Variation in Timing of the Siberian Knot Calidris c. canutus Autumn Migration in the Puck Bay Region (Southern Baltic)

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Source: Acta Ornithologica, 40(2) : 95-101

Published By: Museum and Institute of Zoology, Polish Academy of Sciences

URL: https://doi.org/10.3161/068.040.0205

ACTA ORNITHOLOGICA
Vol. 40 (2005) No. 2

Variation in timing of the Siberian Knot *Calidris c. canutus* autumn migration in the Puck Bay region (southern Baltic)

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Meissner W. 2005. Variation in timing of the Siberian Knot *Calidris c. canutus* autumn migration in the Puck Bay region (southern Baltic). Acta Ornithol. 40: 95–101.

Abstract. The first stage of the Siberian Knot's autumn migration between its breeding grounds in Taimyr, Siberia and the W European tidal flats is still poorly understood, despite our expanding knowledge of this species. This paper analyses data (1988–1995) on the numbers of Knots and the timing of their migration in the Puck Bay region of the Baltic Sea (N Poland). The timing varied greatly between seasons. The timing of adult migration is linked to breeding success. In seasons with low breeding success both males and females leave the breeding grounds earlier, and the correlation between the mean date of adult migration and the number of juveniles is consistent with this phenology. The differences between the departure dates from the Taimyr breeding grounds provided by published sources and the dates of arrival at Puck Bay suggest that Knots cross the northern tundra regions very quickly (at least, the earliest birds to arrive do so). The numbers of juvenile Knots turning up on the Polish coast appear to depend not only on the lemming cycle in the breeding grounds, but also on other factors, like local weather conditions, which could influence the number of juveniles observed.

Key words: Knot, *Calidris canutus canutus*, autumn migration, migration timing, Baltic

Received — Aug. 2005, accepted — Nov. 2005

INTRODUCTION

The Siberian Knot occurs in the southern Baltic almost exclusively during autumn migration. Spring records are very rare (Gromadzka 1992, Meissner & Sikora 1995). This species is observed mainly on the seacoast, but has also been recorded regularly in some inland sites in very low numbers (Glutz von Blotzheim et al. 1975, von Knorre et al. 1986, Tomiałojć & Stawarczyk 2003). The tidal areas of the Wadden Sea are the main European refuelling site for Siberian Knots migrating from breeding grounds on the Taimyr Peninsula to west African wintering grounds (Boere 1976). The birds stay there for several days or weeks and gain fat reserves before departure to West Africa (Piersma et al. 1992, Nebel et al. 2000). The very low body mass of adult Knots caught on the Polish Baltic coast leads to the conclusion that Baltic sandy beaches with no regular tides are only emergency stop over sites, used by birds forced to interrupt their flight to the Wadden Sea due to e.g. worsening of weather conditions during the flight or poor feeding conditions at the preceding refuelling place (Piersma et al. 1992). A similar situation has been found for adult Sanderlings *Calidris alba* and adult Bar-tailed Godwits *Limosa lapponica* caught in Puck Bay region (Meissner & Włodarczak 1999, Meissner & Ściborski 2002). Juveniles carried relatively larger energy stores than adults and they may use southern Baltic as one of many stop-over sites on the way to their wintering grounds (Meissner & Kamont 2005).

Data published so far on the Knot migration phenology in the Baltic area concerned only a few seasons (Meissner 1992, Meissner & Sikora 1995) or showed only a general migration pattern (Brenning 1986, Frikke & Laursen 1992, Gromadzka 1992). Adults arrive at southern Baltic coasts about 20–30 days ahead of juveniles, similarly to other waders that breed in high arctic (Gromadzka 1987, Meissner 1992, Meissner & Sikora 1995). Conspicuous variability in migration terms of this species has already been noted (Meissner 1992), but has not previously been quantified.

The main aim of this study is to analyse the causes of interseasonal variation in the timing and dynamics of autumn migration of Knots passing through the southern Baltic.

STUDY AREA AND METHODS

Studies were conducted between 1988 and 1995 in Puck Bay region, on the sandy spit in Rewa (Fig. 1). The length of the spit depended on water level and varied from ca. 500 to 1000 m. During this period counts of waders were made every day between mid July and the end of September. 398 adult Knots were caught, ringed and measured in a standard way (Meissner & Kamont 2005). A more detailed description of the study area and methods are given in Meissner & Remisiewicz (1998).

The timing of the fieldwork differed slightly among seasons. To standardise this, a reference period at 19 July–27 September was established, when counts were conducted every day in all years. To compare the number of migrants in different years, the sum of the total numbers of birds recorded on each day of reference period was used. Due to an unknown turn-over rate of birds staying in the study area, this sum does not reflect the real number of Knots that migrated in a given season. The median retrapping intervals in studied seasons varied between 2 and 3 days in adults and between 3 and 4 days in juveniles (Waterbird Research Group KULING, unpubl. data). Thus, it was assumed that variation in the length of birds' stay among seasons are not so great as to have a major influence on the observed large differences in the sums of counted birds in different seasons. Thus, these sums were used as a relative measure of migration intensity in each autumn.

Adults and juveniles were identified on plumage differences and the analyses of migration phenology were performed separately for each age class. For the reference period, the date of the median, the first and third quartiles and 5th and 95th percentile of the total number of migrants were calculated for each analysed year.

To examine if there were differences in the migration timing between adult males and females, the sex of trapped birds was assessed using the discriminant function derived by Tomkovich & Soloviev (1996). In total, 190 adults were identified as males and 117 as females. All statistical procedures were performed using STATISTICA 6 software (StatSoft 2001) according to Zar (1996).

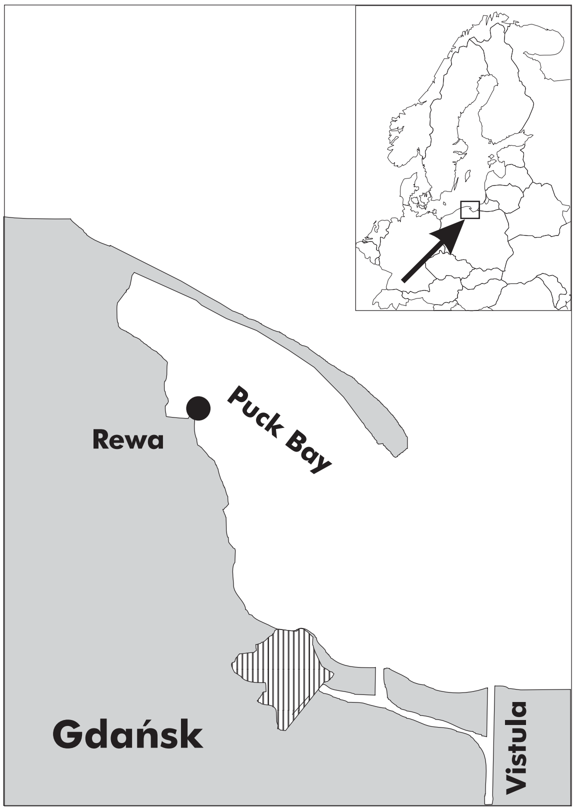

Fig. 1. Location of study area.

RESULTS

Number of Knots in different autumns

The number of juveniles was noticeably higher in 1988, 1990, 1991 and in 1995 than in other years (1989, 1992, 1993, 1994) (Fig. 2). Numbers of adults also showed great between-year fluctuations with the highest numbers recorded in 1988, 1992 and 1995. There was no significant

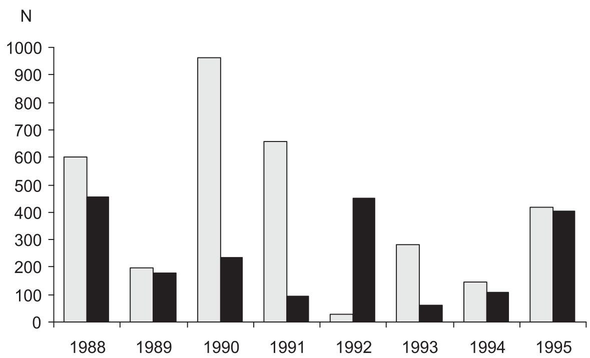

Fig. 2. Numbers of juvenile (grey bars) and adult (black bars) Knots recorded at Rewa in autumn 1988–1995.

correlation between the number of adults and juveniles recorded in subsequent seasons (Kendall rank order tau < 0.01, $p > 0.05$).

In Rewa 62% of caught adults were classified as males and this result significantly differ from equal share of both sexes ($\chi^2 = 8.6$, $p < 0.05$).

Phenology of autumn migration

Adults. Adult Knots arrived at the Puck Bay about mid-July. The earliest migrant was seen on 13 July. The phenology of adult migration varied between years (Fig. 3). Their main migration period, when over 95% of birds passed through the study area, was lasted between 23 and 38 days in different years. The earliest median date of migration was noted in 1992, when vast majority of adult Knots passed study area in four days between 29 July and 1 August. This year was exceptional — in other years median dates all fell within the 11 day period from 7 to 17 August. The last adults were seen usually in the Puck Bay region in the first decade of September, however, exceptionally, a single bird was recorded on 22 September.

For the analysis of migration timing of adult males and females two groups of years were chosen. The first one consisted of years with high number of juveniles implying years of high breeding success: 1988, 1990, 1991 and 1995 (see Fig. 2); the other four years with lower numbers of juveniles formed the second group. In general, females migrated through the Puck Bay earlier than males. The difference between median dates was 7 days in seasons with presumed low breeding success and 8 days in season with high numbers of juveniles. In years with large number of juveniles, both males and females migrated significantly later than in other seasons (median tests: $\chi^2 = 27.3$, $p < 0.001$ for males and $\chi^2 = 6.5$, $p = 0.01$ for females) (Fig. 4).

Juveniles. The first juveniles reached the Puck Bay in the first half of August (median date 10 August, range of medians in different years 11 days). The earliest one was observed on 6 August 1988. Migration periods of juveniles varied between years (Fig. 3). The variation of juveniles' median date of migration was two weeks. The earliest median date occurred in 1995 (28 August), with the latest in 1991 (10 September). The migration of juveniles usually was over by the end of September. The latest juvenile Knot was observed on 17 October.

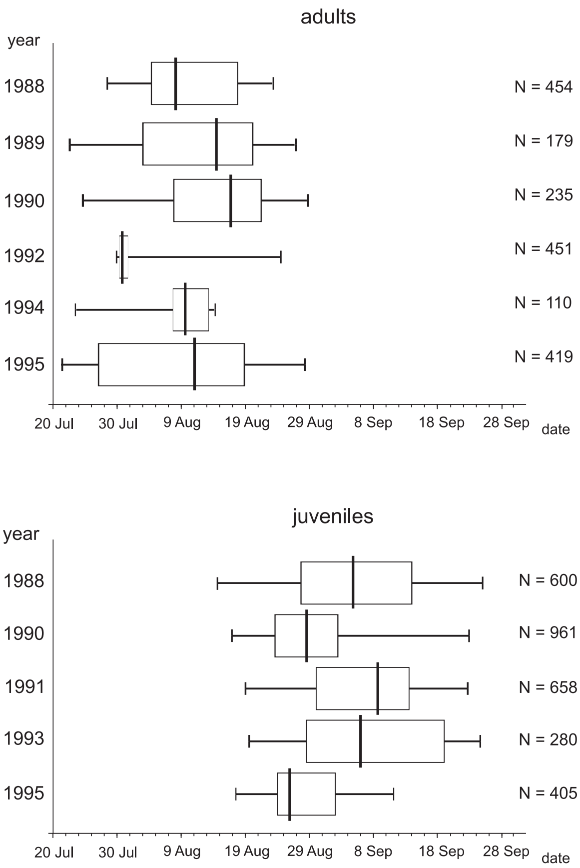

Fig. 3. The timing of autumn migration of adult and juvenile Knots in different autumns 1988–1995. Vertical line — median date, rectangle — 25% and 75% of migrant number (interquartile range), horizontal line — 5–95%.

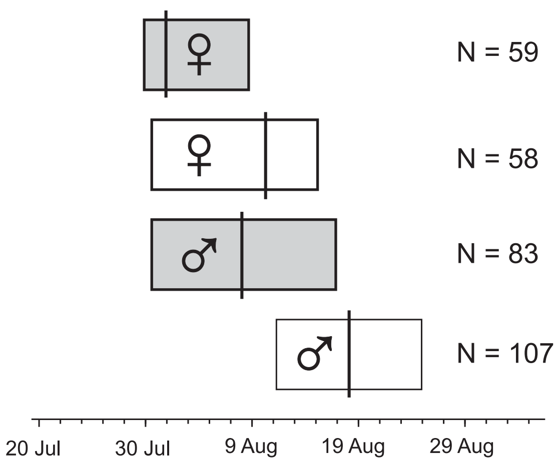

Fig. 4. Phenology of autumn migration of adult males and females of Knots caught in Rewa in years with high numbers of juveniles (white bar) and with moderate to low numbers of juveniles (grey bars). Vertical line — median date, rectangle — 25% and 75% of migrant number (interquartile range).

There was a significant correlation between the number of juveniles and the median date of adult migration in a given autumn (Kendall rank order tau = 0.50, $p = 0.05$). However, there were no relationships between the number of juveniles and their median date of migration (Kendall rank order tau = -0.07, $p > 0.05$) or between the median dates of adult and juvenile migration (Kendall rank order tau < 0.01, $p > 0.05$).

DISCUSSION

Similar to other wader species (Meissner & Sikora 1995; Meissner 1996, 1997, Anthes et al. 2002), the period of Knot migration varied among seasons. However, in adults and in juveniles other factors could have influence on observed interseasonal variation.

Adult Knots start to depart from Taimyr in late June/early July (Tomkovich & Soloviev 1996). The earliest adult migrants were observed in the Puck Bay about two weeks later, a similarly timing to those on the Finnish coasts (Lilja 1964) and in other places along the southern Baltic (Teichmann & Conrad 1984, Brenning 1986, Gromadzka 1992). The early migrating adult Knots — if they follow a great circle route, have to cross the distance of about 4500 km in about 10–15 days. It gives an average migration speed between 300 and 450 km/day. This speed is possible in the light of examples given by Glutz von Blotzheim et al. (1975). The relatively short period between the departure from Taimyr and the arrival at the Baltic area suggests that adult Knots overfly the west Siberian and European tundra. However, Tomkovich & Soloviev (1996) found that adults leaving breeding grounds had very low body mass and the body mass of Knots arriving at the southern Baltic region is also very low (Gromadzka 1992, Meissner 1992). Therefore, it seems that they are able to cover this distance migrating with small energetic reserves probably by short flights and short refueling stops. In years with low breeding success, departures of adults from Taimyr were earlier than usual (Tomkovich & Soloviev 1996, Tomkovich 1998a), which corresponded to observations from the Puck Bay, assuming that low number of juveniles there indicated low breeding success. The extreme situation was noted in 1992, when after Pinatubo eruption aerosol cloud reached the Arctic and caused significant cooling (Ganter & Boyd 2000). Unfavourable weather resulted in widespread nonbreeding among waterbirds, with the extremely low breeding success being also a consequence of high predation pressure (Tomkovich 1998a, ARCTIC BIRDS 2005). In that autumn, the median date of adult migration in Puck Bay was the earliest. Thus, it seems that the median date of adult migration recorded in Puck Bay region depends not only on the beginning of the breeding season in Siberian tundra, but also on breeding success. Arctic waders had not enough time for a second attempt, because the Arctic summer is short and bird populations breeding there are less buffered against unfavourable events. Hence, due to a very narrow time window for successful brood rearing in Taimyr, unsuccessful breeders departed earlier than usually. It is known that males take care of chicks (Glutz von Blotzheim et al. 1975) and therefore migrated after females even in years with low breeding success.

The data on the phenology of juvenile Knot migration in the Puck Bay are consistent to some extent with information about weather conditions in the Taimyr Peninsula. In 1991 and 1993, when the median dates of juvenile migration were the latest, the breeding season in Taimyr was delayed due to large amounts of snow (Tomkovich 1998b, ARCTIC BIRDS 2005). In 1990, when the second earliest median dates of juvenile migration were noted, spring in Taimyr was early (Yurlov 1998).

In Rewa, among adults, significantly more males were caught than females. However, if Puck Bay plays a role of an emergency feeding place for adult Knots (Piersma et al. 1992, Meissner & Kamont 2005), the probability of interrupting flight by males and females should be about the same. On the other hand, females, being larger than males, are more efficient fliers (Lindström 1991) and this may explain why more males than females were forced to land in Puck Bay region. Nebel et al. (2000) also found skewed sex ratio of Siberian Knots in the western Wadden Sea during autumn passage, but opposite to the Puck Bay, females outnumbered males there. This result and data from Puck Bay may suggest that adult males and females of Siberian Knots migrate utilising different stop-over sites.

First independent juveniles were observed in Taimyr about the end of the first decade of August (Tomkovich & Soloview 1996), whereas they arrived at the Polish coast usually about mid-August and in some years even earlier (Gromadzka 1992, this study). This may suggest that in some years juveniles depart from the breeding grounds earlier than described by Tomkovich &

Soloview (1996). On the other hand, some of the very early records of birds in grey (non-breeding) plumage may refer to second-year or even first year Icelandic Knots *C. c. islandica* or adults which might not attained breeding plumage (Morrison & Wilson 1992). Biometrical analysis of Knots caught in the Puck Bay region showed that some of the birds fit with measurements to Icelandic Knots (Meissner & Kamont 2005). The possible occurrence of low numbers of Icelandic Knots in western Baltic was also mentioned by Nehls (1987). However, conspicuous between-year variability in measurements of juvenile knots confounds attempts to estimate proportions of subspecies among samples of trapped birds (Meissner 2004). Ringing recovery analyses showed that vast majority of Knots caught in Baltic belonged to the *canutus* subspecies (Nehls 1987, Gromadzka 1992) and if the *islandica* Knots really regularly appeared in the Puck Bay, their number was probably too small to have any serious influence on obtained results, except the earliest in the season records of juveniles.

It is well known that the breeding success of Siberian Knot follows in average a three-year cycle, with the high production of young in years of high lemming abundance (Underhill 1987, Blomqvist et al. 2002). During this study the changes of juvenile number in subsequent seasons were not regular. These fluctuations cannot be compared with results of autumn counts in the Western Europe, because both Siberian Knots and Icelandic Knots occur there numerously in roughly the same period (Frikke & Laursen 1992, Nebel et al. 2000). These two Knot subspecies come from remote breeding areas and their breeding success is influenced by different factors. Only data from Helgoland given by Blomqvist et al. (2002) concern the *canutus* subspecies (Dierschke 1994). The highest number of juvenile Knots between 1988 and 1994 were ringed in 1990 and 1991, which is consistent with the results of counts in the Puck Bay (see Fig. 2). Although the annual number of birds trapped in Ottenby (Sweden) in the period 1988–1995 varied between 1 and 42 birds only (Blomqvist et al. 2002), the highest numbers of juvenile Knots were recorded in 1988 and 1990, which also corresponds to peak numbers in the Puck Bay. These data confirm to some extent the assumption that the number of juveniles observed in Puck Bay reflected breeding success of this species.

Data on wader and lemming abundance in Taimyr gathered by Kokorev & Kuksov (2002) suggest that rodent numbers not always peaked every 3 years. The regular pattern was interrupted quite often by 2-year or 4-year periods. Based on the change in lemming number from the previous year to the focal year, Blomqvist et al. (2002) calculated the index of the predation pressure. Changes in this index and the number of juvenile Knots recorded in Rewa between 1988 and 1995 were negatively, but not significantly correlated (Kendall rank-order tau = -0.40, Z = -1.39, p = 0.17). This suggests that the number of juvenile Knots arriving at the Polish coast depends not only on the lemming cycle in the breeding grounds. There are some other factors, which might influence the number of observed juveniles in a given stop-over place. The conditions like long period of high water level caused by strong winds or deterioration of feeding conditions due to human activity may force birds to abandon the stop-over site in particular season for short or long time.

ACKNOWLEDGEMENTS

I am grateful to all colleagues who were working at Waterbird Research Group KULING ringing sites. Special thanks to members of the ringing team, to Agnieszka Wolna for computer data input, to Magdalena Remisiewicz for her help in correcting an early version of manuscript and to Nick Davidson and anonymous referees for useful comments. This study was undertaken by Waterbird Research Group KULING (paper No 106).

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STRESZCZENIE

[Międzysezonowa zmienność czasu wędrówki jesiennej biegusa rdzawego przez Zatokę Pucką]

Syberyjski podgatunek biegusa rdzawego wędruje dość licznie jesienią przez polskie wybrzeże Bałtyku. Badania prowadzono w latach 1988–95 w okolicy Rewy nad Zatoką Pucką (Fig. 1). Terminy i intensywność migracji wykazują dużą zmienność międzysezonową (Fig. 2,3), jednak jej przyczyny są inne u ptaków dorosłych i młodych. W latach o niskim sukcesie lęgowym osobniki dorosłe odlatują z lęgowisk położonych na Półwyspie Tajmyr znacznie wcześniej, ponieważ krótkie, arktyczne lato nie pozwala im na ponawianie próby lęgu po jego utracie (Fig. 4). Terminy migracji ptaków młodych nie zależą od sukcesu lęgowego, natomiast ważnym czynnikiem wydają się być warunki pogodowe na lęgowiskach, które warunkują rozpoczęcie gniazdowania przez ptaki dorosłe.

Jednym z czynników wpływających na sukces lęgowych arktycznych siewkowców jest cyklicznie zmieniająca się liczebność lemingów. W latach o niskiej liczbie tych gryzoni znacznie zwiększa się presja drapieżników na lęgi ptasie. Nie wykazano by istniał istotny związek między sukcesem lęgowym biegusa zmiennego wyrażonym liczbą ptaków młodych przylatujących nad Zatokę Pucką, a wartością wskaźnika presji drapieżniczej podawanego przez Blomqvista et al. (2002) dla Półwyspu Tajmyr. Sugeruje to, że liczba

ptaków młodych obserwowanych jesienią na południowym wybrzeżu Bałtyku zależy nie tylko od liczebności populacji lemingów, ale również od innych czynników. Długie okresy wysokiego stanu wody na Zatoce Puckiej spowodowane silnymi wiatrami mogą powodować podtopienie dogodnych żerowisk i zmusić ptaki do szukania alternatywnych miejsc do żerowania.

T. Cofta

ERRATUM

In a paper by Wesołowski T., Czeszczewik D., Rowiński P. "Effects of forest management on Three-toed Woodpecker *Picoides tridactylus* distribution in the Białowieża Forest (NE Poland): conservation implications" (Acta Ornithol. 40: 53–60, 2005) the caption of Fig. 1 (page 55) should be as follow:
Fig. 1. Localisation of the Białowieża National Park within the Białowieża Forest (inset) and distribution of *Picoides tridactylus* (dotted) within the Park in relation to habitat and type of management. For every subcompartment the prevailing vegetation type is shown: 1 — deciduous, mostly oak-hornbeam forest, 2 — wet deciduous forest, 3 — coniferous forest, 4 — meadows. Lighter hues — the logged fragment, darker hues — the strictly protected part.