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Brief reports

Spring migration of the Knot *Calidris canutus* in southern Finland

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Introduction

Our knowledge of the spring migration of Knots *Calidris canutus* in Northern Europe has evolved recently. Important spring stop-over sites of Knots, of the subspecies *islandica*, have been found in northern Norway and the passage of this subspecies through Sweden has been described (Strann 1992, Blomqvist & Lindström 1992). Knots of the subspecies *canutus* have a major staging site in the Wadden Sea, and fly across southern Sweden on their flight towards breeding areas in Siberia (Blomqvist & Lindström 1992). A most thorough radar study in Sweden has shown that presumably 500 000–750 000 Knots pass through the country each spring, mainly at night (Gudmundsson 1994).

Data from Finland have been scant, with only the spring of 1979 covered in the literature (Dick et al. 1987). During the springs, 1973–1993, more than one hundred thousand Knots were reported in Finland. Almost all were seen along the south coast, east of 23°E. Only stragglers visit the Gulf of Bothnia. Large flocks are infrequently seen on migration far inland. Yearly spring totals vary more than a hundredfold, due partly to the birds' choice of routes and partly to lack of observation. As the Knots tend to migrate far out to sea they are hard to observe let alone to identify. Large numbers of Dunlins *Calidris alpina*, Grey Plovers *Pluvialis squatarola*, and Bar-tailed Godwits *Limosa lapponica* can further confuse the picture.

Data for this paper were collected at Kummelskär (60°10′N, 25°51′E), which is a rocky islet on the outer edge of the archipelago some 50 km east of Helsinki (i.e. not southeast and northnortheast from Helsinki as stated in Dick et al. 1987). Forty thousand Knots were recorded there from 1973 to 1994. Below, the Knot migration at Kummelskär, its route, timing, flock sizes involved, and the relation to wind directions are outlined.

Methods

Migration was studied at Kummelskär from 1973 to 1994. Observations were made during daylight hours, 02.00–22.00 (GMT+2h) on 427 days between 19 May and 17 June inclusive. There were no observers present in June, 1987–1989. As a rule all movement of migratory birds was noted all day long, except for the average 2.5 hours of fog and/or rain each day. The number of migrants, their orientation and passing distance were estimated. Regular notes on wind, visibility, temperature, and cloudiness were also kept. Wind direction during each hour of observation was based on these notes.

Counting large flocks is difficult and estimates often end up being round figures. Num-

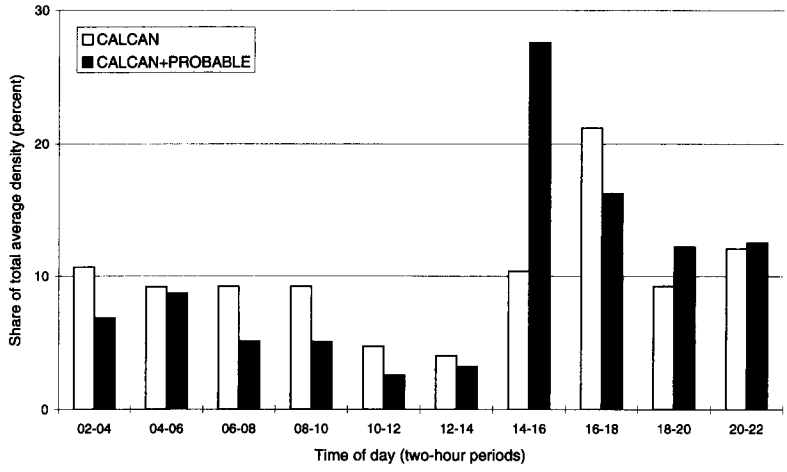

Fig. 1. Diurnal pattern of Knot migration at Kummelskär, 1973–1994, between 19 May and 17 June during the daylight hours. Knots are either identified (CALCAN, n = 39 000) or probable (n = 36 000, see text for definition).

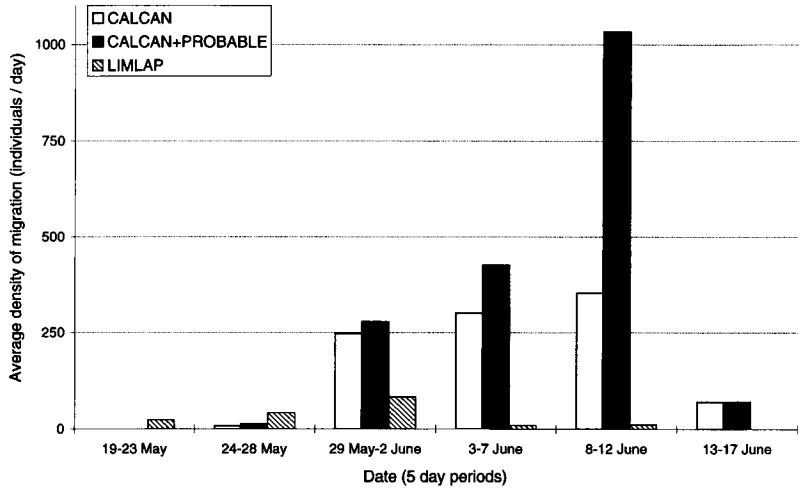

Fig. 2. Seasonal timing of Knot migration at Kummelskär, 1973–1994. Data as in Fig. 1, and Bar-tailed Godwits (LIMLAP, n = 8 300).

bers like 100 and 1000 crop up more often than they occur in reality, so to eliminate their effect flock sizes were grouped logarithmically. A lone individual was taken as one flock. In this analysis there were a total of 39 000 identified Knots in 290 flocks. In addition there were 36 000 probable Knots in 85 flocks in the dataset. Probable Knots were flocks of large waders with Knot-like reddish colour. Identified by colour alone they could also be Bar-tailed Godwits, but their seasonal timing and flock size indicate that most of them were Knots. The number of Bar-tailed Godwits identified during the same period was 8300 in 234 flocks.

The 4840 hours of observation was cut at each full hour (03.00, 04.00, ... , 21.00) into 5640 pieces. If a piece contained at least ten minutes of observation, then its density of migration (individuals / hour) was calculated. All densities were then pooled. They were grouped into 60 separate blocks of five dates by two hours and averaged within each block. Corresponding averages were then summed to obtain the diurnal and the seasonal pattern. Densities were also grouped by wind directions and averaged in sectors of 45°, with calm as a ninth group. The same routine was used for Knots, probable Knots, and Bar-tailed Godwits.

Results

Knots are seen all day long at Kummelskär (Fig. 1). From sunrise until 14.00 the densities are

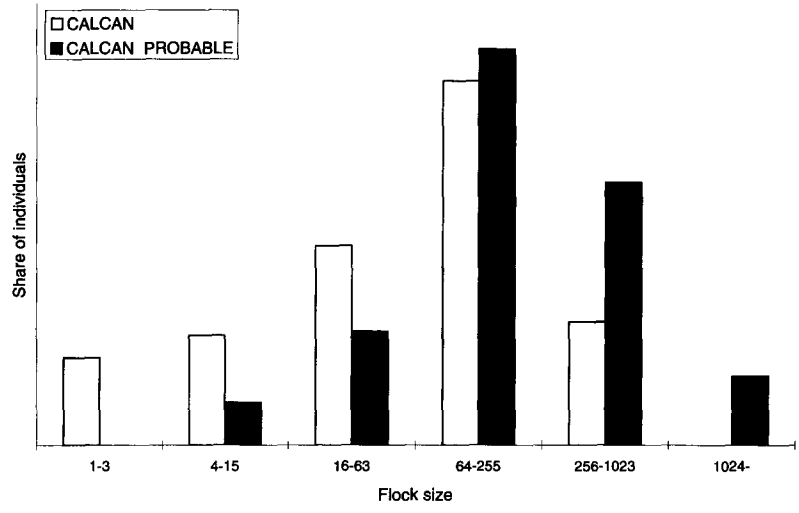

Fig. 3. Distribution of migrating Knots according to flock size (logarithmic grouping). Histograms show how common it is for a Knot to migrate in a flock of indicated size. Data as in Fig. 1.

relatively small and decreasing. Peak densities start abruptly at 14.00. The main migration period is 29 May to 12 June, the median date being 9 June (Fig. 2). The Knot's migration period seems to be earlier now than it was twenty years ago. Comparing the best watched years, 1977–1979 with 1991–1993, the dates of flocks of identified Knots were significantly earlier in the 1990s (median test, $P = 0.002$). When the probable Knots were added the change was highly significant (median test, $P < 0.001$). In the 1970s large numbers were seen around 10–15 June, while in the 1980s most passed some five days earlier. In the 1990s the observed movements peaked ten days earlier still, but the numbers (2000–8000 annually) are so small that they may not reflect the bulk of the Knot migration.

At Kummelskär almost all Knots seen in spring fly towards the east or east-northeast, only 1% of them have been grounded. Densities of identified Knots are distributed fairly evenly between different wind directions. When probable Knots are added, a north wind is very clearly preferred. Half of the total density is in the sector from the north to north-northeast, when migration is some six times denser than during hours when it is blowing from the southwest or west-southwest. The mean vector of this distribution has direction 3°, length 0.42 and its angular deviation is 62°, calculated according to Batschelet (1981).

In the staging areas Knots form flocks of thousands of birds (Davidson & Piersma 1992). During migration the flock size of this subspecies has averaged in the range of 220–290 individuals (Gudmundsson 1994). In the present study the average flock size of identified Knots is 134, of identified and probable Knots combined 200, and of Bar-tailed Godwits 35 individuals. The most common Knot observation is a single bird. As the flock size increases, the number of the observed flocks decreases. Comparing the numbers of individuals/flock size (Fig. 3), we find that flocks between 64 and 255 in size were preferred. Half of the Knots were found in flocks ranging in size between 80 and 300 birds. There are fewer small flocks in the probable group than in the identified Knots. The reason could be that small flocks do not show the colour necessary for inclusion in this group and are also easily overlooked at a distance.

Many waders pass to the south of Kummelskär at such a great distance that identification of their species is impossible (Fig. 4). Between 6 June and 17 June there were 77 000 of these in 270 flocks seen, mostly in the years 1975, 1976, 1979, and 1983. So late in the season it is very likely that they were Knots. Therefore, I checked how they would affect the results. When I combined them with identified and probable Knots the results changed only slightly. The median date moved one day later to 10 June and the peak of

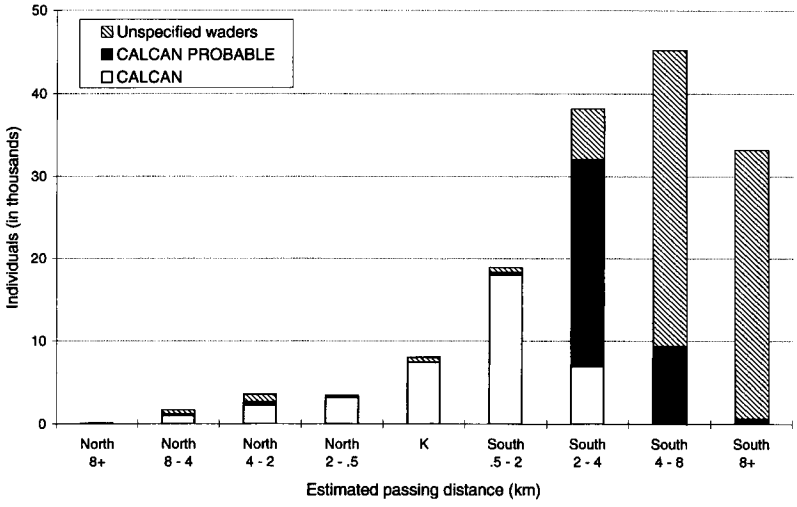

Fig. 4. Estimated distance at which Knots have passed Kummelskär (K) from the north or south side. Data as in Fig. 1. Unspecified waders between 6 and 17 June (n = 77 000).

daily activity shifted two hours later to 16.00–18.00. The average flock size grew from 200 to 235 individuals, but this is partly due to underrepresentation of small flocks, which are easily overlooked from far away. The preponderance of north winds remained, but the share of southwest by west winds grew a little. It may be concluded that the Knot migration at Kummelskär gets only slightly denser during a tail wind and is most concentrated during side winds from the birds' left.

Discussion

Knots are seen every spring along Finnish coasts. From the end of April until 25 May Knots are rare. At that time, up to fifty individuals per year can be seen, most of them stopping locally along the shores of the Gulf of Bothnia. Between the end of May and about 20 June large flocks hurry eastward without stopping. The majority of migrating Knots have been observed in the Gulf of Finland, but inland observations have also been recorded. For instance, between 4 June and 7 June 1980, 7500 Knots were recorded in the vicinity of Lahti, some 100 km from the coast (Reinikainen & Salonen 1981). By and large the occurrence resembles that reported by Blomqvist and Lindström from Sweden (1992).

Radar echoes indicate that 500 000–750 000 presumed Knots cross southern Sweden annually between 4 June and 21 June, preferably with a tail wind. The median time of passage there is 00.40 (GMT+2h), the mean heading is 63°, the average groundspeed is 89 km/h, and the average airspeed is 65–70 km/h (Gudmundsson 1994). The distance to Kummelskär from southern Sweden is 840 km and from the Wadden Sea it is 1200 km. Using the extrapolated departure time from the Wadden Sea (20.30 GMT+2h) reported by Gudmundsson (1994) and the measured average groundspeed over Sweden, most of the Knots should pass Kummelskär before noon. This is just the time of day when the density of migration here is at its lowest. Assuming that the peak departure time from the Wadden Sea is true, and comparing it to the peak time of passage at Kummelskär, the birds have flown for 18.5 hours. Their calculated groundspeed is thus 65 km/h, which is close to the estimated airspeed of this species, indicating little or no wind assistance.

It is clear that in spring only a minority of the migrating Knots are seen in Finland. Supposedly the majority fly either so high as to be visually unobservable or they fly around Finnish territory altogether. There are some theoretical grounds to support the former idea. Firstly, presumed Knots were seen on a radar screen in June 1979 flying over Helsinki at altitudes from 0.5 to 3.0 km (Dick et al. 1987). Secondly, it has been shown that from 1979 to 1991 wind assistance for birds migrating from the Wadden Sea to Taymyr Peninsula was greatest at altitudes from 1.5 to 3.0 km (Piersma &

Sant 1992). On the other hand, the birds do seem to skirt Finnish territory, since the further south you go in Finland or the further south from Kummelskär the density of Knots increases.

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