Brief reports • Tiedonantoja

Breeding biology of Rustic Buntings *Emberiza rustica* in eastern Finnish Lapland

Erkki Pulliainen & Lennart Saari

Introduction

The Rustic Bunting *Emberiza rustica* is a Siberian species breeding as far west as Fennoscandia (von Haartman et al. 1963–1972, Dementjev & Gladkov 1970, Staav 1976, Sonerud & Bekken 1979, Harrison 1982, Ukkonen 1983a, Solonen 1985). The breeding biology was studied by Rymkevič (1979) in the Leningrad area in the USSR, in Norway by Sonerud & Bekken (1979), in Central Finland by Pihlainen (1973a, 1973b), and in eastern Central Finland by Ukkonen (1983b, 1983c).

Study area and methods

Our study area consists mainly of the Värriö Nature Reserve in Forest Lapland (67°44′N, 29°37′E). The composition of the bird fauna has been studied since 1968, receiving particular attention in 1970–71 and 1985–87. From 1974 onwards the breeding biology of the local bird fauna has been studied systematically, members of the staff carrying out daily surveys, each in his or her own study plot. Since then, the study area and the study methods have been comparable. There is a possibility that in the course of time the staff members have become more efficient in finding nests of certain species, including Rustic Buntings, but there has been a fairly great turnover of observers from one breeding season to another, which probably hinders the formation of a specific Rustic Bunting nest search image. The arrival data, on the other hand, are more dependent upon the study effort of the staff members. The arrival of migratory birds was particularly well studied in 1979–85. Rustic Buntings have not been subjected to any special study during the years and we believe that the nest searching effort has been almost constant since 1974.

Commencement of laying was established when the nest was found in the laying period (assuming one egg/day), or when the hatching date was known (assuming 12 days for incubation) or when then fledgling date was known (assuming 9 days for the nestling period). The incubation period was calculated as the time from the day the last egg was laid to the day the (last) chick hatched. As the nests were usually visited only once a day, the hatching date of the last egg could not always be ascertained. If no evidence was found to the contrary, all the eggs were supposed to have hatched on the same day. This may lead to slight underestimation of the incubation period. The nestling period was calculated as the time from the day the young hatched to the day the young were seen in the nest for the last time (provided that the nest was visited on the following day) and this period may also be somewhat underestimated.

The material consists of records from 1974–88 for 51 nests, but for some the information is scanty. The nesting success was estimated by Mayfield's (1975, Johnson 1979, Tiainen 1988) method.

The study area is situated near the northern limit of the range of Rustic Buntings (see Ukkonen 1983a) and thus the results are not necessarily representative of the whole of Finland.

Development of population and arrival in spring

In 1985–87 a total of 943.4 km of line transects were censused in 17 different habitats near our study area (Pulliainen & Hildén, unpublished). The Rustic Bunting densities are shown in Table 1. The densities for both the main belt (MB), i.e. birds recorded within ± 25 m of the observer, and the survey belt (SB) are shown. No Rustic Buntings were recorded on alpine heaths, fens, clear-cut areas, seedling stands of different ages, or heaths of dead birches and junipers. In forested plots the MB densities varied between 0.9 and 2.0 pairs/km^2.

Compared with the observations in the early 1970s, the densities seem high. In 1970 several observers studying the bird fauna of the Värriötunturi area did not record this species even once, and in 1971 it was recorded on three sites near the Research Sta-

Table 1. Densities of Rustic Buntings (pairs/km²) in 1985–87 in different habitats in eastern Lapland. Main belt (MB) and survey belt (SB) densities are shown with the length of the transects in different habitats. (The Ortolan Bunting *Emberiza hortulana* is reported to have a SB density of 0.1 in pine forest with no undergrowth and MB and SB densities of 1.1. and 0.3, respectively, in spruce-birch forest. As the Ortolan Bunting is extremely rare in the area and no Rustic Buntings were recorded on the routes in question, we interpret these results as a slip of the pen. Consequently, the Rustic Bunting densities are probably somewhat higher in these habitats than shown below.)

Habitat	Km censused	MB density	SB density
Strip-cut forest, clear-cut strip	64.2	–	0.2
Strip-cut forest, uncut strip	30.6	1.3	1.0
Birch-juniper forest	55.0	1.1	1.7
Pine forest, no undergrowth	60.1	–	0.2
Pine forest, with undergrowth	60.0	2.0	1.4
Mixed forest	58.9	1.0	0.7
Spruce-birch forest	55.0	1.1	0.6
Spruce forest	45.0	0.9	1.2
Pine-peat bog	57.2	–	0.2

tion (including one fledged brood), but on extensive excursions in eastern Forest Lapland it was observed on only three occasions in June and July, and on four occasions in August (see Saari 1973, 1977). As all the bird species seen were recorded daily for nearly two months in an area between the Värriötunturi and Saariselkä fells, it is very probable that with the present densities Rustic Buntings would have been recorded much more frequently. Two of the birds recorded were on the study plots censused in late June and early July: in birch-dominated riverside HMT and EMT forest, where the density was 1.2 pairs/km², these probably being optimal habitats for this species.

The number of nest records also indicates an increase. In 1974–82 the number of nests found annually averaged 2.1±1.3 (range 1–5); in 1983–88 it averaged 5.3±1.9 (range 3–7; t=4.21, p<0.01, df=13).

The average arrival date in 1974–85 was 14 May, the extremes being 29 May in 1978 and 26 April in 1983. The arrival was considerably earlier during the latter half of this period (20 vs 7 May), probably because more attention was paid to the arrival of birds in the 1980s.

Nesting habitat and site

Of 49 nests 63% were in swampy spruce forests (often by brooks, twice in almost treeless habitats), 16% were in usually wet spruce-birch mixed forest and 20% in drier (usually birch-dominated) heaths mixed with junipers. Of 50 nests 48% were found on the ground in a tussock or in the field layer, 20% under a tree or bush, 16% in a juniper and 16% above the ground on the roots of birches or in other trees. The most exceptional nest sites were in a rotten spruce and on a birch branch, 1.8 m and 3.0 m above the ground, respectively. Thirty-four nests were found on the ground and 16 between 0.1 and 3.0 m, on average 0.8 m, above the ground level.

Table 2. Survival rates (±SD) of Rustic Bunting nests during the incubation and nestling periods. Figures in brackets after "nest days" give the number of destroyed nests. N gives the number of nests under observation.

Period	Nest days	N	Survival of nests: Daily rate	Survival of nests: Over the period
Incubation	245.5 (4)	34	0.984±0.0081	0.821
Nestling	183.5 (8)	34	0.956±0.0151	0.670

Clutch size and breeding success

The size of the completed clutches averaged 5.03 (SD=0.80, range 3–6, n=31). In 1974–82 the clutch size was 4.91±0.79 (n=12); in 1983–88 it was 5.11±0.81 (n=19; t=0.45; p>0.5, df=29). The clutch size remained almost stable up to 15 June (5.20±0.71, n=25). Clutches started later were smaller (4.33±0.82, n=6; t=1.58, p>0.1, df=29). The average ±SD number of fledglings per nest was 1.73±1.97 (n=26), for successful nests 3.46±1.27 (n=13). These figures are minimum values, since a few (at most 7) nestlings may have fledged before the last inspection in nests visited infrequently in the nestling period.

The survival rate of Rustic Bunting nests was calculated by the method of Mayfield (Table 2). The proportion of nests surviving the incubation period (assumed to be 12 days) was 82% and the proportion surviving the nestling period (assumed to be 9 days) was 67%. The difference was not significant (t=1.60, df=66). Thus 55% of the nests survived the incubation and nestling periods. When partial losses are included, the survival rate was 47% (Table 3: 73 eggs or young lost during 2064.5 egg or nestling days; in these figures seven young, some of which may have fledged before the last visit, are considered lost).

Table 3. Survival rates (±SD) of Rustic Bunting nests, and eggs and nestlings. Figures in brackets after "nest days", and "egg and nestling days", give the number of destroyed nests, and the dead eggs and nestlings, respectively. N gives the number of nests under observation.

Years	Nest days	Egg and nestling days	N	Survival of nests		Survival of eggs and nestlings	
				Daily rates	Over the period	Daily rate	Over the period
1974–82	141 (8)	629 (47)	16	0.943±0.0195	0.293	0.925±0.0105	0.196
1983–88	288 (4)	1435.5 (26)	23	0.986±0.0069	0.746	0.982±0.0035	0.681

Table 4. Survival rates of Rustic Bunting nests at different times of the summer, in different habitats and nest sites. For explanations see Table 3.

	Nest days	N	Survival of nests Daily rate	Over the period
Start of laying:				
May	169.5 (8)	15	0.953±0.0163	0.362
June–July	259.5 (4)	24	0.985±0.0076	0.722
Nest site:				
Above the ground	145.0 (4)	13	0.972±0.0136	0.556
On the ground	284.0 (8)	26	0.972±0.0098	0.549
Habitat:				
Birch	164.0 (5)	15	0.970±0.0134	0.522
Spruce	247.0 (7)	23	0.972±0.0106	0.547

The nest survival was significantly lower in 1974–82 than in 1983–88 (Table 3; for nests t=2.07, p<0.05, df=35, for eggs and nestlings t=5.06, p<0.01, df=35). Only 29% of the nests (20% of the eggs and nestlings) survived in the former period, 75% of the nests (68% of the eggs or nestlings) in the latter.

The start of laying also seemed to influence the nesting success, when the most probable date of commencement of each clutch or brood was calculated (e.g. when the nest contained eggs on the first visit and nestlings on the second, hatching was assumed to have taken place in the middle of the interval; the error is less than ±6 days, usually much less). Table 4 shows that the clutches started in May had a breeding success of 36%, those in June and July 72% (t=1.78, p<0.10, df=37, two-tailed). The breeding success did not differ between habitats (birches vs swampy spruce forests) or nest sites (on the ground vs above ground level).

One of the nests was deserted in the building stage and another after the first egg had been laid. Four nests were destroyed in the incubation period (two probably due to bad weather, two probably due to predation), and eight in the nestling period (the young starved in two and were killed by predators in six). In the successful nests one egg disappeared in the incubation period, three eggs in two clutches failed to hatch, and four young disappeared from three nests (two of these were parasitized by fly larvae). The fate of seven nestlings is unknown.

Eggs were laid daily. The incubation period in four cases was 11 days. Both sexes incubated: the female was seen incubating 15 times, the male six times. Once hatching was spread over two days. The nestling period was calculated in seven cases: 7 days, < 9 (twice), 9 (twice), at least 9 and at least 10 days.

Breeding season

In the nests in which the start of laying could be calculated with an error of ±1 day (nests found in the laying period, hatching or fledging dates known) the first egg was laid on average on 6 June (SD=12.9 days, range 22 May – 5 July, n=24). In all the other nests (maximum error ± 6 days) the average was 8 June (SD=12.2 days, range 23 May – 30 June, n=26). The median date for all nests was 4 June. Ten nests were started between 21 June and 5 July and at least some of these were probably genuine second clutches. Thus at most 20% of the pairs lay a second clutch, the proportion probably being much smaller.

The nests situated above the ground were started on average on 31 May (SD=9.2 days, n=15), those on the ground on average on 10 June (SD=12.6, n=34, t=2.76, p<0.01, df=47).

Discussion

In our study area, 20% of the nests were found in birch-juniper woods, which is an unusual habitat for Rustic Buntings elsewhere in Finland. The frequent nests in junipers in our study area are also unusual. Ukkonen (in litt.) has not observed such nest sites in his study area. We do not know yet whether the shortage of swampy spruce forests in our area has forced Rustic Buntings into marginal habitats. It may be noted that birch-juniper woods are a special habitat, characteristic of our study area, but lacking in many other regions.

The average clutch size in our study area is 5.0. The average clutch size given by von Haartman (1969) for the whole of Finland is 5.3 (n=8). In the present study area, breeding mostly commences in late May – early June (median date of all clutches 4 June). Some genuine second broods probably occur (maximally 20% of the nests) and laying then takes place in late June – early July. In the Kemi-Tornio area, laying commences about 20 May (Rauhala 1980). In Kaavi, eastern Central Finland, in 1978–79, laying reached a first peak around 15–25 May and in 1980 around 25 May – 5 June, and had second peaks on 12–22 June and in the second half of June, respectively (Ukkonen 1983c). In 1978–79 (warm springs) about 70–75% and in 1980 (cold spring) about 50–60% of the females laid a second clutch (Ukkonen 1983c). In our study area the nesting success was about 47% (55% when partial losses are excluded). The nesting success was almost equal to that recorded by Ukkonen (in litt.): 54% (Mayfield's method).

The present incubation period (11 days) was slightly shorter than those mentioned in the literature. von Haartman (1969) reported 12–13 days, von Haartman et al. (1963–72) in one Finnish case c. 12 days, and Leinonen (1980) 12 days.

The nestling period seems to be variable according to the available information. von Haartman et al. (1963–72) cited Finnish records of c. 7 and 12 days. Leinonen (1980) reported 8 days. Ukkonen (in litt.) (6) 7–8 days (n=25) and Rymkevič (1979) 7–9 days. In our study area the nestling period was c. 7–10 days, somewhat longer than in other studies.

We do not know why the breeding success of the Rustic Bunting has increased significantly since 1983. An amelioration of the climate is one possible explanation. At Sodankylä observatory the average June temperature in 1974–82 was 10.7±2.4°C and in 1983–88 it was 12.2±1.4°C. The long-term average (1931–1960) was 11.3°C (data from the Finnish Meteorological Institute).

Acknowledgements. Juha Tiainen, Paavo Tunkkari and Markku Ukkonen read earlier drafts of this report and made several valuable suggestions for its improvement.

Selostus: **Pohjansirkun pesimisestä Itäkairassa**

Pohjansirkku esiintyy Itäkairassa levinneisyysalueensa pohjoisrajoilla. Itäkairan pesimälinnuston tutkimuksissa vuodesta 1968 on löydetty 51 pohjansirkun pesää vuosina 1974–88. Pesälöytöjen määrä on viime vuosina kasvanut, minkä oletamme johtuvan pohjansirkun kannan kasvusta. Vuosina 1974–85 pohjansirkku saapui Itäkairaan keskimäärin 14.5. (ääripäivämäärät 26.4. ja 29.5.). Pohjansirkun saapuminen alueelle oli 1980-luvulla keskimäärin selvästi varhaisempi kuin 1970-luvulla (7.5. ja 20.5.), mutta kannan kasvun lisäksi tehostuneella havainnoinnilla voi olla osuutta asiaan. Muninta alkaa Itäkairassa toukokuun lopussa – kesäkuun alussa. Jotkut parit pesinevät kaksi kertaa kesässä. Molemmat puolisot hautovat. Hautomisajaksi saatiin 11 vrk, pesäpoikasajaksi n. 7–10 vrk. Keskimääräinen pesyekoko täysilukuisissa pesissä oli 5.0. Kesäkuun puoleenväliin mennessä aloitetuissa pesissä pesyekoko oli keskimäärin 5.2, myöhemmin aloitetuissa 4.3, mutta ero ei ollut merkitsevä.

Mayfieldin menetelmällä laskien pesistä selviytyi haudonta- ja pesäpoikasajan yli 55%. Mikäli osittaiset tappiot otetaan lukuun, onnistumisprosentti on 47. Pesimätulos oli vuosina 1974–82 selvästi huonompi kuin 1983–88. Korkeammat kesäkuun keskilämpötilat jälkimmäisellä jaksolla ovat mahdollisesti osaselitys tilanteeseen.

References

Dementjev, G. P. & Gladkov, N. A. (eds) 1970: Birds of the Soviet Union. V. — Israel Program for Scientific Translations, Jerusalem.

von Haartman, L. 1969: The nesting habits of Finnish birds. I. Passeriformes. — Comm. Biol. Soc. Scient. Fennicae 32: 1–187.

von Haartman, L., Hildén, O., Linkola, P., Suomalainen, P. & Tenovuo, R. 1963–72: Pohjolan linnut värikuvin I–II. — Otava, Helsinki.

Harrison, C. 1982: An atlas of the birds of the western Palaearctic. — Collins, London.

Johnson, D. H. 1979: Estimating nest success: the Mayfield method and an alternative. — Auk 96:651–661.

Leinonen, A. 1980: Korpiemme pohjansirkku. — Suomen Luonto 39:193–194.

Mayfield, H. F. 1975: Suggestions for calculating nest success. — Wilson Bull. 87:456–466.

Pihlainen, J. 1973a: Pohjansirkun, Emberiza rustica, esiintymisestä ja elintavoista Keski-Suomen länsiosissa. — Suomenselän Linnut 8:36–40.

Pihlainen, J. 1973b: Pohjansirkun, Emberiza rustica, pesimisestä ja käyttäytymisestä 1973 Keuruulla. — Suomenselän Linnut 8:100–104.

Rauhala, P. 1980: Kemin-Tornion seudun linnusto. — Kemi.

Rymkevič, T. A. 1979: Materialy po ekologii ovsjanki-remezu (Emberiza rustica) Pall. v Leningradskoi oblasti. — Vest. Leningradskogo Univ. 1979(3):37–47.

Saari, L. 1973: Itäkairan linnusto. — Unpubl. MS. University of Helsinki, Dept. of Environmental Conservation, 74 pp.

Saari, L. 1977: Change of habitat preference during the summer in certain passerines. — Ornis Fennica 54:154–159.
Solonen, T. 1985: Suomen linnusto. — Lintutieto, Helsinki.
Sonerud, G. A. & Bekken, J. 1979: Vierspurvens utbredelse i Norge og dens habitatvalj i Hedmark. — Vår Fuglefauna 2:78–85.
Staav, R. 1976: Videsparven i Sverige, utbredning och uppträdande under flyttningen. — Fauna och Flora 71:202–207.
Tiainen, J. 1988: Ornitologian menetelmät 5. Lintujen pesimistuloksen arvioiminen Mayfieldin menetelmällä. — Ornis Fennica 65:122–124.
Ukkonen, M. 1983a: Pohjansirkku Emberiza rustica. — In: Hyytiä, K., Kellomäki, E. & Koistinen, J. (eds): Suomen lintuatlas, pp. 474–475. Lintutieto, Helsinki.
Ukkonen, M. 1983b: Pohjansirkun (Emberiza rustica) pesimäbiologiasta. — Unpublished M. Sc. Thesis, University of Helsinki, Dept. of Zoology, 210 pp.
Ukkonen, M. 1983c: Milloin pohjansirkku pesii. — Siivekäs 4:117–122.

Authors' addresses: Erkki Pulliainen, Department of Zoology, University of Oulu, Linnanmaa, 90570 Oulu, Finland; Lennart Saari, Värriö Subarctic Research Station, University of Helsinki, 00710 Helsinki, Finland.

Received 9 March 1989, accepted 21 November 1989

Poor predictability of the threatened status of waterfowl by life-history traits

Terhi Laurila & Olli Järvinen

Twenty of the (about) 149 waterfowl (Anatidae) species in the world (Johnsgard 1978) are considered threatened or recently extinct (Collar & Andrew 1988). A recent collation of demographical and other data on the waterfowl of the world (Laurila 1988) makes it possible to examine whether the threatened waterfowl form a subset that deviates from the common waterfowl pattern. Threatened waterfowl species might be expected to share some features that make them especially prone to decline in numbers, e.g. late age at maturity, small clutches or long breeding periods. As the data are not sufficient for the inclusion of many variables, we are limited to the basic life-history traits reported in the literature. Even so, we have to exclude seven species because of insufficient data, and one threatened species (the Freckled Duck *Stictonetta naevosa*) because it is the sole representative of its tribe. Owing to differences between the classifications by Johnsgard (1978, used by Laurila 1988) and Collar & Andrew (1988, used by us), the data for the Hawaiian Duck *Anas wyvilliana* and the Laysan Duck *A. laysanensis* are added here.

Four of the seven species excluded because of scanty data were threatened (Crested Shelduck *Tadorna cristata*, Madagascar Teal *Anas bernieri*, Brazilian Merganser *Mergus octosetaceus* and Scaly-sided Merganser *M. squamatus*). This reflects the fact that little attention is paid to species having restricted ranges in remote corners of the world. This is also true of a fifth omitted species, the Labrador Duck *Camptorhynchus labradorius*, extinct since the 19th century.

Table 1 shows the ranges of reproductive parameters for threatened and other waterfowl. No marked differences are evident (the narrower ranges among the threatened species are most probably a statistical consequence of the smaller sample size). This observation may, however, be misleading, as size and phylogeny were found to explain 30–90% of the between-species variation in reproductive traits (clutch size, incubation period, egg size, time required for breeding) in waterfowl (Laurila 1988). Larger species mature later and have smaller clutches than small species. Also, all true geese (Anserini) are "poor reproducers" compared with ducks (Anatini), as the former mature later and have smaller clutches in relation to their size (Laurila 1988). We therefore compared the reproductive traits of each threatened spe-

Table 1. Ranges of the reproductive parameters and size of 15 threatened and 129 other waterfowl species.

	Threatened	Other
Female weight (kg)	0.4–2	0.2–10
Clutch size	5–11	2–14
Egg weight (g)	31–144	23–340
Incubation period (d)	25–31	22–43
Time required for breeding (d)	71–119	66–207