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RADIO-TELEMETRY OBSERVATIONS OF THE FIRST 650 KM OF THE MIGRATION OF BAR-TAILED GODWITS *LIMOSA LAPPONICA* FROM THE WADDEN SEA TO THE RUSSIAN ARCTIC

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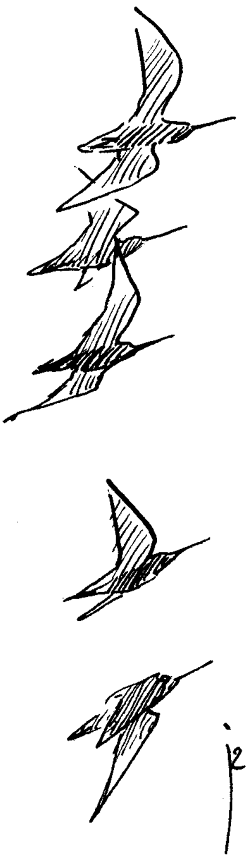

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In 1999 and 2000, 45 Bar-tailed Godwits *Limosa lapponica* were supplied with radio-transmitters during spring staging on the island Texel in the western Wadden Sea. With the use of Automatic Radio Tracking Stations (ARTS) on Texel and in south Sweden, and hand-held receivers on Texel, it was possible to follow the later part of the stopover period on Texel for 34 birds (76%) and the passage over south Sweden for 26 birds (58%). Thus, the method of automatic tracking of overflying migrating shorebirds works successfully where the migration corridor is narrow and predictable, as in the case with late spring shorebird migration from the Wadden Sea towards arctic Russia. The timing of departure from Texel and passage over south Sweden of radio-marked birds, with median dates of 30 May and 2 June respectively, were in agreement with published data on the spring migration of Siberian-breeding Bar-tailed Godwits *L. l. taymyrensis*. The individual variation in migration dates was larger than expected, with birds passing south Sweden between 25 May and 10 June, indicating that the time-window for departure might be broader than previously thought. There was no clear difference between males and females in timing of migration. The time difference between departure from Texel and passage over south Sweden (average 3.3 days) indicates that most Bar-tailed Godwits do not embark on the long flight towards Siberia directly from the western Wadden Sea, but are more likely to stop in the more easterly portion of the Wadden Sea before the final take-off. This pattern is similar to what has been found in other shorebirds and geese (e.g. Red Knots *Calidris canutus* and Dark-bellied Brent Geese *Branta bernicla*) migrating along the same route.

Key words: *Limosa lapponica taymyrensis* - long-distance flight - stopover ecology - radio-tracking - sex differences

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INTRODUCTION

Studying migration in process of known individual birds requires special techniques. During the last decade, developments on the technical side have allowed the use of satellite telemetry on larger birds such as storks, swans, geese and raptors (Benvenuti 1993; Fuller *et al.* 1995; Beekman *et al.* 1996), in order to get detailed information on individual migratory behaviour including stopover use, routes, timing, responses to weather, etc. So far, satellite tracking is limited to larger species due to the size and mass of the transmitters. With a recommended maximal ratio of transmitter mass to bird body mass of 0.02-0.03 (Gladher *et al.* 1996), the method is presently restricted to birds heavier than 500-750 g.

For birds of smaller size other methods have to be used. VHF-radio-tracking is probably the only alternative method existing today, rendering at least the possibility of collecting the same type of data as satellite telemetry, but it does of course require a very different work effort. In order to get similar data as satellite telemetry, the researcher has to follow the bird in one way or another (by car, boat or aeroplane), as maximal detection distance of the transmitters generally is restricted to a few tens of kilometres, but usually the detection distance is much shorter. Despite these logistical problems, the method has been used successfully to follow complete, or parts of, migrations for various species (Cochran & Kjos 1985; Iverson *et al.* 1996; Johnson *et al.* 1997; Wege & Raveling 1984; Warnock & Bishop 1998). At the same time, conventional radio-tracking is a much more economical method than satellite telemetry if the need for costly transport, i.e. aeroplane flight time spent on following the birds, can be reduced. For birds migrating along narrow and predictable corridors, much interesting data on individual migratory behaviour can be gathered by VHF radio-tracking if receivers are stationed in a way so that a large part of these corridors are covered. When this is the case, data on exact timing of migration can be collected.

This paper reports on a study employing such a method to get data on stopover-time, departure and timing of migration. Bar-tailed Godwits *Limosa lapponica* were equipped with radio-transmitters during spring staging in The Netherlands. The birds were then monitored in the staging area and during migratory flight over south Sweden by the use of Automatic Radio Tracking Stations (ARTS). Radar-studies of late spring migration of Arctic-nesting waders and geese have shown that the migration corridor of these birds over the southernmost part of Sweden is relatively narrow (Gudmundsson 1994; Green unpubl. data). In most years spring migration of birds flying from the Wadden Sea (The Netherlands, Germany, Denmark) towards arctic Russia is very much concentrated to a < 100 km wide corridor over the province of Skåne, making this migration system suitable to test using ARTS. This is a progress report based on studies during two seasons (1999 and 2000) that builds on earlier work on the migration and stopover ecology of Bar-tailed Godwits (Piersma 1987; Drent & Piersma 1990; Piersma & Jukema 1990, 1993; Landys *et al.* 2000). The effectiveness of this novel technology will be discussed and data on the timing of migration of this Bar-tailed Godwit population are reviewed.

METHODS

The population of Bar-tailed Godwits covered in this study winters in Mauritania and Guinea-Bissau (Western Africa), breeds in central Arctic Russia (Fig. 1A; Cramp & Simmons 1983; Piersma & Jukema 1990). This population has recently been assigned subspecies status as *L. l. taymyrensis* (Engelmoer & Roselaar 1998). The main stopover area between winter and summer destinations is the Wadden Sea (The Netherlands, Germany and Denmark). The birds leave West Africa in late April and, as far as is known, fly 4300 km non-stop to the Wadden Sea (Drent & Piersma 1990; Piersma & Jukema 1990; Landys *et al.* 2000). These Bar-tailed Godwits stay for about a month of refuelling in the Wadden Sea and then leave in late May-early June for another, presumably direct flight of 3000-5000 km to the tundra breeding grounds (Piersma & Jukema 1990).

Catching and transmitters

Bar-tailed Godwits were caught on Texel, The Netherlands (53°03'N, 04°48'E; Fig. 1B), with a large , wind-driven pull-net, a so called *'wilsternet'* (Koopman & Hulscher 1979), during 19-29 May 1999 and 18-22 May 2000. Captured birds were sexed, measured (wing, bill, tarsus+toe),

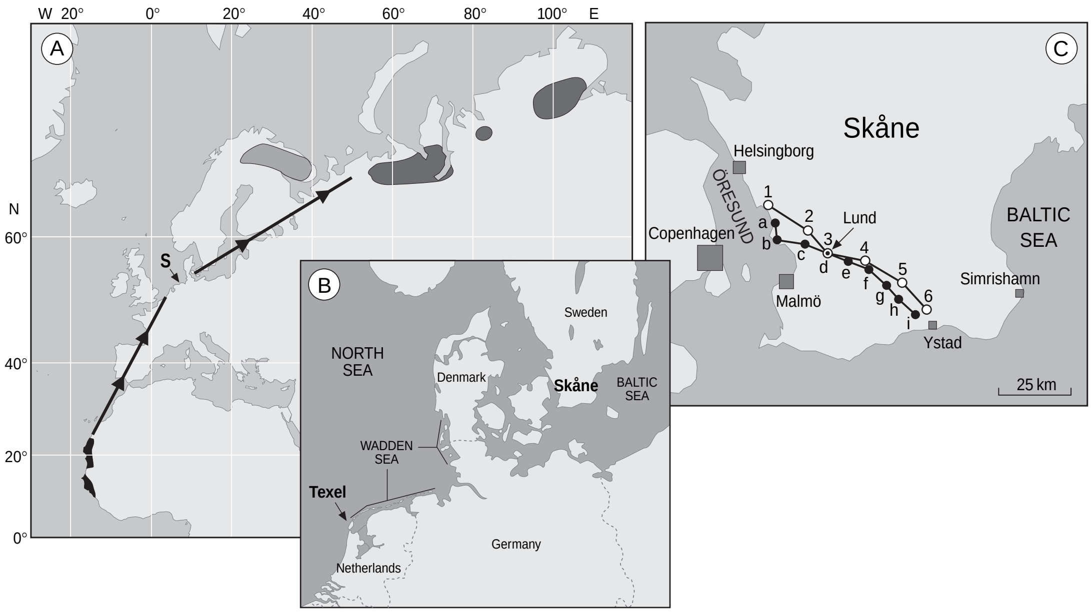

Fig. 1. (A) Map showing wintering areas in Africa (black), stopover area (the Wadden Sea, S), breeding areas of *L. l. lapponica* (grey shading) and *L. l. taymyrensis* (dark shading), and migration routes of northward migrating Bar-tailed Godwits. (B) shows the position of Texel, where catching took place, and Skåne where migration of radio-marked Bar-tailed Godwits was registered with Automatic Radio Tracking Stations (ARTS). (C) Map of the province of Skåne, south Sweden, showing the ARTS. Open symbols (1-6) are stations used in 1999. Filled symbols (a-i) are stations used in 2000. Station 3/d was used in both seasons.

weighed and scored for moult directly after catching (Piersma & Jukema 1993). By this method, only few individuals are caught at the same time, so that processing could be fast and efficient. Within 15 min after capture, selected birds were supplied with radiotransmitters on their backs (see Nebel *et al.* 2000). In a small area (ca. 2 x 2 cm) on the back of the birds the feathers were cut down to 1 cm length. The transmitters were then glued to the clipped feathers with Super Attack glue, with the thin whip antenna protruding backwards over the tail. After the glue had hardened for a few minutes the birds were released at the catching site. The transmitters used were Holohil BD-2G (Holohil Systems Ltd., Ontario, Canada). With a mass of 1.75 g, the transmitters weighed

Table 1. Summary data of Bar-tailed Godwits supplied with radio-transmitters on the Dutch island Texel in 1999 and 2000.

Year	Non-moulting males	Moulting males	Non-moulting females	Moulting females	Total
1999	6	3	5	3	17
2000	12	2	12	2	28
Sum	18	5	17	5	45

less than 1% of the birds body mass. Frequencies used were in the 173 MHz (1999) and 172 MHz band width (2000). Individual frequencies differed by about 20 kHz. Battery life-time according to the manufacturer was six weeks. Altogether 17 birds in 1999 and 28 birds in 2000 were equipped with radio-transmitters. Sex ratio of the selected sample was 1:1 (Table 1).

Radiotracking

Radiomarked Bar-tailed Godwits were searched for on the Texel meadows with directional Yagi antennas and hand-held portable receivers (TRX-2000S, Wildlife Materials Inc., Carbondale, Illinois, USA) from 19 May to 6 June and on a high-tide roost on the north-eastern part of the island between 19 May and 13 June in 1999. In 2000 the island was regularly searched with hand-held receivers from 18 May to 9 June and in addition there was an Automatic Radio Tracking Station placed at the high tide roost at 'De Schorren' in the north-eastern part of Texel, receiving from 22 May to 9 June. The ARTS consisted of a radio-receiver (ICOM ICR10) that automatically scan for selected frequencies (the frequencies emitted by the transmitters) according to a pre-programmed scheme. The receivers were programmed to scan for each frequency in six seconds (1999) or four seconds (2000), where after it scanned for the next frequency for the same time-period in a rolling scheme. In this way each frequency was scanned for in six sec every 102 sec (1999) and for four sec every 112 sec (2000). The receivers were connected to a palmtop computer that numerically log in the levels of background noise and received signal for the selected frequencies together with data on date and time of the day. Thus, it is possible to decide afterwards whether an individual transmitter has been within receiving distance from the station or not. In addition to this the ARTS were also supplied with an 1.2 m multi-directional antenna. The equipment was powered with ordinary 220 V net electricity (1999) or 12 V car batteries (2000).

In south Sweden six receiver stations were placed along a 75 km transect in the province of Skåne in 1999, running from north-west towards south-east, more or less perpendicular to the expected direction of migration (Fig. 1B,C). The location of the transect was determined after going through surveillance radar films (see Gudmundsson 1994, for an example) for the relevant period in order to get an idea of the general geographic pattern of late spring migration of waders and geese (Green unpubl. data). The transect was then placed in an attempt to cover the area where migration was most likely to be intensive. When deciding the length of the transect, and thus the distance between receivers, we used a conservative estimate of transmitter range of about 5 km in open air. Tests on Texel with a transmitter mounted on an aeroplane resulted in a maximum receiving distance of 3-4 km when the plane was flying at a few 100 m altitude. Studies on Western Sandpipers *Calidris mauri* (Iverson *et al.* 1996) supplied with similar equipment, had detection distances of up to 10 km from an aeroplane when birds were on the ground. The manufacturers themselves expect a maximum receiving distance of up to 40 km through open air.

In 1999 the receiver stations were placed in contact with peoples homes, e.g. with the antennas of the receiver stations mounted on roofs, to get access to continuous electrical power supply. However, there were relatively large problems with disturbance (of unknown sources) when having the receiver stations in contact with human activities. Also, due to some initial technical difficulties the stations were not working properly until 31 May, thus the early part of the migration season was missed and an unknown number of radiomarked birds surely did pass over south Sweden before the receiver stations were fully operational. The receivers where retrieved on 10 June in 1999. In year 2000, 10 receiver stations were placed along more or less the same transect but at different localities (away from human activities) in an effort to minimise disturbance problems (Fig. 1C). Transect length was kept constant despite the higher number of available receiver stations in an attempt to get better coverage of the core area of the migration corridor. Receiver stations were placed in open areas, if possible on elevated ground, to maximise receiving distance. The change in methods was successful and disturbance problems were much fewer in that year. Unfortunately one receiver station was stolen during the field work and only nine stations were retrieved. The receiver stations were out in the field from 24 May to 10 June in 2000.

When a signal is heard with a handheld receiver, it is certain that the transmitter (on the bird) is there and it is usually possible to find the transmitter-carrying individual in the flock. With the ARTS, assessing the presence of a bird with a transmitter is more complicated. The ARTS register levels of received transmitter signal and background noise for each frequency. If the transmitter is out of receiving distance these two levels are supposed to be equal, showing a ratio between the two of 1, as they both represent the general level of background noise. If the transmitter on the other hand is within receiving distance, the level of transmitter signal will exceed the background noise level and the ratio will be higher than 1. Ideally a ratio of 1 would mean that the transmitter-bird is not present and a ratio > 1 would be the same as that the transmitter-bird is present within receiving distance. In reality the ratio does however show variation depending on local interference and thus it is necessary to assign a critical ratio level higher than 1 to positively identify whether the actual transmitter-signal has been received or not.

A critical level of 1.5 at Texel and 1.8 in Skåne was used to identify presence/passage of our birds. The reason for the difference in levels used is the larger amount of radio interference found in Skåne. In the Wadden Sea, the general level of signal to noise ratio rarely exceed 1.4, thus the used critical level of 1.5. In Skåne on the other hand the general level of this ratio often exceed 1.4, but seldom 1.6. To be certain that a recorded high signal/noise ratio did correspond to the passage of a transmitter-carrying bird, a critical ratio level of 1.8 was used. On Texel, the presence of a number of individuals with a transmitter could be established with certainty with the handheld receivers by scanning flocks of Bar-tailed Godwits in the meadows and on the mud flats. At the high tide roost on Texel where an ARTS was situated, birds were always present for a longer period of 0.5 to 4 hours. Therefore, it was easy here to distinguish between disturbances (a ratio > 1.5 occurred only now and then and with no relation to the tide) and the presence of birds with a transmitter (long series of ratio > 1.5 during the period of high tide). For the Swedish part of the material, recorded ratios higher than the critical level were visually inspected and suspected cases of disturbances (showing multiple peaks in ratios) were excluded. During 1999, several frequencies showed large amounts of interference, making any meaningful analysis of received signals impossible. In 2000, however, only a few cases with interference showing multiple peaks in a

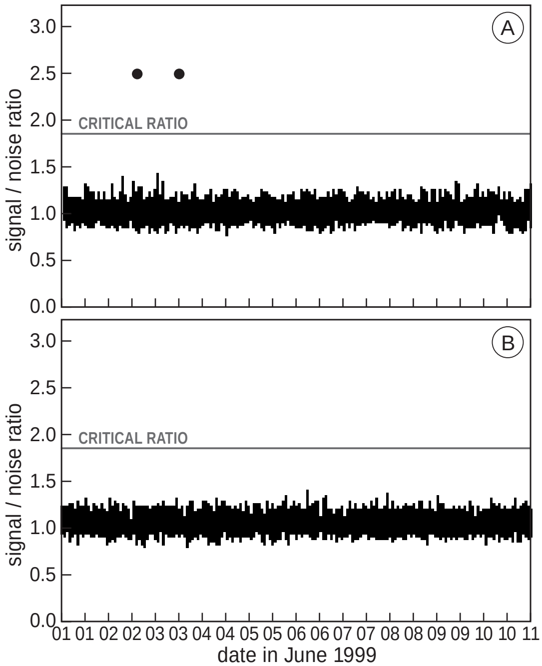

Fig. 2. Two examples of recorded passage of radio-tagged Bar-tailed Godwits over south Sweden in spring 1999. Passage is indicated by peaks above the critical level of ratio between signal and noise. Black dots in (A) show observations on Texel.

way differing completely from the expected pattern of a migrating bird were registered. Finally, only clear cases with single peaks, indicating passage of a transmitter carrying bird, were included in the analysis. An example of the registered passage of two transmitter-carrying birds are shown in Fig. 2. Several of the birds recorded on passage over Sweden passed during days when radar-trackings in Lund (Fig. 2) revealed ongoing migration of shorebirds over the area (Green unpubl.). Even though this shows the general correspondence between migration activity and recorded passage of transmitter-birds, there were no cases where a certain transmitter-bird could be assigned to the specific passage of a radar echo (flock).

RESULTS

Departure from Texel

In total, 34 of 45 marked Bar-tailed Godwits were subsequently radio-tracked at least once on Texel (15 in 1999, 19 in 2000). Using the last date a bird was radio-tracked as the day of departure for birds tracked at least once on the island after catching yielded an overall median departure date of 30 May (*n* = 34, range 18 May-6 Jun). If the 11 birds that have not been not radio-tracked after capture were included, while using catch-date as departure date for these cases, the median departure date changed to 29 May (*n* = 45, range 18 May-6 Jun). There was no difference in median departure date for birds radio-tracked at least once on the island between the years (30 May 1999, *n* = 15, range 21 May-3 Jun; 30 May 2000, *n* = 19, range: 18 May-6 Jun). Median dates of males (30 May, *n*= 14) and females (31 May, *n* =20) did not differ from each other (Fig. 3A; Mann-Whitney *U*-test, n.s.). If birds that had not been radio-tracked after catching were included, there was a tendency for earlier departure by males (24 May, *n* = 23) than by females (31 May, *n* = 22) (Mann-Whitney *U*-test, *U* = 175, *z* = -1.78, *P* = 0.075).

Passage over south Sweden

Twenty-six birds (58% of those marked) were

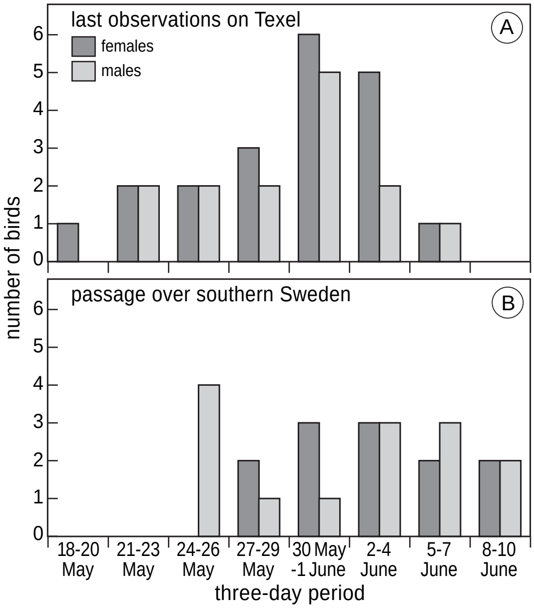

Fig. 3. (A) Time pattern of last observations on Texel of marked Bar-tailed Godwits radio-tracked at least once on the island after catching (*n* = 34). For median dates see text. (B) Time pattern of registered passage over south Sweden by radio-marked Bar-tailed Godwits (*n* = 26).

tracked during migratory flight over south Sweden (5 in 1999, 21 in 2000). The comparatively low number of tracked birds in 1999 should be seen in the light of receiver stations not working properly until 31 May and additional problems with radio-disturbance. Overall median passage date was 2 June (*n* = 26, range 25 May-10 Jun). Median passage date for 2000 was 1 June (*n* = 21, range: 25 May-10 Jun). There was no difference in timing of migration between males and females, neither when considering both years together (Fig. 3B; Mann-Whitney *U*-test, n.s., males 2 June, *n* = 12, females 2 June, *n* = 14) nor when looking only at year 2000 (Mann-Whitney *U*-test, n.s., males 1 June, *n* = 10, females 1 June, *n* = 11).The geographical pattern of registrations of migrating birds did not show any differences within the area covered by the transects. Instead, registrations were relatively evenly distributed between the different receiver stations. Only one of the birds tracked over Sweden was picked by two receiver stations more or less simultaneously. All other birds were recorded at only one receiver station.

Over the two years a total of 13 birds were radio-tracked both on Texel and during passage over Sweden, allowing us to calculate the time interval between approximate time of departure from Texel and passage over Sweden. Time between the last registration on Texel and passage the line of ARTS in Sweden ranged from 19.5 h to 188.6 h with a mean (± SD) of 80.2 ± 58.1 h. For five birds the time between last observation on Texel and passage over Sweden was less than 36 h.

DISCUSSION

Methodological issues

The high percentage of birds tracked by the receiver stations over south Sweden during spring migration (overall 58%, 75% in year 2000) shows that the method of using radiotags in combination with automatic receiver stations works excellently in cases when the migratory corridor of the study birds is fairly narrow and predictable. However, there are a few pitfalls that one needs to be aware of before employing the method. First of all, problems with disturbance can be large in areas close to human activities as we experienced in 1999. Radio-disturbances can make it impossible to positively identify the transmitter signals from the background noise. In these cases the ratio of signal to noise was exceeding the critical level for most of the time, at all locations for four frequencies. The origin of these disturbances remain unknown in detail but was clearly connected to human activities: less disturbance was recorded in 2000 when the receiver stations were moved away from direct contact with houses and built up areas. In 2000 only a few cases of interference were registered and these were easy to sort out as they showed multiple peaks in a way very different from the expected pattern of a migrating bird passing by. Thus we are confident that the ratios exceeding the critical levels and recognised by us as passing birds in 2000 do really represent the true passage of our birds.

Another issue of importance is detection distance. Despite the fact that we placed our receivers fairly close to each other, with average distances between receivers of 12.5 km in 1999 and 7.5 km in 2000, only one single bird was simultaneously picked up by two stations. This shows that detection distance, when using this type of transmitters, is probably not very much longer than our conservative estimate of about five km. Assuming that the godwits flew at altitudes 2-3 km above ground level, as has been recorded by tracking radar for spring migrating waders over Lund (M. Green in prep.), and using the distance between receivers gives a calculated maximum detection distance of 4.2-4.8 km if the transmitter signals were to be received by only one station.

Another way of calculating this is to use the fact that most transmitter signals were received during 2-4 scans during passage. The way the receivers were programmed in 2000, four scans took 464 sec. Assuming a groundspeed of about 100 km h^{-1} (27.8 m s^{-1}, migration in good tailwinds), similar to average groundspeeds recorded by tracking radar over Lund for spring migrating waders in 2000 (M. Green in prep.), the godwits travelled about 13 km during this time interval. Detection distance calculated this way is then at least 6.5 km. Bearing these things in mind we strongly recommend that automatic receiver stations should be used away from human activities to minimise disturbance problems and that stations should be placed not very far apart in order get good coverage of the area of interest.

Timing of migration

The timing of the flights of radio-tracked Bar-tailed Godwits followed previously published data quite closely. Departure from the Wadden Sea towards Russian breeding grounds is reported to be in the last days of May and first days of June (Prokosch 1988; Drent & Piersma 1990; Meltofte 1993). Median departure date from the Dutch part of the Wadden Sea was 1 June in 1984 and 31 May in 1985 and 1986 (Piersma & Jukema 1990); both are in excellent agreement with the data presented here. The period during which birds were passing over south Sweden, i.e. departed on the long flight towards the Arctic, was relatively long. In 2000 there was passage during the entire period that receivers were activated. This demonstrates that the migration towards the Arctic is not as synchronised as people may have wanted to believe. Instead, there is substantial variation in the timing of departures from the Wadden Sea, with individuals spread out over a two-week period. Furthermore, there may be birds departing from western Europe even earlier than 25 May, and there may be a few birds that depart even later than 10 June. It is possible that the large variation is reflected in the large longitudinal breeding range of birds passing through the Wadden Sea (Fig. 1A: ca. 100 degrees). Along such a large range the date that snow melt starts is likely to vary widely and systematically.

Earlier it has been suggested that males migrate a few days ahead of females, both during the flight from Africa to western Europe and during the flight from western Europe to Siberia (Prokosch 1988; Piersma & Jukema 1990), but no significant differences were found in this material. However, the data on passage over Sweden showed a skewed distribution for males with comparatively many birds in the first three-day period (four males recorded 24-26 May, no females recorded during this period) which might be an indication of that there can be a small sexual difference in passage dates if a larger data-set were to be collected. Further indications of a difference in timing between the sexes is shown by the distribution of last observations on Texel, including birds not recorded after tagging. The variation in departures from Texel does not necessarily have to reflect differences in the timing of the long migratory flights as relatively more males than females may leave Texel to stop at other sites within the Wadden Sea before taking off for a flight over Sweden and beyond.

Hopping before jumping?

The mean time recorded between last observation on Texel and passage over Sweden for 13 birds, exceeding 3 days and 8 h, was much longer than the expected flight time between Texel and Sweden. Distance from Texel to Lund (station 3/d in Fig. 1C) is about 650 km along a constant geographic course. This can be translated to about 10 h of flight in windless conditions with an expected airspeed of 65 km h^{-1} (18 m s^{-1}) as recorded for Bar-tailed Godwits during spring migration by tracking radar over Lund (M. Green in prep.). If the godwits fly with wind assistance (tailwinds) flight time would be even shorter. Thus, it seems likely that many godwits do not depart directly from the western part of the Wadden Sea on the flight towards Russia. Instead, many birds must spend a few days somewhere in between Texel and Sweden just before they depart on the final leg of spring migration.

Most likely the godwits move on towards north-east, in the general direction of migration, and make a short stop in the eastern part of the Wadden Sea just before they embark on the long flight towards Russia. The reason behind this move late in the season may be that in order to make the best possible judgement of flying weather for a really long flight, it may pay to be as close as possible to the weather system that the bird is going to fly in. By moving some 300 km to the eastern part of the Wadden Sea, Bar-tailed Godwits may have better cues to be able to choose the best wind conditions for the flight over southern Sweden and the Baltic (cf. Piersma & Jukema 1990; Piersma & Van de Sant 1992).

It is interesting to note that other species of waders and geese migrating along the same route towards similar breeding areas seem to behave in the same way. Red Knots *Calidris canutus canutus* on their way to breeding areas on Taymyr Peninsula, Russia, also gather in the eastern part of the Wadden Sea in late spring, possibly as a result of higher benthic food availability but maybe also to be close to relevant weather systems and to reduce the overall cost of flight (Piersma *et al.* 1994). Dark-bellied Brent Geese *Branta berni-*

cla behave perhaps even more like Bar-tailed Godwits. The geese depart from the western part of the Wadden Sea for a flight towards their next stopover area in the White Sea region, north-west Russia (and subsequently for breeding areas on Taymyr), but many birds make a short stop somewhere in the Wadden Sea, similar in length to the ones indicated by the time differences between departure from Texel and recorded migration over south Sweden for the Bar-tailed Godwits in this study, before they embark on the long flight over the Baltic to the White Sea (Green *et al.* 2002). Nevertheless, in Bar-tailed Godwits there appear to be individuals that actually depart from the western Wadden Sea for an uninterrupted flight over south Sweden and beyond. For five radio-tracked birds the time difference between last observation on Texel and passage over Skåne was less than 36 hours. These individuals may leave Texel to fly to the Arctic directly.

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SAMENVATTING

Rosse Grutto's *Limosa lapponica* die in West-Afrika overwinteren, vliegen via de Waddenzee naar de toendra's van West- en Centraal-Siberië om te broeden. Eerder onderzoek in het Oostzeegebied suggereerde dat de vogels begin juni, na vertrek uit de Waddenzee, via een vrij smalle corridor over Zuid-Zweden naar het noordoosten zouden vliegen. In dit artikel worden de resultaten gepresenteerd van een onderzoek naar de timing van de trek van Rosse Grutto's die waren uitgerust met radiozenders. In mei 1999 en 2000 werden 45 Rosse Grutto's (mannetjes zowel als vrouwtjes) met een *'wilsternet'* in de graslanden op Texel gevangen en voorzien van 1,75 g zware radiozenders (deze zendertjes werden met superlijm op de rug geplakt, gaan een week of acht mee en vallen na een paar maanden vanzelf weer af). Vervolgens probeerden we de gezenderde vogels op Texel iedere dag op te sporen met handmatige ontvangers en in 2000 ook met een automatische ontvanger (*Automatic Radio Tracking Station* = ARTS) die bij de hoogwatervluchtplaats op de Schorren was geplaatst. Een transect bestaande uit zes (1999) en 10 (2000) automatische ontvangers werd in de Zuid-Zweedse provincie Skåne dwars op de vermoede trekroute van de Rosse Grutto's geplaatst. Zo konden we de individuele vogels daar, als ze op 1-3 km hoogte op ca. 650 km afstand van Texel overvlogen, ontdekken op het moment dat ze net waren begonnen met de lange, waarschijnlijk ononderbroken, vlucht naar de Siberische broedgebieden. Een deel van de Rosse Grutto's werd na het zenderen niet meer gehoord, maar voor 34 vogels (76%) kregen we goede informatie over het verblijf op Texel in de rest van mei en de eerste dagen van juni. Niet minder dan 26 vogels (58%) werden geregistreerd op het moment dat ze over de ARTS in Zuid-Zweden vlogen. Deze nieuwe methode maakt het dus mogelijk om er achter te komen wanneer Rosse Grutto's aan de 4000-5000 km lange laatste etappe naar de broedgebieden beginnen. Het tijdstip van vertrek van Texel (mediane datum 30 mei) en het tijdstip waarop de vogels Zuid-Zweden passeerden (mediane datum 2 juni), komen overeen met de verwachtingen op grond van eerdere visuele waarnemingen aan de trek van de Siberische ondersoort *Limosa lapponica taymyrensis*. Niettemin was de individuele variatie in vertrek- en doortrekdata veel groter dan we hadden verwacht. De Rosse Grutto's trokken gedurende een periode van meer dan twee weken, tussen 25 mei en 10 juni, over Zuid-Zweden door. Met de huidige steekproef konden we niet aantonen dat mannetjes eerder met de trek naar de broedgebieden beginnen dan vrouwtjes. De gemiddelde tijd die verstreek tussen het vertrek van Texel en het overvliegen van Zuid-Zweden (3,3 dagen; voor een directe vlucht van 650 km zijn maar 10 uur nodig) doet vermoeden dat de meeste Rosse Grutto's niet vanaf de westelijke Waddenzee naar Siberië vertrekken, maar eerst in kortere etappes naar de oostelijke Waddenzee trekken om daarvandaan aan de grote trekvlucht te beginnen. Een dergelijk patroon komt overeen met dat van Kanoetstrandlopers *Calidris canutus* en Zwartbuikrotganzen *Branta bernicla* die van dezelfde trekroute gebruik maken.

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