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Autumn migrating Bluethroats *Luscinia s. svecica* orient in an east-southeasterly direction at Gävle, East Sweden

HANS ELLEGREN & KJELL WALLIN

Abstract

The orientation of Bluethroats captured during autumn migration at a stopover site in eastern Sweden was investigated by cage experiments during the twilight period after sunset. The mean direction of 63 juvenile birds tested under clear skies was 117° (ESE). This direction is consistent with data from ringing recoveries within as well as outside Scandinavia. We suggest that an earlier assumption that Scandinavian Bluethroats migrate towards both southwest and southeast should be reconsidered.

Hans Ellegren, Department of Animal Breeding and Genetics, Swedish University of Agricultural Sciences, Box 596, S-751 24 Uppsala, Sweden.
Kjell Wallin, Kubbovägen 4, S-805 92 Gävle, Sweden.

Introduction

Much of our knowledge of migratory directions and wintering areas in birds is derived from recoveries of ringed individuals. Consequently, available information may depend on how many birds of a particular species are ringed and on their probability of being recovered and properly reported. Considerable variation in the probability of obtaining recoveries from different regions thus influences the amount of knowledge that we can obtain about the migratory directions and wintering areas. For example, much of the uncertainties regarding the migration of southeastern migrants can be ascribed to the extremely low probability of obtaining ringing recoveries from Asia due to linguistic, cultural or political obstacles.

The northern, Red-spotted Bluethroat *Luscina s. svecica* is a presumed southeastern migrant but although 70 000 birds have been ringed in Scandinavia until 1989, not a single bird has been recovered during December to February (Ellegren & Staav 1990). Originally, two main migration routes were assumed for northern Bluethroats: migration towards south/southwest and towards southeast (see review by Rendahl 1967). But, on the basis of a few recoveries from the migration periods, Staav (1975) showed that southeast probably is the predominant migratory direction of northern Bluethroats. In a recent ringing analysis this suggestion was given further support (Ellegren & Staav 1990). In the standard literature, however, the Red-spotted Bluethroat is still described as a subspecies with two migration routes (Cramp 1988, Glutz von Blotzheim & Bauer 1988, SOF 1990).

Orientation experiments with captured birds, mostly used for basic studies of navigation and orientation behaviour of birds, may also be suitable for exploring migratory directions (see e.g. Bergman 1987, Hilgerloh 1989). In order to further investigate the autumn migration directions of northern Bluethroats, we adopted the orientation cage technique described by Emlen & Emlen (1966). Experiments were performed with migrating birds captured at Inre Fjärden, Gävle, a stopover site in eastern Sweden.

Material and methods

During 26 August-21 September 1989 and 20 August-27 September 1990, Bluethroats captured at Inre Fjärden, Gävle (60°41'N. 17°11'E, see Ellegren *in press*) were used in orientation experiments. Immediately after capture and ringing, birds were transported by car to a test site situated 20 km southwest of the trapping site. At the test site, birds were housed indoors in individual cages for 1-3 days before the experiments were carried out. The room where the birds were kept had windows facing east and west, and the temperature was approximately the same as outdoors. Birds were regularly fed with mealworms and had access to water.

The experimental set-up and procedure followed Sandberg *et al.* (1988) except that we did not use plastic cylinders surrounding the orientation cages. Thus, our set-up allowed the birds to see approximately 145° of the overhead sky. As cages were placed in an open meadow, birds were unable to see landmarks.

Under clear skies birds mostly orient in the appropriate direction for the season but under solid overcast directions are usually more scattered (see e.g. Alerstam 1982, Sandberg 1990). For this reason we only used birds tested under clear skies for the following analysis. Since most of the birds were juveniles and in order to analyse a homogeneous group of birds, we excluded adults. Sixty-three juvenile birds were available for evaluation. Each bird was tested only once.

Practically all birds carried extensive fat deposits at the time of the experiments, a situation known to stimulate migratory activity (Zugunruhe) in natural conditions as well as in orientation experiments (e.g. Bairlein 1987). Most of the fat was put on during the short period when birds were kept before the experiments.

On the basis of individual headings a second-order mean vector was calculated and the Rayleigh test was used to determine significant directional preferences (see Batschelet 1981).

Results and discussion

All 63 test birds showed a significant directional preference according to the Rayleigh test. The mean vector direction of the sample was 117°±44° (95% confidence interval of 104°-130° assuming a von Mises distribution, cf Batschelet 1981) and the mean vector length was 0.70 ($p<0.001$). Individual headings are illustrated in Fig. 1. All except four birds grouped in the sector south-northeast.

In order to investigate if test date had any general effect on the orientation direction, the sample was divided into two groups (birds tested before 4 September and birds tested on 4 September or later). The mean headings of these two groups were 108° and 126° but this difference was not significant ($F=0.84$, d.f.=1, 61, Watson-Williams test).

The mean number of registrations during the test hour was 2468 ±159 (range 89-6976). This value is higher than that obtained for Robins *Erithacus rubecula* (1200) tested during spring and autumn migration in southern Sweden using identical equipment and a similar test procedure (Sandberg *et al.* 1988). However, the force needed to close the microswitches in these orientation cages is adjustable, making comparisons between different experiments difficult.

Some conclusions concerning the methodological reliability and the autumn migration direction of Bluethroats in a narrower and a wider perspective, respectively, can be drawn from our data.

(1) The mean orientation direction revealed by the experiments (117°) is strikingly similar to the migration direction indicated by ringing recoveries both within (120°) and outside Scandinavia (125°, Ellegren & Staav 1990). Moreover, the angular deviation of the orientation data is close to that of short-distance ringing recoveries in Scandinavia (47°, Ellegren & Staav 1990; both approaches indicating wide-angle orientation, cf Alerstam 1990). These similarities are important since they suggest that the orientation experiments reliably record the Bluethroats' directional preferences. However, it should again be emphasized that the experiments ought to be carried out under clear skies. Our preliminary data suggest that Bluethroats

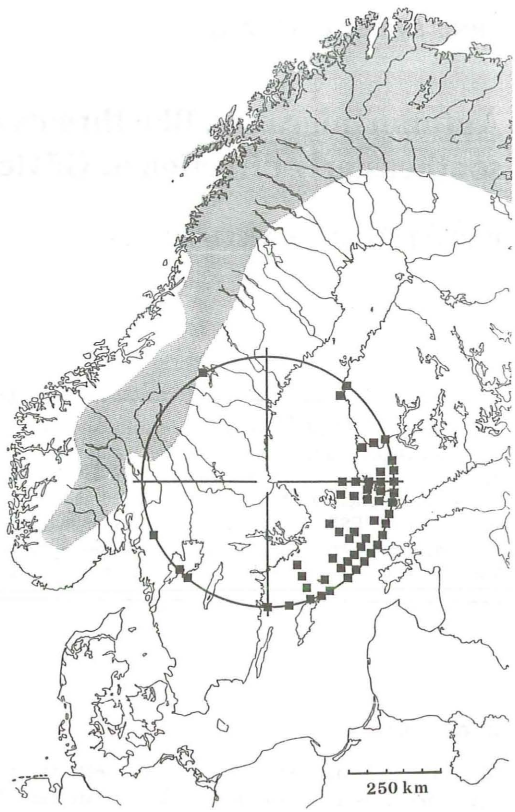

Fig. 1. Autumn orientation of Bluethroats at Gävle, East Sweden, under clear skies. The individual heading of each bird is indicated by a dot. The angular direction of the mean vector is 117° and the mean vector length is 0.70 ($n=63$, $p<0.001$). The test site is situated in the midpoint of the circle. The Scandinavian breeding range is indicated by the shaded area.

Orientering hos höstflyttande blåhakar (varje punkt representerar en fågel) testade under klar himmel vid Gävle (beläget mitt i cirkeln). Medelriktningen är 117° och medelvektorns längd är 0.70 (n=63, p<0.001). Artens häckningsområde är skuggat.

orient in a more scattered fashion under solid overcast (Ellegren & Wallin unpubl.).

(2) The orientation direction found in the experiments indicate that from this part of Sweden, most Bluethroats continue their autumn migration along the coast of the province of Uppland, possibly heading for Estonia on the other side of the Baltic Sea. In fact, the only ringing recovery outside Scandinavia of a Bluethroat ringed at our stopover site is from the Estonian island Ösel.

The distance from Gävle to the Estonian coast is 400 km. If Bluethroats, resting at the stopover site at Gävle, migrate in a non-stop flight to Estonia, a fat load of at least 8-10% would be needed (fat mass relative to fat-free body mass; still-air calculations from Pennycuick 1975). Since it probably is disadvantageous for a migrating bird to metabolize the complete fat reserve during flight, however, we may expect fat loads somewhat above 10% for this hypothetical migratory flight. Interestingly, the departure fat load of Bluethroats resting for one week or more at the stopover site has been estimated at 10-17% (Ellegren *in press*).

(3) More generally, data from the orientation experiments support the statement of Ellegren & Staav (1990) that the northern Bluethroat is a (east)-southeastern migrant. It is true that for three (out of 63) birds we recorded orientation towards southwest. However, we do not interpret this as evidence for the existence of a fraction of birds migrating towards southwest since these three birds showed rather scattered orientation pictures (a mean length of the individual vectors of 0.15 compared with 0.45 for the total sample), and also since possible elements of reorientation (Alerstam 1978, 1990) cannot be excluded. Thus, we suggest that the opinion expressed in the standard literature that northern Bluethroats migrate both towards south/southwest and southeast should be reconsidered.

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Sammanfattning

Höstflyttande blåhakar Luscinia s. svecica orienterar i ostsydostlig riktning vid Gävle

Ringmärkningsåterfynd är ett av de viktigaste redskapen för kartläggning av fåglars flyttningsvägar och övervintringsområden. Men eftersom chansen att erhålla återfynd varierar mellan olika geografiska regioner (t.ex. som en följd av språkförbistring), varierar också kunskapen om olika fågelarters flyttning. Som ett komplement till de fåtaliga fjärråterfynden av blåhake har vi använt orienteringsburar för att undersöka flyttningsriktningen hos höstflyttande fåglar fångade på en rastplats vid Gävle. Under 1989 och 1990 testades 63 unga blåhakar under klar himmel och alla visade ett signifikant riktningsval. Majoriteten av fåglarna strävade mot SO-O (se Fig. 1), med en medelriktning på 117°±44° och ett 95% konfidensintervall på 104°-130°. Vi kunde inte finna någon signifikant förändring i fåglarnas riktningsval under sträckperiodens förlopp.

Våra orienteringsdata visar en stor överensstämmelse med tillgängliga ringmärkningsåterfynd; det gäller såväl

riktning som spridning. Båda metoderna indikerar att många blåhakar som rastar i östra Svealand och längs södra Norrlandskusten fortsätter sin flyttning i en ostsydostlig riktning mot Estland. I ett större perspektiv stöder orienteringsuppgifterna vårt tidigare antagande att den skandinaviska blåhaken uteslutande flyttar i en sydostlig riktning mot södra Asien. I flera större handböcker anges att den skandinaviska blåhaken flyttar både mot sydväst och sydost, en uppgift som det nu finns anledning att ompröva.