärä parhaimpina vuosina lienee 30–40. Keräkurmitsan kanta Värriötunturilla on ilmeisesti taantunut. Syynä tähän lienevät raskaat tappiot muuttomatkalla ja talvehtimisalueilla. Sekä Itävallan Alpeilla että Värriötunturilla kannan kehitys on ollut samansuuntainen.

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