Satellite tracking of Greenland White-fronted Geese

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(Med et dansk resumé: Satellitsporing af Grønlandsk Blisgås)

Introduction

The objective of deploying satellite transmitters on Greenland White-fronted Geese during spring was to determine the migration strategies of the geese and to identify spring staging areas in both Greenland and Iceland in order to protect the geese from impacts from e.g., mineral exploration and hunting.

The population of the Greenland White-fronted Goose has doubled since the early 1980s to its current level of about 33 000 individuals (Fox et al. 1999). Despite this increase it remains important to identify and designate specific sensitive areas and periods, since the population size is small compared to those of other global goose populations (Madsen et al. 1996) and has a restricted geographic distribution and low productivity (Fox et al. 1983).

Major spring staging areas have been localised in Iceland (Francis & Fox 1987) and in Greenland (Glahder 1999), but staging periods and the possible use of different staging areas has been difficult to establish (Francis & Fox 1987, Glahder et al. 1999). In order to supplement the research work already carried out in the vast and remote areas of Greenland and Iceland, this satellite project was initiated in 1996 by two departments of the National Environmental Research Institute (NERI), Denmark and Dúchas/The Heritage Service, National Parks & Wildlife, Ireland (Glahder et al. 1996, 1997).

In 1996 we studied the effects of two different sizes of dummy satellite transmitters and two different harness types on the geese (Glahder et al. 1996, 1997). During 1997-1999 a total of 21 small satellite transmitters were attached to adult male Greenland White-fronted Geese cannon-netted in Wexford, Southeast Ireland, during March. This paper gives a review of the preliminary results; data are updated until 1 June 1999 at which time all eight transmitters deployed in 1999 were still functioning.

Methods

Before satellite transmitters were attached to geese the effects of two different dummy transmitter weights and two different harness types were tested on wintering Greenland White-fronted Geese. The average weights of the dummy transmitters were 38.0 g (SD=2.3, n=6), and 54.1 g (SD=2.2, n=6), respectively. The average weight of the lightest dummies corresponded to that of the subsequently chosen Microwave Telemetry satellite transmitters, PTT100, 30 g version (35.6 g, SD=0.4, n=6). The dummy transmitters contained a radio transmitter

White-fronted Goose # K3F with transmitter, Wexford 22 March 1998. Photo: Christian Glahder.
Blisgås K3F med påmonteret sender, Wexford 22. marts 1998. Denne han ankom til området omkring Ilulissat i Grønland d. 10. maj samme år (se Fig. 1).

and their size was comparable to that of the satellite transmitters (65×16×25 mm). Harnesses were made of either knicker elastic or neoprene tape. Seven geese were fitted with a knicker elastic harness on 13 and 19 January 1996, and five geese with a neoprene harness on 19 January 1996. During a three month period (13 January – 22 April 1996) the geese were studied on the Wexford Wildfowl Reserve in Ireland. The behaviour of the dummy-fitted geese was recorded and compared with controls from the same family group, the positions of the geese in the area were noted and their abdominal profile index (API) was scored. For more details refer to Glahder et al. (1997).

During 1997-1999 satellite transmitters, PTT100, 20 g version (7 in 1997) and 30 g version (6 in 1998 and 8 in 1999) were attached to adult male Greenland White-fronted Geese with a knicker elastic harness. The geese were marked with a white leg band and an orange neck collar, both imprinted with three characters. The 216 mm antenna was made of 2 mm of braided wire (1 mm in 1997) with the base protected by a 4 cm long spring (no such protection was used in 1997). The signals transmitted every 90 seconds (in 1997 and 1998) and every 60 seconds (1999) contain information on transmitter temperature, battery voltage and goose activity; geographic positions were calculated from the signals transmitted. The transmitters were programmed to transmit for 8 hours and "sleep" for 29 hours. The transmissions from the satellite transmitters were received by two polar orbiting NOAA satellites and downloaded by Argos, CLS (Collecte Localisation Satellites), in France, and were both received on-line UTC time (Coordinated Universal Time) and, retrospectively, on floppy disks. Positions calculated by Argos were given in accuracy classes 3 (<150 m), 2 (150-350 m), 1 (350-1000 m) and 0 (>1000 m), on the basis of at least four messages received during a satellite pass, and in class A and B (three and two messages received, respectively; no estimate of location accuracy) (Argos CLS 1996). Data were transformed using Argos Satpack and presented in MapInfo Professional.

Results and discussion

Pilot study

Geese fitted with dummy satellite transmitters preened significantly more than controls two to three days after the attachment (23.4% of activity budget in dummy-fitted birds, 8.6% in controls, p=0.03, t-test, Glahder et al. 1997). The back and neck were preened the most at this time. However, by seven days after attachment there seemed to be no behavioural differences in the two groups of geese. Other general behaviour such as site fidelity, flying to roost and family group cohesion all appeared normal over the study period. The knicker elastic harness proved to be the most effective type of the two tested. From the pilot study it was concluded that (i) the satellite transmitters should be attached at least two weeks prior to spring migration, i.e., in late March to minimise disruption to behaviour during the prelude to migration, (ii) the transmitters should be as light as possible, and (iii) pre-stretched knicker elastic would be the most effective harness.

Transmitter lifetime

Based on these findings, seven 20 g satellite transmitters were attached to adult male geese on 28 and 30 March 1997. Six of the transmitters ceased to function one to three days after attachment, probably due in part to a weakness in the antenna mounting. The seventh transmitter functioned for 35 days, enabling the goose to be tracked to Iceland, where it stopped transmitting on 4 May (Glahder & Fox 1997). Because of technical problems with the six satellite transmitters in 1997, Microwave supplied an additional six devices which were attached to Greenland White-fronted Geese on 18, 21 and 22 March 1998 (Glahder et al. 1998). The average transmission life span was 102 days (SD=94.8, n=6), but three of the transmitters functioned for an average of 187.7 days (SD=6.0, n=3). These three geese were tracked to West Greenland and one of the geese were tracked back to Iceland on its autumn migration. In 1999 eight satellite transmitters were attached to Greenland White-fronted Geese on 27, 30 and 31 March, and on 4 April. On 1 June seven geese had reached West Greenland and one was still in East Greenland.

Migration initiation from Ireland

In 1997 the one goose fitted with a functional transmitter left Wexford as early as 7-9 April together with the majority of geese which left Wexford on 7 April (AJW obs.). Normal departure time is around the middle of April. On 10 April, the transmitter-fitted goose showed up in Loch Foyle area of Northern Ireland (Fig. 1), where it staged until 16 April. The goose left the area around midnight on 16 April calculated from a position in the Atlantic Ocean c. 250 km south of Iceland on 17 April at 16:30 (UTC). In 1998 the three geese fitted with

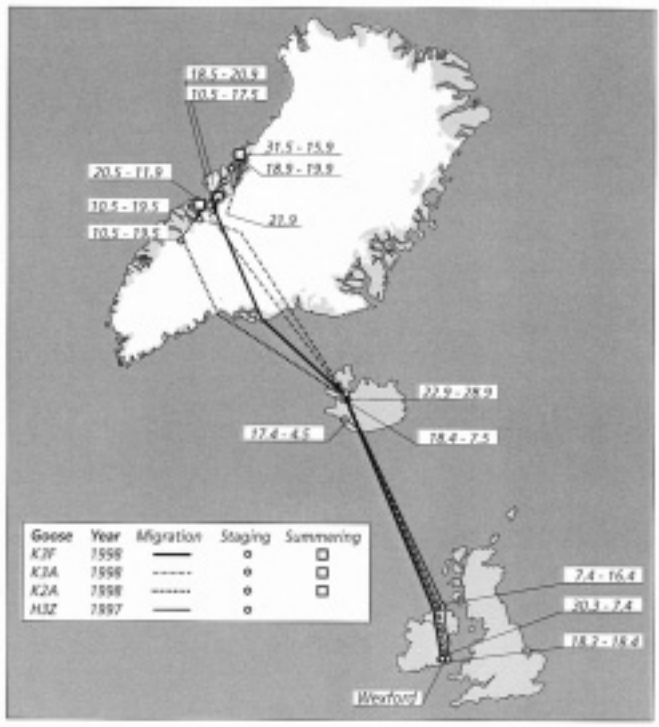

Fig. 1. Migration routes for four Greenland White-fronted Geese in 1997 and 1998. The geese were caught on their wintering ground in Wexford, SE Ireland. Staging areas, summering grounds and staging periods are shown.
Trækruter for fire Grønlandske Blisgæs i 1997 og 1998. Gæssene blev fanget i vinterkvarteret i Wexford, SØ Irland. Rastepladser (staging), yngleområder (summering) og rasteperioder er vist. Otte gæs forsynet med satellitsendere i 1999 fulgte omtrent de samme ruter.

satellite transmitters migrated north 16-18 April, which was in agreement with most geese leaving Wexford during 14-18 April (AJW obs.). None of the three geese staged in Northern Ireland but continued directly towards Iceland. In 1999 the eight satellite-fitted geese left Wexford during 17-19 April and all migrated directly to Iceland.

In all three years the geese left Ireland on their northward migration during a very short period, 14-19 April. In most years the geese leave Wexford during this period and probably migrate directly to Iceland, but in some years, like in 1997, the geese may leave early and then stage in other parts of Ireland before their migration towards Iceland. The early spring of 1997 was extremely dry in the Wexford area (Wilson 1997) and this could have led to the early departure from Wexford.

Migration Ireland-Iceland

We have positions of three geese migrating from Ireland to Iceland in 1997 and 1998, all of them placed on an almost straight line between Wexford and Southwest Iceland (Fig. 1). In 1999 we have positions covering this migration route from four satellite-fitted geese, three of them following the same route as shown in Fig. 1. The width of the migration corridor used by all 7 geese is about 100 km. The fourth goose in 1999 followed a more easterly route from North Ireland to Southeast Iceland.

According to meteorological data (B. Jørgensen, DMI, pers. comm. 1997, 1998) there are indications that the geese in 1997 and 1998 initiated migration shortly after the wind had changed to a southerly direction, but all data, including the 1999 data, need a thorough analysis. Ground speeds of c. 50 and 90 km/h were calculated for two of the geese, respectively, and seems to correspond with prevailing wind speed and direction and a cruising speed of a goose of about 60 km/h (Owen 1980). This subject will be analysed in more detail elsewhere.

Staging in Iceland

Eight of the geese with functional satellite transmitters staged in West Iceland in the Hvanneyri and Mýrar areas, and four in Southwest Iceland in the Olfusa-Landeyjar area (Fig. 1). One of the geese moved from Southwest to West Iceland after about one week, the rest staged for the entire period in one of the areas. These staging areas are well known and described by Francis & Fox (1987). The average length of stay in Iceland was 18.2 days (SD=2.6, range 12-21 days, n=11, 1998 and 1999).

Departure from Iceland

All three geese in 1998 left Iceland on 7 May when major departures were observed from the ground (ADF obs.). As observed in Ireland, migration seemed to commence after a change in wind direction to tail winds. The three geese arrived in West Greenland during 8-10 May 1998 after possibly staging in East Greenland for up to two days. There are only few positions covering their migration route, but they show that the geese migrate over a broad range of about 300 km (Fig. 1). One goose stayed in East Greenland south of Ammassalik (Pikullit 65°N, 40°W), and another 30 km off the cost north of Ammassalik (Kangertittivatsiaq 66°15'N, 35°W).

In 1999 the average departure date from Iceland was 8 May (range 2-10 May). The migration corridor this year was identical to that of 1998 (Fig. 1), with seven of the geese crossing East Greenland north of Ammassalik.

Arrival and staging in West Greenland

The arrival of the geese in West Greenland in 1998 was on average 9 May (range 9-10 May, n=3) and in 1999 11 May (range 3-17 May, n=7). First arrivals in West Greenland are observed during the first week of May (Fox & Madsen 1981, Fox & Ridgill 1985, Glahder et al. 1999). In 1998, the geese staged on three different staging areas between Kangerlussuaq (67°N) and Ilulissat (69°20'N). The average length of stay was 9.3 days (SD=1.2, n=3) before the geese continued to their summering areas. During the staging it seems that two of the geese briefly explored their summering area during the middle of their staging period before they settled for the summer. These summering areas, Naternaq (68°20'N) and Ilulissat, were about 50 km to the northwest of the staging areas. One of the geese were resighted back at Wexford on 27 October 1998 without juveniles, whereas the other bird was shot in Iceland around 1 October 1998 (BTO ring recovered). The third goose continued north to its summering area on the Svartenhuk peninsula (72°N) which was reached on 31 May. This goose was resighted in Wexford on 21 October 1998 without juveniles. So, none of the resighted birds were successful breeders that year,

Wexford 18 March 1998. Photo: Christian Glahder.
Wexford, Irland 18. marts 1998. En flok Blisgæs slippes løs efter mærkning, deriblandt K2A og K3A (ikke synlig) med satellitsendere (der dog heller ikke kan ses).

a year with below average breeding success (10.8% juveniles from 1998 in Wexford (D. Norriss pers. comm. 1999) compared to a Wexford average of 17.7% ± 1.9% s.e., 1982-1993 (Fox et al. 1999)).

In 1999 the seven geese that arrived in West Greenland staged on seven different staging areas between the Kangerlussuaq Fjord (66°30'N) and northern Disko Bugt (69°50'N). The geese seemed to move to their summering areas during 28-30 May, indicating an average length of stay in 1999 of about 16 days (range 13-21 days, n=5).

Summering in West Greenland

All three geese in 1998 remained within a very restricted area during the period from May to September. On average the geese staged for 115.3 days (SD=8.0, n=3). Autumn migration started around mid September with the last transmissions received from the summering areas between 11-20 September. The goose summering at Svartenhuk moved southward between 15-21 September, with the last position received c. 100 km east of Ilulissat ice fjord (Fig. 1). We lack data from the autumn migration flight from West Greenland to Iceland, probably because the power levels of the batteries were too low to sustain up-links in the low temperatures experienced during the ice-cap crossing.

Autumn staging in Iceland

The goose summering in the Naternaq area arrived at Mýrar in Iceland on 22 September 1998; this was the same area which the goose used during spring. The last up-link was on 28 September and the goose was shot around 1 October (Fig. 1). This was the last position received from any of the transmitters.

Resightings in Ireland

Four of the six geese attached with a satellite transmitter in 1998 were resighted in Ireland during October the same year. None of them showed any trace of the transmitter or harness. Also, the goose shot in Iceland around 1 October had no transmitter or harness attached (A. Sigfusson, pers. comm. 1999).

Final remarks

Satellite telemetry is a very effective tool for tracking birds during migration, timing the migration, and identifying staging areas. In the present study we already have obtained considerable information on movement patterns of individual Greenland White-fronted Geese during the period from March to October, and it is hoped the eight geese fitted with transmitters in 1999 will continue to yield high-quality positions during the summer and autumn. Such information comes at a considerable cost, however, especially during the period when the hardware still remains in the technical development stage. In our study it has proved expensive to obtain an adequate sample of marked birds, owing to technical problems and because vigorous preening by the geese apparently damaged several fitted transmitters. Furthermore, there are indications that positions are not as accurate as claimed by Argos. Field observations of tagged geese in Iceland appears to support this supposition, although further analysis is needed. Such inaccuracy does not negate the enormous value of the technique, but the limitations must be borne in mind when planning future projects. Another consideration is that transmitter and harness (c. 1.3% of the average body weight in the present case) might affect the behaviour and migration patterns of the birds. However, the only negative effect apparent from our 1996 pilot project and our field observations at Wexford and in Iceland was an excessive preening during the first few days after transmitter attachment, and the timing of migration of transmitter-fitted geese did not differ from that of the general population. We therefore believe that if our satellite packages have any influence on the migration of the geese, the effect is of minor importance only.

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Resumé

Satellitsporing af Grønlandsk blisgås

I 1996 påbegyndtes et satellitsporingsstudium af Grønlandsk blisgås *Anser albifrons flavirostris* under forårstrækket. En forundersøgelse i gæssenes overvintringsområde i Wexford i det sydøstlige Irland viste, at gæs med påsatte satellitsender-attrapper brugte signifikant mere tid på at pudse sig end kontrolgæs i de første få dage, men en uge efter påsætningen syntes gæssenes adfærd at være normal. Den bedste metode til at fastgøre satellitsenderne på gæssene viste sig at være vha. et seletøj af bukseelastik. I årene 1997-1999 blev der sat 21 satellitsendere (30 g) på adulte hanner af Grønlandsk Blisgås. Tolv af gæssene blev sporet til Island og 10 blev fulgt videre til Vestgrønland. Indtil videre dækker de indsamlede positionsdata perioden 18. marts til 28. september. Undersøgelsen har bl.a. givet nye informationer om de enkelte gæs' trækruter, fænologi, rastepladser og rasteperioder. I 1997 startede forårstrækket fra Wexford allerede 7. april, mens afrejsen var normal i 1998 og 1999 (14.-19. april). Alle tre år ankom gæssene med satellitsendere til Island i perioden 17.-22. april. Dette skyldtes, at gæssene i 1997 rastede ca 1 uge i Nordirland inden det videre træk til Island. Gæssene rastede i gennemsnit 18,2 dage (SD=2,6, n=11) i Island inden de i perioden 2.-10. maj (i gennemsnit 8. maj, n=11) trak videre til Grønland. I 1998 rastede gæssene i gennemsnit 9,3 dage (variation 8-9 dage, n=3) på vestgrønlandske rastepladser inden de fortsatte til yngleområderne. I 1999 var den gennemsnitlige rasteperiode ca 16 dage (variation 13-21 dage, n=5). Efterårstrækket blev i 1998 påbegyndt 11.-20. september, og én af gæssene rastede i det vestlige Island 22.-28. september. Denne gås blev skudt omkring 1. oktober, og dens sender var da faldet af. Fire af de satellitmærkede gæs blev genset i Wexford i perioden 21.-27. oktober, men på det tidspunkt havde de alle mistet deres sendere.

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