RESULTS OF THE WSG PROJECT ON THE SPRING MIGRATION OF SIBERIAN KNOT Calidris canutus 1979

by W.J.A.Dick

Introduction and Methods

With almost all data now to hand, the results of the project are most encouraging. This article is intended to summarise the results, which will shortly be submitted for full publication in a journal.

The project outline was detailed in WSG Bulletin 24, pp 5-7. The distribution of observers who volunteered to participate, and/or sites from which data have been obtained, are shown in Fig.1. The record of negative counts has been of considerable importance, as will be shown later. Several participants supplied valuable counts or ringing data from previous years. As expected, ringing and biometric data were obtained from few sites only. These data are, however, essential to the interpretation of the overall migration strategy.

It has not been possible in the text to mention the exact contribution of the numerous individual observers, but contributors in each country are listed under "Acknowledgements".

Results

a) Colour-dyeing

The colour dyeing programme has proved to be the most disappointing aspect of the project.

Fig. 1. Distribution of participants. Stars - ringing and counting
Circles - counting

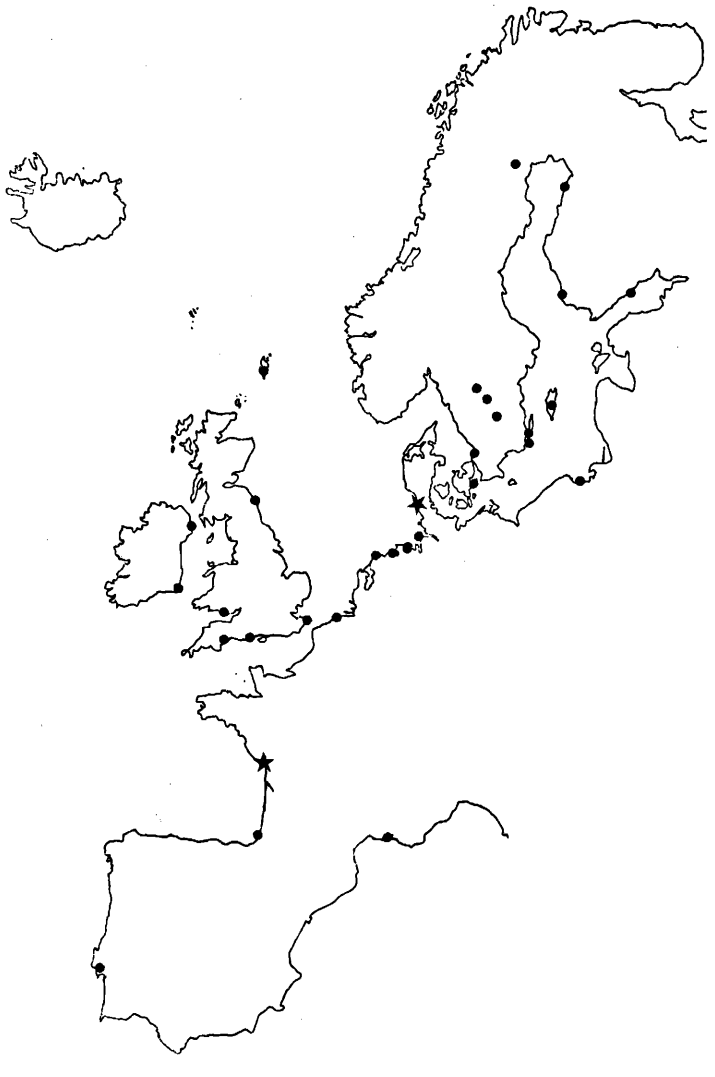
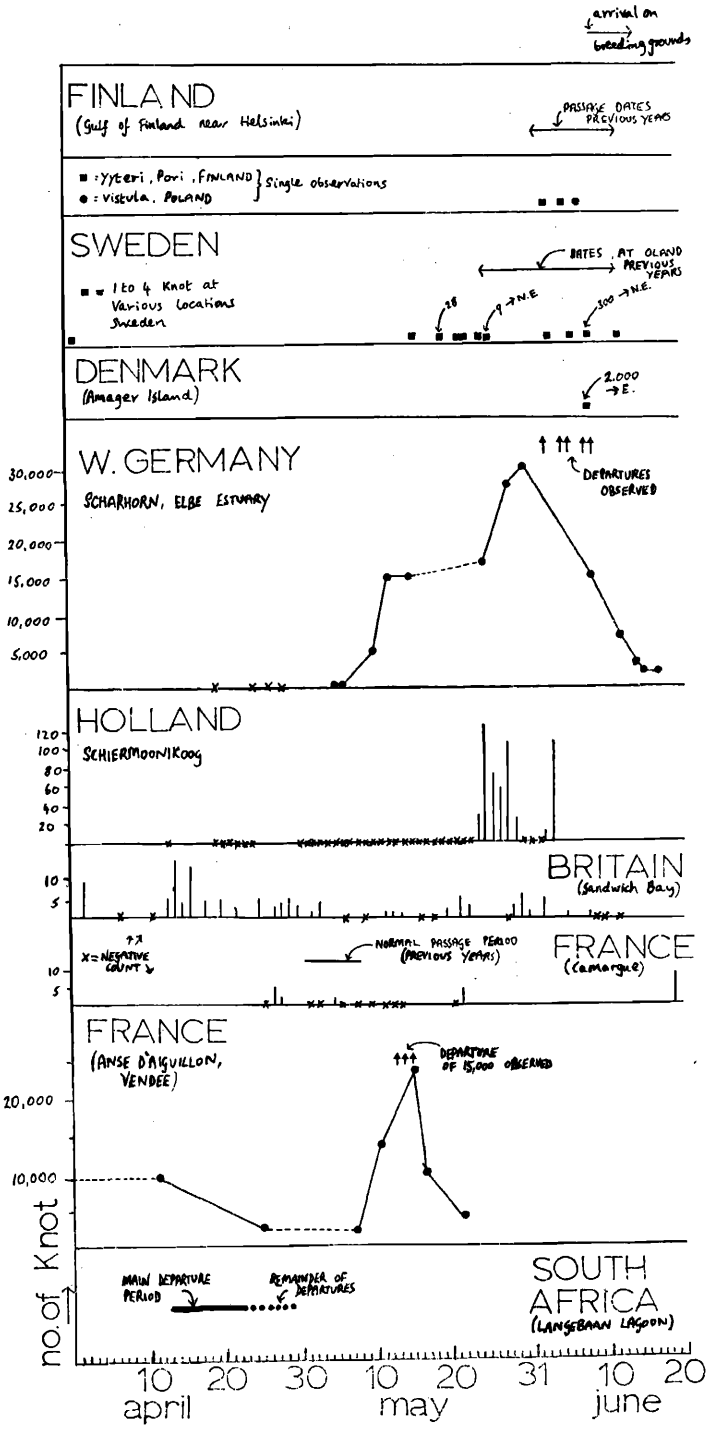


Fig. 2. Summary of timing of migration.



54 adult Knot were dyed between February and April 1979 with picric acid on the undersides, rump and wing bar, at the Langebaan Lagoon, South Africa. At the Anse d'Aiguillon, Vendée, France, 200 were dyed blue in the same positions, mainly on 12th and 15th May. No sightings of either group were reported. The largest numbers searched were in the Vendée (at least 5,000 searched), Nordfriesland, Germany (over 3,000 searched) and Scharhorn, Germany (over 7,000 searched, although some of the same birds may have been present on several days when searches took place). Smaller numbers were searched in Holland, Britain and elsewhere.

The lack of sightings cannot be taken as firm negative evidence. Although the blue-dyed Knot were strikingly obvious shortly after being dyed in Vendée, it is not known how long the dye lasted. The picric acid could easily have been missed due to its similarity in colour to the breeding plumage of Knot, and in any case the samples dyed were small.

b) Counts

A very good spread of observations was obtained along the Atlantic seaboard of Europe. In spite of the lack of data from the African coastline, the departure information from South Africa allows us to predict the likely pattern of migration along the African coast. A summary of the timing of the passage is shown in Fig.2. Details of the data to hand at present are summarised below.

South Africa. The departure period was mainly between 14 April and 21 April. Some adults were still present as late as 28 April. The 1979 departure period was both later and more drawn out than in previous years.

France. Knot were counted in the Anse d'Aiguillon from mid April onwards. Fig.2 shows that there was a rapid build up of numbers to a peak of about 25,000 on 15 May. Flocks, totalling about 15,000 birds, were observed departing in a NE direction on 13, 14 and 15 May. Following this numbers fell and passage was probably complete soon after 24 May, although further counts were not made.

Counts on 11 and 24 April reflect the departure of the Greenland/Canadian population, which overwinter in Vendée. There is probably little overlap of the two populations in the Vendée.

The arrival date in the Vendée in 1979 was at least a week later than in previous years, although departure dates were similar.

In the Camargue, exceptionally few Knot were seen in spring 1979, about 20 birds. Numbers fluctuate very much from year to year, maximum counts ranging from 26 to 1,100 birds, the major passage period being during the first week in May (A.R.Johnson, pers. comm.). The occurrence of Knot at all at the Camargue is of interest in considering the possibility of trans-Saharan migration.

The Anse d'Aiguillon is by far the most important site in France for both wintering and passage Knot.

Belgium. There are no important feeding areas for Knot on the Belgium coastline. Large numbers of Knot have been observed in previous year migrating at sea, but quantitative data are not available. Counts of small numbers of resting Knot near Oostende in previous years show the spring peak during May.

Britain. Counts were made at Sandwich Bay in SE England on an almost daily basis. Very few Knot were observed and there was no pattern discernable. This contrasts the position in the autumn when Knot, probably particularly juveniles of the Siberian population, are more numerous.

Negative counts were made at Poole Harbour on the south coast, in Glamorgan, south Wales, and in the Shetland Islands, Scotland. All these are "marginal" areas for wintering Knot. The major estuaries were not counted due to the problems of separating small numbers of Siberian passage birds from Knot of the Greenland/Canadian population.

Holland. A very valuable set of counts were made on the island of Schiermoonikoog on a daily basis. Negative counts were made from 13 April to 23 May, Flocks of 10 to 125 Knot were observed resting or migrating in an ENE direction most days from 24 May to 4 June, when observations ceased. This area of the Dutch Waddensee is of far less importance to Knot during spring than it is in autumn. The passage during 1979 was considered to be about a week later than in previous years.

West Germany. A most valuable set of data were obtained from the island of Scharhörn in the Elbe estuary. Practically no Knot appear there except on migration. Numbers built up rapidly to about 15,000 between 5 and 12 May. There was a further increase to 30,000 on 30 May (Fig.2.). Flocks were observed departing from Scharhörn between 2 and 10 June (Fig.3), which coincided with a rapid fall in numbers to only about 200-500 by 16 June. The 1979 counts reflect a similar pattern to 1978 counts, although there was a less marked peak at the end of May in 1978. Counts made in 1955 suggested a marked double peak in spring numbers (Temme 1967).

Further north in Germany, counts were made over the whole of the Schleswig-Holstein coast by air, and at certain areas on the coastline in the Nordfriesisches Wattenmeer on a regular basis on the ground. The following approximate totals of Knot were counted over the Schleswig-Holstein coast:

25 March : 48,400; 22 April : 139,000: 6 May : 253,200.

Five study areas in Nordfriesland counted on a weekly or fortnightly basis showed peak numbers between 20 and 31 May. Of particular importance were the counts in the Nordstrander Bucht, under threat of reclamation (see elsewhere in this Bulletin), where nearly 10,000 Knot were present on 20 May but very few present on 6 May and 10 June. Due to the presence of both Siberian and Greenland/Canadian Knot in Nordfriesland, interpretations of the data is difficult (see Discussion). 1,000 Knot were observed departing in a NE direction on 28 May, together with Bar-tailed Godwit Limosa lapponica, Grey Plover Pluvialis squatarola and Brent Geese Branta bernicla, all Siberian breeding species.

Denmark. The part of the Wattenmeer north of the Danish border has been shown to be of little importance in spring to Knot, in comparison to the German part (Meltofte 1979 and in litt.).

On Amager island, near Copenhagen, three flocks of 500, 500 and 1,000 Knot were seen departing on migration due east on 8 June.

Sweden. 11 observations of between 1 and 4 Knot were made at scattered locations on the following dates: 24, 25 March; 1 April; 16, 20, 22, 23, 25 May; 3, 6, 12 June. Four of these were at inland sites, and the three records prior to 16 May were all in the Skane district, close to Denmark. 28 Knot were seen in Skane on 20 May. 300 Knot were seen flying NE at Ottenby, Oland, on 8 June. 9 were seen on the island of Gotland on 26 May, flying in NE direction.

Knot do not rest or feed on the Swedish coasts in spring, and are only seen irregularly, particularly in bad weather. In previous years flocks have been seen on Oland in spring: 600 on 9 June 69; 120 on 12 June 69; 1,000 on 30 May 70; 150 on 6 June 71; 100 on 28 May 76; 370 on 29 May 76; 160 on 30 May 76 and 55 on 25 May 77.

Poland. Observations were made on the estuaries of the Rivers Vistula and Reda. Two Knot in breeding plumage were seen on 7 June at the Vistula. Knot only occur in small numbers in spring and autumn on the Polish coastline.

Finland. Counts were made on a daily basis at Tauvo and Yyteri in the Gulf of Bothnia. No Knot were seen at Tauvo from mid-April until 15 June. At Yyteri only two individuals were seen on 3 and 5 June in spite of daily counts in May and June.

In previous springs very few Knot have been seen at Yyteri with a maximum of 5 to 10 observations per year.

In the Gulf of Finland in 1979 mixed flocks of Grey Plover Pluvialis squatarola and Knot were seen on 3 June (1530), 5 June (2630) and 6 June (370). Substantial numbers of Knot - as many as 40,000 to 60,000 - have been seen on migration near Helsinki in previous years, mostly between 1 and 12 June. Knot and other species of waders migrate rapidly up the Finnish Gulf, highest numbers being observed from rocky islets in the Gulf; they do not stop to feed or rest on the Finnish coast and numbers are very variable from year to year depending on weather conditions. Radar observations indicate migration at 2 to 4.5km height (T.Tallgren, pers.comm.)

c) Ringing recoveries

Recoveries of Knot discussed by Dick et al (1976) related to the autumn migration of Knot. The first two spring controls of African ringed Knot were made in 1978. All known spring recoveries and controls are listed below:

1) Pretoria 4-29249 14.12.74 Euring age code 7 Langebaan Lagoon, South Africa v 7.5.78 Anse d'Aiguillon, France
2) Pretoria 4-23904 & 4-19389 4.3.73 age code 3 Langebaan v 30.12.73 age code 6 Langebaan v 7.5.78 Anse d'Aiguillon
3) Pretoria 4-19389 30.12.73 age code 3 Langebaan v 15.5.79 Anse d'Aiguillon
4) Paris GE 0403 16.11.73 age code 4 Serenni, Mauritania v 26.5.79 Tümlauer Bucht, Schleswig-Holstein
5) Paris GE 0612 17.11.73 age code 4 Serenni x 15.5.75 Gironde, France
6) Paris GC 87026 7.9.72 age code 3 Sidi Moussa, Morocco x 19.5.78 Cadiz, Portugal

Ringing details are awaited of a Swedish ringed Knot controlled in Germany on 26 May 79 and a Danish Knot controlled on 15 May 79 in the Vendée, both most probably Siberian birds.

Two British ringed Knot were controlled on 9 May 79 at Föhr, Nordfiesland, amongst 98, confirming bill length analysis that these birds were of the Greenland/Canadian population.

d) Population determination by bill length analysis

Separation of Siberian and Greenland/Canadian populations is possible using bill length data. In the Vendée in 1979, as in 1978, bill lengths on 12 and 15 May clearly indicated Siberian birds (35.26 ± S.D. 2.02mm, n=331). In Germany, the situation is more complicated. Bill lengths of catch at Föhr, Nordfriesland, (33.33± 1.80mm, n=98) were clearly Greenlandic/Canadian. Unfortunately, in spite of considerable efforts, few Knot were caught after this date. The mean bill lengths of 13 Knot caught at Tümlauer Bucht, Nordfriesland (which included the Mauritanian and Swedish controls mentioned above) was intermediate between the two populations.

e) Weights

Weights are available from South Africa, France and West Germany, and are summarised in Fig.4. In South Africa, the mean weight of catches on 21 and 28 April was 188g. Previous years data have shown an increase in weights from a "summering" (i.e. northern winter) weight of about 130g to a mean of about 190g at departure (Summers and Waltner 1979). Bearing in mind that it is probably the top quartile of individuals in such weight distributions which have achieved departure weight, it is probable that 210g is a normal departure weight. This weight is closely in line with known departure weights of the Greenland/Canadian population from Morecambe Bay on the NW coast of England and from Iceland.

In the Vendée, mean weights on 12 and 15 May were 126.1 and 113.5 respectively. These are very low weights indeed, some birds weighing as little as 84g. Fat free weights of Knot in temperate areas are about 130g (e.g. Minton 1975) although lower in tropical areas (Dick and Pienkowski 1979). Minimum survival weight of emaciated juvenile Knot found in Mauritania was about 65g. Arrival weights in Vendée therefore probably represented depletion not only of fat reserves, but also other body reserves, e.g. protein. It is interesting to note the difference in mean weights between 12 and 15 May is due to departure of birds weighing about 130g (Fig.4). This period corresponds with observed departures from Vendée (see above).

In Germany, information is limited. The weights of the Greenland/Canadian sample on 9 May were extremely spread (180.6 +S.D. 26.7g, n=99 range 122 to 230g). On 26 May the small sample of probably Siberian birds weighed 189.5±S.D. 13.6 (n=13).

Discussion

The Migration route

The known wintering areas of Siberian Knot are mainly in Mauritania (130,000 birds) and South Africa (about 10,000 birds). Recent counts (Trotignon 1979) suggest that numbers in Mauritania may be considerably higher (334,000). Between these areas the coastline is essentially uncensused, although the little data available suggest few Knot winter there (Dick et al 1976). The Mauritanian population has been studied only from September to December, but in South Africa has been studied throughout the year. Thus there is no departure information or arrival information in West Africa.

The evidence that Africa is the destination of Siberian-breeding Knot is based largely on the recovery patterns in Western Europe and other data collected mainly in autumn (Prater 1974, Dick et al 1976). A migration route via the European coastline is logical, on consideration of great-circle routes, for Mauritanian-wintering Knot, although recoveries nos. 4 and 5 above provide the only firm evidence for spring migrants. For South African birds, minimum flight distance is via the East African coast, 13,300km as opposed to at least 15,500km via west Africa and western Europe. However, the evidence from recoveries 1, 2 and 3 is that the spring migration is, as in autumn, via the western route. The lack of observations of Knot in East Africa and central Europe, the probable lack of suitable feeding areas, and the flight calculations shown below, support the hypothesis that this route is most likely for South African birds.

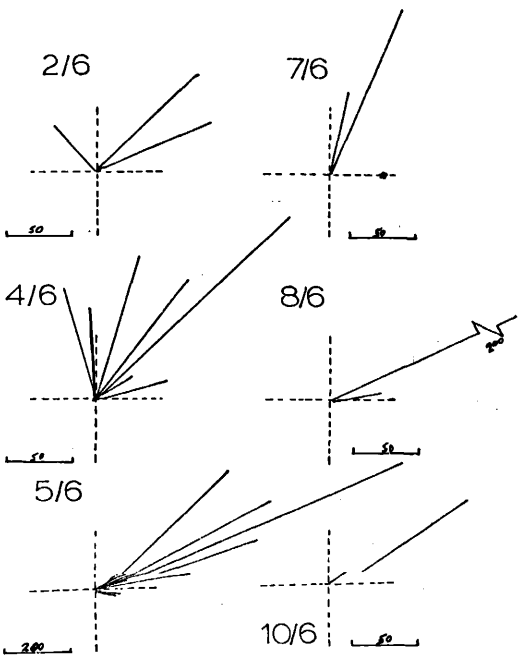


Fig. 3. Departure directions of Knot on six dates from island of Scharhorn, Elbe Estuary.

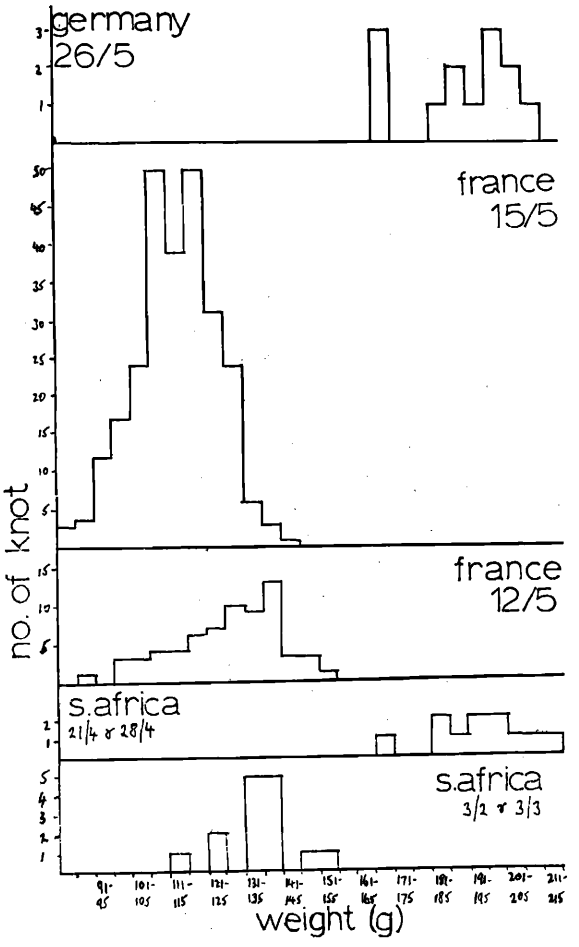


Fig. 4. Weight distribution of Knot in four countries.

To the south of the Vendée, it is not possible to say how closely the coastlines of Africa and the Iberian peninsula are followed. The occurrence in the Camargue of irregular numbers of Knot in spring does not preclude the possibility that the birds migrated via the west African coastline beforehand, although other species such as the Curlew Sandpiper occurring there are known to follow an overland route.

To the north of the Vendée, the pattern of estuary usage is clearer. There are no areas of significant importance where Knot rest or feed between Vendée and West Germany. Negative data from 1979 and previous years shows that Siberian Knot do not alight or feed on the coasts of Northern France, Britain, Belgium or the Netherlands in significant numbers: areas where concentrations of Knot occurred would have been detected but none were found. A minimum of, say, 100,000 Knot (allowing for sub-adult birds remaining in winter quarters) must overfly these coasts (or fly inland). The lack of observations indicates that Knot move long distances in continuous flights between known feeding areas at heights above observer range.

This year's observations support previous year's data on the route through the Baltic. Knot leaving Scharhörn, West Germany depart mainly on bearings between NE and E (Fig.3). They do not regularly alight on the shores of Denmark, Sweden, Poland or Finland. They are observed in flight in variable numbers in these areas depending on weather conditions. They appear to migrate through the Gulf of Finland rather than through the Gulf of Bothnia. This route is close to the great circle route to the Taimyr Peninsula, the nearest part of the breeding range.

The timing of migration

Fig. 2 presents a fairly clear picture of the timing of the migration from South Africa to arrival in West Germany. The initial arrivals at Scharhörn are at the same time as arrivals at the Vendée, which is consistent with the hypothesis that some birds overflew the Vendee and migrated direct to West Germany. However, we cannot say that the Scharhörn birds definitely did not contain any of the Greenland/Siberian population. But the pattern there is different from the numbers in Nordfriesland. The Schleswig-Holstein surveys showed 140,000 Knot there when none were at Scharhörn. Numbers in Schleswig-Holstein increased to 253,000 on 6 May (partially reflecting a more complete survey), some of which could have been Siberian birds. The situation in Nordfriesland is under close analysis (Prokosch et al, in prep.) but it is possible to say that the Nordfriesland area is of proven importance to the Greenland/Canadian population, and almost certainly also of great importance to the Siberian population. Total numbers at Scharhörn do not account for more than one third of the Siberian population, the balance of which was probably in Nordfriesland.

The timing of the passage through the Baltic is very consistent from year to year in the first two weeks in June. Observations in 1979 were all consistent with these dates and with departures from Scharhörn. They also correlate well with arrival information in the Taimyr Peninsula given by Birula (1907).

Timing of migration in relation to energy requirements

The count and biometric data from the project allow one to compare departure and arrival dates, distances travelled, energy requirements and time available for flying and feeding. Certain assumptions have been made in the following calculations:
- Great circle distances have been used between key points on the migration route. These approximate to distances along coasts except round the Gulf of Guinea, and in any case there is no evidence that Knot necessarily follow a coastal route, but some that they take the shortest routes (Evans 1968, Grimes 1974, Dick et al 1976).

- A rate of weight increase of 3g/day is assumed, following the rates for the Greenland/Canadian population given by Prater & Wilson (1972) for Britain and Iceland.

- For calculation of maximum flight range, a fat free weight of 120g is used and a departure weight of 210g, winglength of 175mm and estimated flight speed of 80km/h. Using these figures in the formulae given by McNeil & Cadeaux (1972) and Greenwalt (1975), a flight range of approximately 5,000km was calculated.

The following calculations are based on an "average" migration dates of: depart South Africa 18 April, arrive Vendée 10 May, Depart Vendée 14 May, Arrive West Germany 16 May, Depart West Germany 5 June, Arrive Taimyr 9 June, 22 days pass between leaving South Africa and arrival in Vendée. The great circle route to Vendée follows the coast to Nigeria (3,300km) then overland (5,700km). A flight via the West African coast (e.g. via Mauritania) involves a minimum distance of 6,800km plus 3,300km. Flight time (based on 80km/h) of 4⅓ days leaves 17½ days when the birds stop somewhere to feed. At 3g/day, this is equivalent to a weight increase of 52.5g.

We know that Knot arrived in the Vendée weighing 105g, probably implying utilization of protein, as well as fat reserves. Thus, calculated total usage of (210 - 105) + 52.5g fat, gives a calculated flight range of about 8,700km. This, within a reasonable margin of error, is similar to the actual distance - a flight speed of about 90km/h would balance the equation.

Therefore, there must be at least one staging post between South Africa and the Vendée, where about 50g fat is deposited. We do not know whether the staging post is Mauritania or not. Note, however, that most of the Siberian birds start from Mauritania.

From the Vendée to West Germany is a distance of 1,100km, a flight of about 14 hours requiring approximately 20g of fat. Knot leaving the Vendée were known to weigh 130g on 14 May, giving an arrival weight in Germany of 100g. 7 days in the Vendée would, in theory, be required to deposit 20g fat, which corresponds exactly with known first arrivals to first departure dates, i.e. 7 May and 14 May. Knowing the weight distribution on 15 May, and the counts after that date, one can predict that the majority departed weighing about 125g, and the lighter arrivals rather less.

In West Germany no catches are available to confirm arrival weights. For the Vendée birds, arriving at 110g on 16 May, a weight gain of 3g/day gives a departure weight of only 170g on 5 June. In fact, the mean weight of a sample on 26 May was 180.5g. This provides some support to the hypothesis that some birds arrived earlier than, or in better condition than, the Vendée birds. Knot weighing 180g on 26 May could achieve a departure weight on 5 June of 210g.

The distance from Germany to the Taimyr is about 4,000km, a flying time of two days. About 78g of fat are required and, in addition, feeding conditions on arrival in Siberia may be very poor depending on the date of snow melt. Reserves would be required for survival and possibly for egg formation to allow an early start to breeding.

The well established passage period through the Baltic confirm that there can be no feeding grounds in the Baltic and the short time between known departure dates from Germany and arrival dates on the breeding grounds do not allow significant feeding time. The findings of the project underline the crucially important position of the German Wattenmeer within the migration system, as a final fattening ground for Siberian and Greenland/Canadian populations.

The calculations given above are approximate only and will be discussed in more detail in the main publication of the project. Small differences in, for example, weight gain or ground speed (which may be substantially affected by altitude and upper air streams), which are assumed in these calculations could alter the equations. However, it would appear that there is a fine balance between energy available and flight distances involved.

Conclusions

The most important findings of the project can be summarised as follows:

1) Most, and probably all, the South (and West) African wintering population migrate via the western European seaboard, and not via the East African coastline. This is in contrast to other species of wader such as the Curlew Sandpiper and the Little Stint, which migrate via a more direct route across East Africa and the Caspian Sea (Summers and Waltner 1979). The divergence of migration strategy may be related to the availability of suitable intertidal habitat which appears to be required by the Knot.

2) Knot migrate in extremely long flights between few strategic feeding sites. They are rarely recorded in flight or resting between these sites. The only estuaries where large numbers of Knot of the Siberian population have been recorded in previous years or in 1979 are in Portugal; in Vendée, France; and in West Germany.

3) At least one staging area must exist between South Africa and the Vendée.

4) It seems probable that a proportion of Knot migrate direct from wintering grounds in Mauritania to West Germany. In 1979 probably only birds in least good condition stopped at sites such as the Vendée. Evidence from 1978 and 1979 suggests that South African (as opposed to Mauritanian) birds predominated at these intermediate sites despite their lower overall numbers. Sites such as the Vendée probably have an essential role in providing feeding areas for birds held up by e.g. poor weather.

5) The migration, from leaving South Africa to arriving in Germany, appears to have been about a week later than in previous years.

6) The observed weight levels and flight schedule fits remarkably well with calculated flight ranges and rates of deposition found elsewhere. The calculations indicate, possibly in connection with the delayed migration in 1979, that the part of the population occurring in the Vendée was in a very poor condition which would give a fine balance in accumulating the necessary reserves in time for onward migration from Germany to the breeding grounds.

7) Germany is shown to be the last fattening site within the migration system, and is the single most important site for Siberian Knot in Europe. It is also shown to be of major importance to the Greenland/Canadian populations.

Publication of results

Some of the interpretations in this article are speculative and represents the first stage of analysis. A fuller paper is being prepared with joint authors from four countries and will hopefully be submitted for publication before the year ends. It will also contain a fuller analysis of previous years' data and the literature and should be used when referring to the results of the project. It will have been scrutinised more closely by referees!

Acknowledgements

The results of this project could not have been achieved other than by co-operative fieldwork of observers and ringers over a wide geographical area. I am extremely grateful to all those taking part for their efforts and helpful comments. I hope that participants will appreciate that it has not been possible, due to the data being drawn from such a large number of people, to acknowledge individual contributions in the main text. It is intended that fuller acknowledgement will be given in the main paper.

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Future Plans

Departure information from West Africa, and the location of staging areas in Africa are still (and likely to remain) unknown. Within Europe, some of the main questions posed by the project are, for example:

- Was the arrival date and poor condition of Knot in 1979 a normal occurrence?
- Which areas in Germany are used by which population, and what are the rates of weight increase for each population? Is there competition?
- What proportion of the population normally stops in areas such as the Vendée, and is this a particular segment of the population?
- What effect is reclamation likely to have in areas such as Wattenmeer?
- How fine is the balance between energy available and flight requirements?

It seems that to answer these questions fieldwork needs to be concentrated in areas such as Portugal, Vendée and Germany. Probably it is not worthwhile mobilising a general observation network as this year, as it seems clear that Knot do not occur except at these key areas. Colour dyeing at the Vendée to plot movement to Germany, for example, would be valuable as there is no firm, only circumstantial, evidence of the movement. Future plans are under discussion and will be reported in WSG Bulletins.

Previous years data and weather patterns will be investigated.

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