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Reproductive success of the Shore Lark *Eremophila alpestris* in southern Lapland

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Decline of the Shore Lark population

Evidence from many sources shows that the Shore Lark *Eremophila alpestris* population of northern Fenno-Scandia has declined much during this century and also in recent decades. The decline in Finland has been summarized by Hildén (1987). The Shore Lark was common both in northern Finland and on migration in southern Finland around the turn of the century, but a rapid decline occurred already about 1910. Numbers were then rather stable until about 1950 when a new decline began and continued through the 1960s and 1970s. Merikallio (1958) estimated the Finnish population at about 10,000 pairs from line transects in 1941-1956. Although the estimate was based on a rather small sample (only 12 records along about 240 km of line transects), it contrasts drastically with the most recent information obtained in the 1980s on many hundreds of kilometres censused in suitable habitats, producing only five records. Hildén (1987) estimated that the present Finnish population was at most only some tens of pairs.

Less is known about the Swedish population. No comprehensive survey has yet been made. Good data are available only from the Ammarnäs area of southern Lapland (Svensson 1990). In a one square kilometre plot of suitable habitat, censused since 1963, about two pairs bred every year until 1976. After that year the Shore Lark has bred only once, in 1978, in that plot. Extensive line transects have been made around Ammarnäs since 1972. In 1972-1977 an average of 6 and a maximum of 9 birds were recorded annually, whereas only one observation has been made in 1978-1991.

The decline has been recorded also on migration and in the winter quarters. Autumn migration data from Ottenby bird observatory (Edelstam 1972, and excerpt from the observatory diary by Jan Pettersson) and Falsterbo bird station (Rudebeck 1950, Ulfstrand et al. 1974, Roos 1991) have partly been summarized in Svensson (1990). In North Jutland, where careful records have been kept since 1974 (Anon. 1990), 1400 birds were reported in 1974. The numbers declined rapidly to an average number of about 100 in 1982-1988. However, starting in 1988, there has been some increase, with 318 in 1989 and 801 in 1990 (Anon. 1991). Also at Falsterbo and Ottenby more birds than previously have been observed after 1989. Such fluctuations may, however, be quite temporary and only reflect, for example, improved survival during the unusually mild recent winters. This suggestion is supported by the Ottenby data. Two autumns with deviatingly high numbers, 1973 (135 birds) and 1975 (136 birds), happen to coincide with a series of very mild winters. The mean number of larks in 1963-1978 (1973 and 1975 excluded) was 37 and the maximum number was 67. For 1979-1989 the figures were 7 and 18, respectively.

The aim of this study was to document if low breeding success could explain the decline of the Shore Lark population in Sweden. We chose the Ammarnäs area because we knew that a few pairs still remained on the mountains north of Ammarnäs.

Two of us (O.B. and J.T.) carried out most of the field work in 1990, between 10 June and 10 July. In 1991 we worked from 7 June to 4 August, O.B., Å.E., M.H., P.N. and J.T. from 7 June to 5 July, Å.B. and T.J. from 30 June to 31 July, and S.S. from 25 June to 3 August. Thus we covered most of the breeding season, though missing the early phase of arrival and territory establishment and the late phases of post-fledging events of the young. The missing of the late phase means that we were not able to follow the broods long enough after fledging to determine the final breeding success.

In 1990 we searched an area of about 10 square kilometres on Björkfjället northeast of Ammarnäs. In 1991 we searched a larger area, about 25 square kilometres on the same mountain, including the area of 1990 (the centre of the study area is at approx. 66° 05' N, 16° 20' E). The Shore Larks bred on or near the peaks

Table 1. Laying date, clutch size, and fledging success in the Shore Lark at Ammarnäs in 1990 and 1991. The letters in the 1st egg column indicate method of date calculation: H = from known hatching date, A = from age of young, E = from age of embryos in deserted nest, L = laying date known exactly, O = nest found with sitting female, depredated at next visit; the possible range given.

Läggningsdatum, kullstorlek och häckningsframgång för berglärka i Ammarnäs 1990 och 1991. Boskstäverna i kolumnen för 1:a ägg anger metoden för beräkning av datum: H = från känt kläckningsdatum, A = från ungars ålder, E = från embryons ålder i övergivna ägg, L = exakt läggningsdatum känt, O = bo funnet med ruvande hona, rövat vid nästa besök; möjligt intervall givet. Typ av kull: replacement = omläggning, late first = sen förstakull, true second = genuine andrakull.

Year *År*	Site *Plats*	Type of clutch *Typ av kull*	1st egg June date *1:a ägg Juni datum*	Clutch size *Kull-storlek*	No. of hatchlings *Antal kläckta*	No. of fledglings *Antal flygga*
1990	ÅB		7 H	4	3	2
	MI		1 A	4	4	3
	LI		1 A	4	4	3
1991	ÅB		10-15 E	5	0	0
	ÅB	replacement	28 L	5	5	5
	LI		6 H	4	3	3
	JN	late first?	27 H	3	3	2
	DÖ		12 H	5	5	5
	DV		3 A	3	2	2
	DV	genuine second	29 H	3	3	3
	BÅ		11 H	5	3	3
	LA		4-14 O	5	0	0
Mean per nest	*Medeltal per bo*			4.2	2.9	2.6
Mean per pair	*Medeltal per par*				3.5	3.1

at elevations between 900 and 1100 m. The forest line runs at about 760 m and the highest peaks reach just above 1100 m.

All but one of the mountain peaks where we found Shore Larks but no nests were searched at least twice and most often many times in order to make it likely that no birds bred. When we had located a nest it was monitored by repeated visits to determine final clutch size, number of hatchlings, and number of fledglings. We also tried to find the fledglings after they had left the nest, but this proved difficult.

Results

In 1990 we located 5 pairs and three nests. One pair may not have bred, whereas a second pair certainly did, although the nest was not found. In 1991 we located 7 breeding pairs and 9 nests, two pairs laying twice. A number of single, most likely non-breeding birds, most of them males, were located in both years.

The breeding data of the Ammarnäs Shore Larks are given in Table 1. The only clutch sizes recorded were 3, 4, and 5 eggs with a mean of 4.2 (s.d. 0.83) eggs. Two females laid more than one clutch. In one case it was a replacement clutch after depredation of the first clutch at the incubation stage. In the other case it was a second clutch following a successfully raised first brood. Both females laid the same number of eggs in their first and second clutches.

We do not know what predator was responsible for the two complete losses. The LA nest was empty without any trace of eggs and with the nest material torn out and scattered around. No larks were seen on the next visit although the area was searched carefully so it is unlikely that a replacement clutch was laid. In the ÅB nest there was one cold egg left with egg shell fragments around the nest. Small tooth marks on the remaining egg suggested a weasel to have been responsible. In all other cases the losses were either eggs that did not hatch or one nestling that died. In the ten clutches that did hatch, 5 out of 40 eggs did not hatch (12.5 %), and of 35 hatchlings 4 (11.4 %) died before they left the nest. Thus the total loss was 22.5 % of all eggs laid, the two depredated clutches not included. If we include the pair LA that probably did not lay a replacement clutch, the loss was 14 out of 45 or 31 %. We do not know why some eggs did not hatch. We examined all the five eggs and found embryos in four of them and one that apparantly was unfertilized. Using Mayfield's (1975) method, survival probability during the incubation pe-

riod (2 nest losses, 49 exposure days, incubation period 11 days) was 63.2 %. Combining the three survival probabilities of incubation, hatching (87.5 %), and fledging (88.6 %) the total survival probability from onset of incubation to fledging was 49 %.

We do not yet have sufficient information about mortality to compare it with the production of young. Both of two females ringed in 1990 returned in 1991 as well as two of eight ringed young. We have also recieved reports about two of the young of 1990 in the wintering area, one seen in north Jutland in April 1991 and one on the Swedish west coast in the autumn of 1991. Both these birds and both young that returned to Ammarnäs came from the same brood of three. Since these young were identically colour-ringed we cannot tell whether the records represent two or three different birds (the two birds that returned to Ammarnäs were almost certainly different because one was raising young several kilometres away from where we saw the other one).

Discussion

Mean clutch size was the same as given in the handbooks (e. g. Haftorn 1971, Glutz von Blotzheim 1985, Pätzold 1987) for the *flava* subspecies (3-5, mostly 4). Judged from this, clutch size has not declined recently, and consequently this is an unlikely cause of the population decline. Different subspecies have different typical clutch sizes, so comparisons with the more extensive data from other geographical areas cannot be used to judge if present clutch size has declined. The Shore Lark may lay larger clutches late than early in the season (Cannings & Threlfall 1981), but our data set is yet too small to show much in this respect.

Other workers have found much lower proportions of unhatched eggs than we did: 1 of 24 eggs, 4.2 % (6 nests; Sutton & Parmelee 1955), 2 of 44 eggs, 4.5 % (14 nests; Verbeek (1967), and 1 of 86 eggs, 1.2 % (26 nests; Cannings & Threlfall 1981). This gives a total of 4 of 154 eggs or 2.6 %. Our figure, 12.5 %, is significantly larger ($p = 0.004$, Mann-Whitney $U = 153.0$, $N = 10, 46$; the data from the three other studies were pooled).

As with clutch size the number of fledged young cannot be compared with that of other populations because there are basic differences between subspecies. Here we make a comparison only with the results of three studies from North America where the conditions seem to be fairly similar to those of the Ammarnäs area, and we compare only the rate of fledging success, namely the proportion of hatchlings that fledged. Sutton & Parmelee (1955) obtained data from six nests. Including one destroyed nest but excluding one nest which was not checked later than three days after hatching the average number of fledged young in 5 nests was 2.4 (66 % of hatchlings). Verbeek (1967) obtained a fledging rate of 61 % of the hatchlings (15 nests). The data given by Cannings & Threlfall (1981) cannot be used for a comparable calculation but they give the figure 59 % of the eggs giving rise to fledged young, which is very similar to our 62 % if we include the two depredated nests.

From Scandinavia we have only the data given by Spjøtvoll (1970) who found ten fledged broods rather late in the season. The average number of juveniles was 3.1, which is identical with the average number of young fledged per pair at Ammarnäs. However, the two figures are not comparable since Spjøtvoll recorded his broods well after fledging and additional mortality may have occurred among our birds soon after they fledged. It is also likely that Spjøtvoll's pairs produced more young per pair since at least some of the females were probably incubating a second clutch. In our area we had no indication of any other second clutches than the one we found.

In summary, the two years of our study indicate that present clutch size is the same as the one expected from litterature data and that it is not evident that the number of young leaving the nests is impaired. We know yet too little about the frequency of true second clutches and survival between seasons for an estimation of the balance between production of young and mortality. We must also learn more about the survival of the young after fledging. The only possible indication of breeding impairment is the rather high proportion of eggs that did not hatch in otherwise successful nests. However, the sample size is small and we cannot yet evaluate the significance of this observation.

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Sammanfattning

Häckningsframgång hos berglärka i södra Lappland

Berglärkan har minskat kraftigt i norra Fenno-Skandia (Hildén 1987, Svensson 1990). För att studera häckningsframgång och dödlighet startade vi studier av berglärka i trakten av Ammarnäs sommaren 1990. Vi har bestämt kullstorlek, antal kläckta ungar och antal flygga ungar för tre bon 1990 och sju bon 1991. Av bona 1991 var ett en omläggning efter predation och ett annat en äkta andrakull efter en framgångsrik första häckning.

Resultaten framgår av Tabell 1. De två honorna som lade mer än en kull hade samma äggantal i båda. Medelkullen för samtliga bon var 4,2 ägg. Två bon förlorades helt genom predation, båda på äggstadiet. Av de 40 ägg som fanns i bon där ungar kläcktes var det 5 som inte kläcktes (12,5 %). Av 35 kläckta ungar dog 4 innan de skulle ha lämnat boet (11,4 %). Totalförlusterna var således 22,5 % i de sju bon som inte spolierades. Om även det prederade boet LA, där det sannolikt inte skedde någon omläggning, inräknas blir totalförlusterna 31 %.

Den observerade medelkullstorleken stämmer med vad som anges i handböckerna. Antalet flygga ungar per par synes inte vara speciellt lågt, men vi har tyvärr inte mycket att jämföra med. Medeltalet ungar i tio flygga kullar i Norge (Spjötvoll 1970) var också 3,1. Denna siffra är dock svår att tolka eftersom observationerna dels gjordes en tid efter utflygningen och dels avsåg förstakullar från par vars honor troligen delvis låg på andrakullar. Förlusterna i våra bon är inte uppseendeväckande stora i jämförelse med nordamerikanska studier. Det enda som är signifikant högre är antalet icke kläckta ägg. I tre nordamerikanska studier var det bara 4 av 154 ägg (2,6 %) som inte kläcktes. Vi vet inte vad som orsakade att en del ägg inte kläcktes, men vi noterade att det fanns embryon i fyra av dem och att ett var obefruktat.

Vi har ännu inte tillräckligt med data om dödligheten för att ställa den mot produktionen av ungar. Båda av två 1990 märkta honor återkom 1991 och av åtta märkta ungar återkom två. Dessutom har vi fått rapporter om ytterligare två ungfåglar mellan häckningsä-songerna, en har setts nära Skagen i april 1991 och en nära Varberg hösten 1991. Tyvärr märkte vi inte ungarna individuellt 1990 så vi vet bara att båda är ur samma kull. Detta tyder på god överlevnad, men materialet är för litet för några slutsatser.

Sammanfattningsvis finns det ännu inget som tyder på försämrat häckningsresultat och som alltså skulle kunna förklara artens tillbakagång. De okläckta äggen är möjligen en varningssignal och vi vet ännu inget om huruvida andelen andrakullar kan vara lägre i dag än förr. Vi lyckades konstatera en säker andrakull och är ganska säkra på att det inte fanns några fler. Undersökningen fortsätter 1992 varvid vi både kommer att få ett större material rörande häckningen och möjlighet att bättre bestämma dödligheten genom att identifiera återkommande fåglar av de 37 som vi nu har märkta.

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