

**Tomas Aarvak, Ingar Jostein Øien & Szabolcs Nagy**

**Migration routes and wintering areas of  
Lesser White-fronted Geese mapped  
by satellite telemetry**



**Norwegian Ornithological Society**



**Report No. 4-1998**

**NOF RAPPORTSERIE**  
**RAPPORT NR.4-1998**

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**NORSK ORNITOLOGISK FORENING (NOF)**  
**KLÆBU 1998**

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This report should be cited as:

Aarvak, T., Øien, I.J., & Nagy, S. 1998. Migration routes and wintering areas of Lesser White-fronted Geese mapped by satellite telemetry. Klæbu, Norwegian Ornithological Society. NOF Rapportserie. Report No.4-1998.

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Front cover photo of *Anser erythropus* with satellite transmitter: Ingar J. Øien

Printed: October 1998

Number of copies: 100

ISSN 0805-4932

ISBN 82-7852-028-3

## PREFACE

This report gives a summary of the activities conducted on the Lesser White-fronted Goose Project run by the Norwegian Ornithological Society (NOF) through a program for environmental collaboration between Hungary and Norway. It has been funded by the *Norwegian Ministry of Environment via the Norwegian State Pollution Control – Eastern Europe Secretariat*. The report is based mainly on the preceding annual reports by Aarvak et al. (1995, 1996 and 1997) as well as the work conducted from December 1997 to August 1998 (annual report in prep.). Emphasis is put on the results achieved so far and its implications for future research and conservation activities.

Many people has been involved in the project in different ways. Juha Markkola and Petteri Tolvanen from the Lesser White-fronted Goose Project of WWF Finland has closely co-operated with us through all phases of the project and we really appreciate the good co-operation we have had with them. We also appreciate all the good help and good co-operation provided from all partners and contacts listed in Appendix 1.

Field surveys has been carried out in several countries and many persons have been involved, which we are in great debt to: Petar Iankov, Irina Kostadinova, Nikolai Petkov, Hristo Hristov and Sergey Dereliev (Bulgaria). Eugen Petrescu and Edmund Ballon (Romania). Aki Arkiomaa, Risto Karvonen, Petro Pynnönen, Petteri Tolvanen and Juha Markkola (Finland). Alexander I. Artiukhov, Alexander V. Astapenko, Yuri M. Karbainov, Mihail Y. Karbainov, Konstantin Litvin, Sergei Osipov, Victor V. Ranov and Eugeny E. Syroechkovski Jr. (Russia). Ulf Berntsen, Morten Ekker, Barb L. Håland, Svein-Håkon Lorentsen, Halvar Ludvigsen, Torkjell Morset, Gunn Paulsen, Jostein Sandvik and Kåre Tannvik (Norway). In Hungary, MME have employed a number of persons during this project, with special thanks to: Zsolte Kalota's, Gabor Kova'cs, Janos Tar, Gabor Magyor and Lajos Varga.

This report is an internal report to SFT. This implies that results of the satellite telemetry from 1997 and 1998 are preliminary and will be published in an international scientific journal and for these data this publication should not be used as citation source. All other data within this report are regarded as public available.

Trondheim/Budapest, October 1998

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# CONTENTS

## ABSTRACT SAMMENDRAG

<b>1. INTRODUCTION</b> .....	<b>1</b>
1.1 Population status.....	1
<b>2. IDENTIFICATION AND MAPPING OF MIGRATION ROUTES BY USE OF SATELLITE TELEMETRY</b> .....	<b>2</b>
2.1 Background and methods.....	2
2.2 Results of the satellite transmitter telemetry.....	5
<b>3. REVIEW OF INFORMATION FROM STAGING AND WINTERING AREAS</b> .....	<b>9</b>
3.1 Staging and wintering localities on the western route.....	12
3.1.1 Hungary.....	12
3.1.2 Greece.....	14
3.1.3 Skjåholmen in East Finnmark, Norway.....	15
3.1.4 The Valdak Marshes in West Finnmark, Norway.....	16
3.1.5 The Baltic Republics.....	17
3.2 Staging and wintering localities on the eastern route.....	18
3.2.1 Staging at the Kanin Peninsula.....	18
3.2.2 Staging in Northern Kazakhstan.....	19
3.2.3 Wintering areas in Azerbaijan.....	20
<b>4. RESEARCH CONDUCTED WITH RELEVANCE TO THE SATELLITE TELEMETRY</b> .....	<b>21</b>
4.1 Population trends in Norway.....	21
4.2 Breeding success in Norway.....	21
4.3 Mortality rates of Norwegian breeding birds.....	22
<b>5. CONSERVATION WORK</b> .....	<b>24</b>
5.1 Protection of the staging area at Kanin Peninsula.....	24
5.2 International and national action plans.....	25
5.3 International public information.....	27
<b>6. MAIN CONCLUSIONS AND FUTURE PRIORITIES</b> .....	<b>31</b>
<b>7. REFERENCES</b> .....	<b>33</b>
<b>APPENDIXES</b> .....	<b>36</b>
I. Co-operation partners and contacts.....	

## ABSTRACT

This report contains the results from the satellite transmitter telemetry study on Lesser White-fronted Goose conducted by the Norwegian Ornithological Society in co-operation with MME/BirdLife Hungary, WWF Finland and the Norwegian Institute for Nature Research (NINA) in the years 1995-1998.

The satellite transmitter study revealed that the Lesser White-fronted Goose after commenced moult return to the staging area at the Valdak Marshes in Norway, before they all fly directly eastwards to the Kanin Peninsula, Northwest Russia. From here the migrating birds divides and follows two separate routes. One route goes in a Southwest direction with staging areas located north of St. Petersburg, in East Germany, Hungary, and finally Greece where the geese spend the winter. The other route goes from the Kanin Peninsula south-eastwards along the eastern side of the Ural mountains to Kazakhstan. The tracking has also documented that non-breeding Fennoscandian Lesser White-fronted Geese migrate to Russia already in mid-summer to moult together with Russian geese, and that Lesser White-fronted Geese even may winter in Northern Europe under favourable weather conditions.

The south-western autumn migration route to the winter quarter for the Fennoscandian breeding population seems well covered, while there is still a lack of knowledge about where the geese migrate after they have reached Kazakhstan. The wintering areas for this route is unknown. The study has also shown that breeding birds from Fennoscandia, Yamal - and Taimyr Peninsulas utilise the same route to Kazakhstan and that they migrate together.

The monitoring work at Valdak has shown that the production of young is generally high, while the mortality for immatures and adults are very high. This is thought to have a major impact on the population development.

In the report period, a Nature Reserve at the Kanin Peninsula has been established on the background of this work. Further, a general hunting ban of all geese has been introduced in the common wintering areas for the Fennoscandian breeding birds passing through Hungary. Work is also in progress to reduce the impact of hunting in the staging areas by an extensive awareness campaign directed towards management authorities and hunters.

## SAMMENDRAG

Foreliggende rapport beskriver resultatene fra satellittsender telemetrien på dverggås utført av Norsk Ornitologisk Forening i årene 1995-1998. Prosjektet er gjennomført i samarbeid med MME/BirdLife Ungarn, WWF Finland og Norsk Institutt for Naturforskning (NINA).

Satellittsender-telemetrien har vist at dverggjessene etter at de er ferdig med å hekke returnerer til Valdak, før de starter på høsttrekket. Trekket går fra Valdak til Kaninhalvøya i Nord-Russland. Her deler trekkruta seg i to. En rute går sørvestover, med rasteplasser nord for St. Petersburg, i det østlige Tyskland og i Ungarn, før overvintringsområdet nås i Hellas. Den andre trekkruta går sørøstover fra Kaninhalvøya langs østsiden av Uralfjellene til Kasakhstan. Hvor trekket går videre herfra er ukjent. Ved hjelp av satellittsender-telemetrien har vi også dokumentert at ikkehekkende dverggjess trekker til Russland allerede i begynnelsen av juli for å myte sammen med russiske dverggjess, samt at dverggjessene også kan overvintre i Nord-Europa (Polen og Tyskland) under gunstige klimatiske forhold. Vi har også vist at dverggjess fra Fennoskandia, Yamal- og Taimyr halvøyene i Russland benytter det samme rasteområdet i Kasakhstan.

Den vestlige høsttrekkruta er nå relativt godt dokumentert, men fortsatt mangler det kunnskaper om vårtrekket etter at gjessene har forlatt Hellas. For den østlige ruta er kunnskapene svært mangelfulle, med unntak av trekkleden som går langs østsiden av Uralfjellene til Kasakhstan.

Overvåking av dverggjessene på Valdakmyra har vist at ungeproduksjonen er god. Dødligheten hos voksne dverggjess er relativt høy, mens den for ungene er svært høy. Sannsynligvis er dette hovedårsaken til den kraftige bestandsnedgangen. Voksendødelighet er den faktoren som gir seg størst utslag for en bestands utvikling, mens tilsvarende variasjon i ungeproduksjon gir mindre utslag.

Innenfor rapportperioden har det blitt opprettet ett Naturresevat på Kaninhalvøya i Russland. En omfattende informasjonskampanje for å redusere virkningen av jakt er nå under utarbeidelse.

# 1. INTRODUCTION

## 1.1 POPULATION STATUS

The Lesser White-fronted Goose *Anser erythropus* is now more threatened than ever. A review of the wintering populations of the Lesser White-fronted Goose (Lorentsen et al. MS) concludes that the rapid population decline still continue. The species is listed as *endangered* by Collar & Andrew (1988), and as *globally threatened*; i.e. considered to become extinct if the negative trend continues (Tucker & Heath 1994).

The world population of Lesser White-fronted Geese has traditionally been divided in three breeding meta-populations; the Fennoscandian, the Central Russian and the Far Eastern.

In **Fennoscandia** the population was estimated to be more than 10 000 individuals in the first half of the century (Norderhaug & Norderhaug 1984). From the 1950s until the early 1980s, the population declined by 90-95% and the range by at least 50%. In the period 1980-1996, the decline continued and at present the population counts about 1% of its former size. This represents approximately 30-50 breeding pairs (Øien et al. 1996, Aarvak et al. 1997).

The core population (**Central Russian**) with an estimated 110 000 individuals in Taimyr (Martynov 1983, cited in Vinogradov 1990), was based on data extrapolated from questionnaires. This estimate was considered to be too high by Rogacheva (1992) and Øien & Aarvak (1993). Based on field observations and questionnaire data, Aarvak et al. (1997) estimated the population in the core breeding range of the Lesser White-fronted Goose in Taimyr to consists of about 1000-2000 breeding pairs and 3000-4000 non-breeders

During the twentieth century, the population of Lesser White-fronted Goose in **East Asia** has experienced a dramatic decline in numbers all over its range. In China the wintering population is estimated to 1000-10 000 individuals (Perennou et al. 1994). However, A. Andrew states that there are probably 6000 wintering in this region (Perennou et. al. 1994). In February 1997, 13 700 individuals were counted at Poyang Lake by Japanese researchers (Iwabuchi et al. 1997). In Japan and Korea the Lesser White-fronted Goose is virtually extinct. It seems as the decline in the wintering populations in China is a result of over-exploitation by shooting and poisoning in China (IWRB Goose Research Group 1994), but Ler et al. (1989 cited in Green 1992) believes that the numbers breeding in the far east of Siberia have declined, not only as a result of excess hunting in the wintering areas, but also due to economic development of the breeding habitat and intensification of agriculture in the wintering areas.

Morozov (1995) estimated the total Russian population to be 30 000-50 000 individuals. Even this estimate, is now considered to be too high, and it has not been confirmed by winter counts in recent years.

## 2. IDENTIFICATION AND MAPPING OF MIGRATION ROUTES BY USE OF SATELLITE TELEMETRY



### 2.1 BACKGROUND AND METHODS

Since 1987, the Norwegian Ornithological Society (NOF) has run the *Lesser White-fronted Goose Monitoring Programme*. The first years were spent on mapping breeding and staging areas as well as studies on the reasons for the population decline in Norway. These studies revealed that the main causes had to be sought along the migration routes and in the wintering areas. The core problem was, and partly still is, that the staging and wintering grounds for the species are virtually unknown. Due to the steady and alarming decrease in the Fennoscandian breeding population of Lesser White-fronted Goose (see Norderhaug & Norderhaug 1984, Øien et al. 1996), actions were needed to locate the staging and the wintering grounds. In 1993 NOF started the planning of a project of locating the staging grounds along the migration routes and wintering grounds for the Fennoscandian population by employing the new satellite transmitter technology.

This was also one of the main **recommendations** at a meeting in May 1993 by the Nordic Lesser White-fronted Goose Research Group and the IWRB Goose Research Group: The status of the population in Central Siberia, wintering in the Caspian Region should be carefully monitored. Use of satellite telemetry on individuals from both the Fennoscandian and Siberian populations will probably be the most efficient method to provide the lacking knowledge about winter dispersal and migratory movements. The tracking should then be followed up by ground surveys. It was also stated that; the monitoring of the wild population in Fennoscandia and Hungary should be continued to assess the trend of the population. Suggested existing staging areas in the Baltic republics should be sought.

The **ultimate aim** of this project is to turn the negative population trend for the Lesser White-fronted Goose through establishment of protected sites, implementation of management plans and conservation efforts. This can only be carried out through a joint effort from the countries managing breeding populations (Russia, Norway and Finland), and the countries managing staging and wintering populations (Germany, Poland, Latvia, Lithuania, Estonia, Hungary, Greece, Romania, Bulgaria, Ukraine, Belarus, Kazakhstan, Azerbaijan and China). Co-operation with Eastern European countries and the former Soviet republics is a prerequisite by the fact that they manage most of the few known staging sites for the species which are important for the Fennoscandian population.

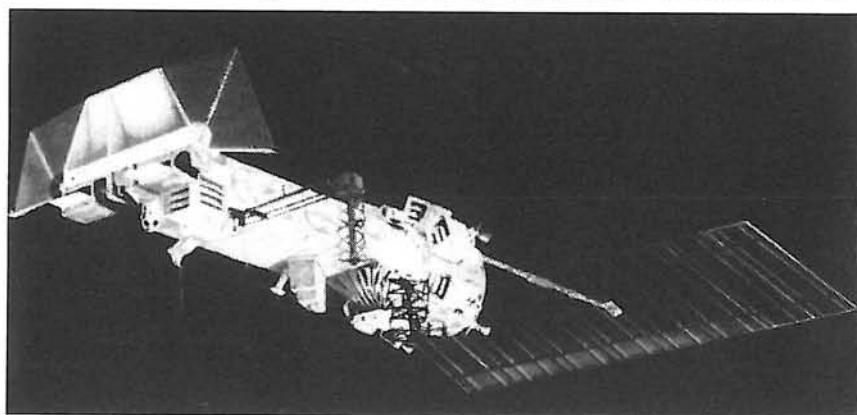
Given this background it was natural to implement a close co-operation with Hungary. Besides Norway and Finland, only Hungary was conducting regular counts of Lesser White-fronted Geese in the migration periods. Besides, Hungary possessed good data on the



occurrence of Lesser White-fronted Geese back to the 1970's thanks to the extensive research conducted by I. Sterbetz (Sterbetz 1982).

Because the remaining Lesser White-fronted Goose breeding population is found in very small numbers in remote and inaccessible areas, traditional methods for mapping of migration routes did not prove successful. But the quick development of miniature satellite transmitters during the latest years, made this the only feasible alternative to traditional methods. The first **satellite transmitters** applied to birds were fitted on Bald Eagle in 1984 (Howey 1992), Whooper and Mute Swans in the late 1980s. The weight of the transmitters were then between 145 and 180 grams, far exceeding the weight suitable for Lesser White-fronted Geese. Today the lightest transmitters weigh between 20 and 30 g. The transmitter used on Lesser White-fronted Goose weigh 30 g., and with the harness used to attach the transmitter, the whole package amounts to 34-35 g. This represents less than 3% of a female's minimum bodyweight of 1200 g. In comparison the weight of a male and a female in good condition is approximately 2000 and 1800 g. respectively. A general rule is that the weight of the transmitter should not exceed 5% of the body weight of the birds.

The **satellite tracking system** consists of four components: the transmitter, the satellites, the computer data processing unit in France (ARGOS), and a modem link between the researcher's PC and the processing unit in France. The transmitter signals are pulsed from the transmitter every 60 seconds at a very stable frequency of 401.65 MHz. Each pulse lasts 360ms and contains information on the identity of the transmitter, activity of the bird, temperature and battery voltage. Power output is about 6 times higher than a conventional radio transmitter because the signal have to reach the satellites from a distance of more than 1000 km. The transmitters were programmed to follow a fluctuating duty cycle. The duty cycle was optimised in order to maximise the life-time of the transmitters so that information could be obtained from autumn, winter and spring. The transmitters were programmed to send frequently during the supposed migration periods (every third day) and at longer intervals during the breeding and wintering periods (every tenth day). Signals are then received by three National Oceanic and Atmospheric Administration (NOAA) satellites (which also collect weather data). These orbit the earth from the north to the south pole once every 102



minutes. Each orbit is displaced from the previous by 25 to the west, so the satellite path covers the entire earth during the course of each day. Data are collected from any transmitter and then stored by the satellite until it passes over France when the information is sent down

to an earth receiving station. In France the data is sent to the processing computer. Here the position is determined by use of the Doppler shift which is the change from a high to low perceived frequency. As the orbiting satellite passes a transmitter, it receives the signal first at an elevated frequency and then at a lower frequency. When the received frequency is exactly what it should be (i.e. 401.65MHz) the satellite is in line with the transmitter (giving us the latitude). The rate at which the frequency changes from high to low tells us how far away the transmitter is from the satellite, allowing us to calculate longitude. In this way, the position of

the transmitter is calculated from the transmit frequencies received on board the satellite. The system is not perfect but most locations are within 2 km of the true point, a remarkable accuracy for tracking migration routes. The last link in the system is the computer modem link (through FTP) between Trondheim and France (in this case). Generally, it takes 2-3 hours for a signal to be sent from the satellite, to France for processing, before it can be downloaded in Trondheim.

**Catching** of highly mobile species as geese is not easy. Use of **cannon-nets** has proved to be the only reliable method for goose catching out of the moulting period. However, also this method has its limitations. The equipment is not easy to move when first arranged, and it can therefore best be utilised when the spatial movements of the individuals can be accurately predicted. The Valdak Marshes area is quite small and therefore, as long as the spring proceeds normally, is suitable for use of cannon-nets. However, in large areas where the movements of the geese are more unpredictable, the only alternative is to catch the geese during the moulting period. Lesser White-fronted Geese has been caught at the Valdak Marshes by cannon-nets during the springs of 1995, 1997 and 1998.

The other option for catching is in the **moulting period**. The geese needs to renew the wing feathers before the migration period starts, because of heavy wear of the feathers during summertime. All the wing feathers are shed simultaneously, and for a period of c. 2 weeks they are unable to fly. They can then be caught by hop-nets or driven into a corral of nets set up in vicinity of the lake they stay. Lesser White-fronted Geese has been caught during moult in Finnmark (Norway), Finnish Lapland and at the Yamal- and Taimyr peninsulas.

The satellite transmitters were **attached as a back-pack** to the geese using 8 mm tubular teflon tape harnesses. Great care was given to assure that the transmitters were not too loose or too tight and that the antenna would always point upwards. With continuous transmitting the batteries last for c. 500 h (P. Howey, Microwave Ltd., personal communication). Data on the position of the birds were obtained via the ARGOS system. References to the accuracy of the locational information are those provided by ARGOS: class 3 < 150 m ( $\pm 1$  SD), class 2 = 150-350 m ( $\pm 1$  SD), class 1 = between 350-1000 m, class 0 = > 1000 m (no upper estimate of accuracy), and class A and B = no estimate of location accuracy provided but has to be judged by the user (ARGOS, 1996).

When the geese were on migration and tracked to a specific area, local ornithologists were contacted in order to verify the signal plots by visual observations. This was also done to obtain information about area use and number of geese.

Further details about methodology of catching, attachment methods of the satellite transmitters, and processing of satellite data is thoroughly described by Lorentsen et al. (1998) and Aarvak et al. (1996, 1997), and we refer to these publications for more information.



## 2.2 RESULTS OF THE SATELLITE TRANSMITTER TELEMETRY

A pilot study was carried out in the bordering areas between Norway and Finland in 1994 by WWF-Finland, where a pair with one gosling was caught during the moulting period. The male was tagged with a satellite transmitter, and was tracked to the island Skjåholmen in the Varangerfjord (Finnmark County, Norway). Here it was found dead, probably after being preyed upon by a White-tailed Eagle *Haliaeetus albicilla* (Lahti & Markkola 1995, Aarvak & Øien 1994). The gosling was later reported shot on 19 November 1994 in Kurchanskiy, one of the many lagoon areas at the Azov Sea coast, near the city of Krasnodar in Southern Russia (Lahti & Markkola 1995, Aarvak & Øien 1995).

In 1995 four individuals were caught in Finnmark; one pair during spring staging at the Valdak Marshes and two individuals during moult in a breeding area. After commenced moult all individuals returned to the staging area at the Valdak Marshes, where they spent approximately two weeks before they all flew directly to the Kanin Peninsula, Northwest Russia. From here the individuals divided into two groups and followed two separate routes. Two individuals followed a south-western route to East Germany, where one individual disappeared (probably shot). The remaining bird went to Hungary, Northern Greece and eventually ended up in the border areas of the Evros Delta between Greece and Turkey (Lorentsen et al. 1998). This individual was observed at the staging ground in Finnmark in the following spring and autumn, and later during the winter in Lake Kerkini (see section 3.1.2). The other two satellite transmitter tagged individuals went eastwards from the Kanin Peninsula and one bird was shot on the western side of the Ural Mountains. The last individual disappeared (probably shot) in the Ob Valley on the eastern side of the Ural Mountains (Lorentsen et al. 1998, see also Aarvak et al. 1996, 1997). Also in Finland, WWF-Finland had caught a male Lesser White-fronted Goose and equipped it with a satellite transmitter. This individual also went to the Kanin Peninsula. From there it followed the eastern route and went all the way to Northern Kazakhstan (Kustanai District) before it disappeared. Two of the goslings belonging to this male were reported shot in the same area (Karvonen & Markkola 1997). By this, two autumn migration routes were detected, and the wintering area for the birds following the western route was located. However, the eastern route, which is probably the most important for the Lesser White-fronted Goose in general, could not be traced all the way to the wintering areas. These are believed to be located in the southern areas of the Caspian Sea, notably in Azerbaijan (Lorentsen et al. 1998). To supplement the loss of individuals, a catching attempt was carried out in Hungary in the beginning of November. No geese were found, since a onset of cold weather a few days earlier forced the geese to continue further south.

In 1996 new attempts were carried out to catch more Lesser White-fronted Geese with the intention to confirm the discoveries from 1995 and reveal both the wintering areas for the eastern migration route as well as the spring migration routes. However, neither NOF nor WWF-Finland managed to catch any geese this year (Aarvak et al. 1996). This was mainly due to the weather conditions. When the geese arrived, the Valdak Marshes were almost covered with snow and ice. The geese then utilised the only available food *Hippurietum tetraphylla* which had hardly started growing in the melt ponds. As the snow and ice melted and protracted from the salt marshes, the geese followed, utilising the newly exposed vegetation. The catching equipment (cannon nets) could not be relocated in the same phase, both due to the rapid change of feeding places, but also due to the disturbance this would imply.



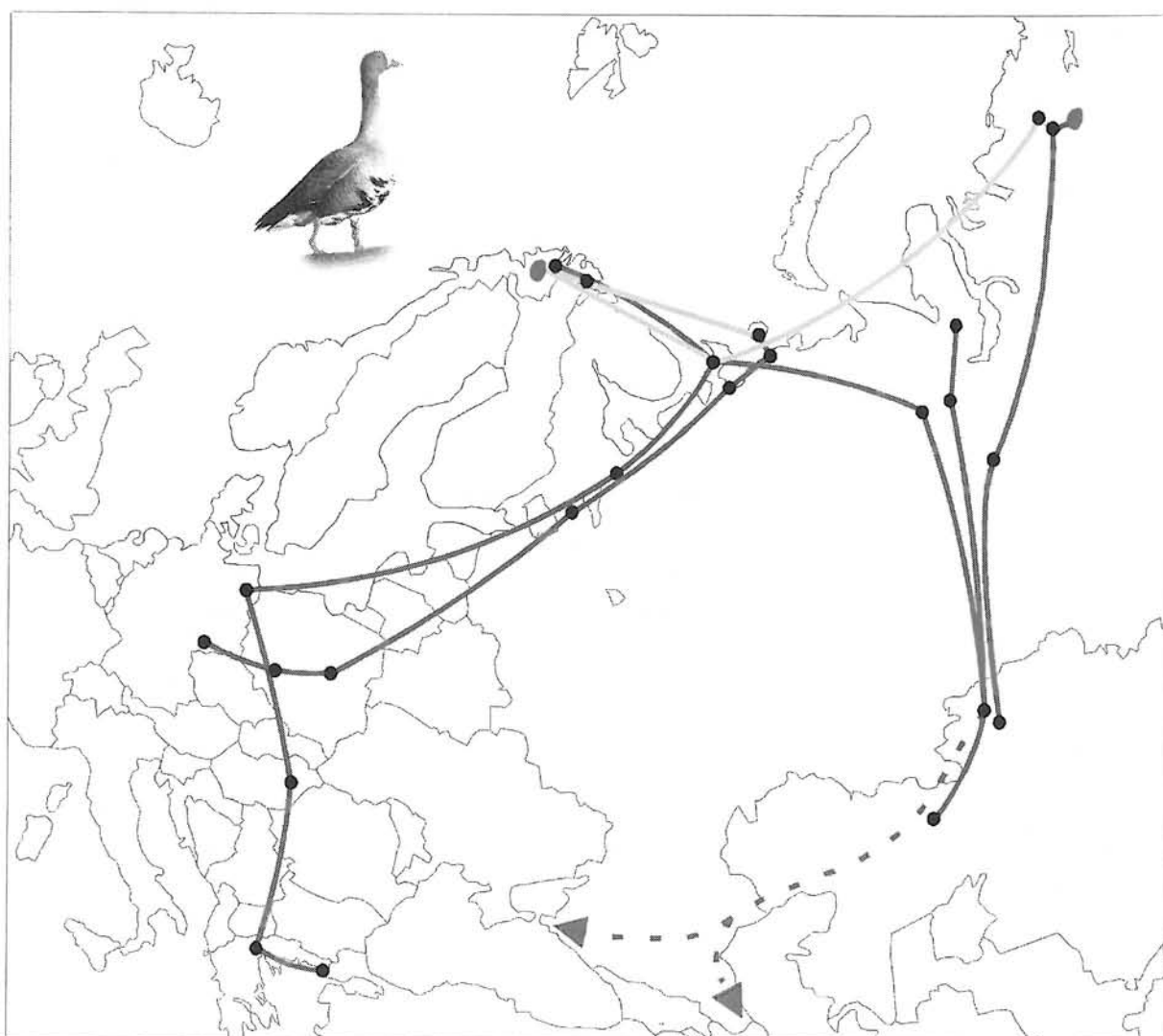
*Male Lesser White-fronted Goose with a satellite transmitter, caught at the Valdak Marshes in May 1997. Photo: Ingar J. Øien.*

**In 1997**, NOF managed to catch and mount satellite transmitters on three Lesser White-fronted Geese at the Valdak Marshes during spring staging. None of these individuals were breeding that year, and they all left Central Finnmark already in the end of June and migrated eastwards. Two of them utilised the Kanin Peninsula, while one individual went somewhat further, - to the Kolgujev Island (see Figure 1). One of the birds staging at Kanin Peninsula continued to the Pyasina River on the Taimyr Peninsula from where the signals ceased. In this area, more than one million geese are known to gather for moulting. The bird staging at Kolgujev Island utilised the south-western migration route revealed in 1995 and uncovered a new staging area to the north of St. Petersburg, Russia, before it decided to spend the winter in Poland and Germany.

Like in 1995, the migration route diverged in a south-east and a south-west direction. Unfortunately, the signals from one bird that moved in a south-east direction from Kanin Peninsula disappeared early on its route, before a possible crossing of the Ural Mountains.

The most interesting finding of the satellite telemetry work this year was that non-breeding Fennoscandian Lesser White-fronted Geese migrate to Russia already in mid-summer to moult together with Russian geese, and that they even may winter in Northern Europe when the weather conditions are favourable.

**In 1998**, three adult Lesser White-fronted Geese and one gosling were caught at the Taimyr Peninsula, and the adults were fitted with satellite transmitters. After they had finished moulting, they moved 60-100 km north-westwards on the peninsula to the same area that one of the Fennoscandian satellite transmitter tagged birds used in the summer 1997 (a bird which migrated from the breeding areas in Finnmark). Here the signals from one of the transmitters ceased. The remaining two adults (a pair) had a short stopover on the western side of the Putorana Mountains before the first major migration lap to the middle parts of the Ob Valley east of Khanty Mansiysk. They spent one week here before they continued to Northern Kazakhstan (Kustanai Region), quite close to the area utilised in 1995 and 1997. They had just arrived there at the 1st of October, when this report was written.



**Figure 1.** Major movement patterns of Lesser White-fronted Geese as revealed by satellite telemetry in the years 1995 to 1998 (after Lorentsen et al. 1998, Karvonen & Markkola 1997, own unpublished data from 1997 and 1998). The dashed line shows the presumed migration route further from the areas in northern Kazakhstan. Some of the lines represent more than one individual. The paler lines represent moult migration in early July 1997. See text for further details.

## The case of the Red-Black-Yellow banded Lesser White-fronted Goose

One of the first Lesser White-fronted Geese caught in this project has an extraordinary history. It was a male caught on the 27th of July 1995 during moult in the core breeding area in Finnmark, Norway. The male was equipped with a satellite transmitter and a colour leg ring with the combination Red-Black-Yellow (read from above). Firstly it went from the breeding area to the Valdak Marshes in Finnmark. Then further to the Kanin Peninsula (Russia), Galenbecker See (Germany), Hortobágy (Hungary), Lake Kerkini (Greece), Evros Delta (Greece) where the transmitter eventually fell off. After this the bird has been re-sighted several times in Greece, Norway and also in Estonia and Finland. The re-sightings have been possible in areas where the available habitat for Lesser White-fronts is relatively limited, so the geese could easily be observed.

Area	Date	Year	Comments
Breeding and moulting area <i>Norway</i>	- to c. 15-22 August	<u>1995</u>	Caught 27 July
Valdak <i>Norway</i>	c. 15-22 to 29 August		Also observed
Kanin Peninsula <i>Russia</i>	c. 30 August to 14 September		
Galenbecker See <i>Germany</i>	c. 20 September to 28 September		Also observed *)
Hortobágy <i>Hungary</i>	29-30 September to 5-11 November		
Lake Kerkini and Evros Delta <i>Greece</i>	c. 5-11 November to c. mid-February	<u>1996</u>	Also observed *) <u>End of satellite tracking</u>
Valdak <i>Norway</i>	24 May to 2 June		Observed
Valdak <i>Norway</i>	24 August to 2 September		Observed
Lake Kerkini <i>Greece</i>	7 to 29 November		Observed
Valdak <i>Norway</i>	17 to 22 May	<u>1997</u>	Observed
Matsalu Bay <i>Estonia</i>	1 May	<u>1998</u>	Observed
Hailouto <i>Finland</i>	c.12 to 17 May		Observed
Valdak <i>Norway</i>	17 to 26 May		Observed

*Sequential locations (as based on satellite telemetry) and observations for one individual Lesser White-fronted Goose (from Lorentsen et al. 1998 and own data).*

*(\* = Observers where directed to the locality after satellite locations were received)*



### 3. REVIEW OF INFORMATION FROM STAGING AND WINTERING AREAS

The major migration routes are depicted in Figure 1. As can be seen, the major migration routes during autumn migration are now quite well covered. Out of the staging areas found on the **western** route by the satellite telemetry, 11 out of totally 14 areas were previously unknown (The Valdak Marshes not taken into account). In the areas which were known to hold good numbers, at least formerly, we demonstrated that the Lesser White-fronted Geese which utilise the Hortobágy area in Hungary, Lake Kerkini and the Evros Delta in Greece belong to the Fennoscandian breeding population. As demonstrated on the map, there is a lack of knowledge about the spring migration route. Where the geese spend their time from the middle of February until May is virtually unknown. However, based on the observations of the Red-Black-Yellow individual (see the box at the former page) we know that the last lap of the spring migration route goes from Haeska in Estonia to Hailouto in the Bothnian Bay of Finland and further to the Valdak Marshes in Norway. The latter is the last spring staging area before the onset of the breeding period.

The **eastern route** is not well covered (from the Kanin Peninsula and eastwards). Of the eight areas located by the satellite telemetry, only two were previously known, namely one area in the Ob Valley and one in the Kustanai Region in Northern Kazakhstan. Ground surveys have after the discovery been conducted in the Kustanai Region and at the Kanin Peninsula. There exists no "on site" information for the Kolgujev Island, the coast of the Malosemelskaya Tundra and the two areas in the Ob Valley (see also Figure 2). It is likely that other major staging areas on the eastern route remain undiscovered. However, a crucial finding is that the Lesser White-fronted Geese from Fennoscandia, Yamal and Taimyr utilise the same areas in Northern Kazakhstan. It is known that most of the Russian White-fronted Goose population and the entire world population of Red-breasted Goose *Branta ruficollis* pass these areas on the autumn migration (Scott & Rose 1996). It is thus important to survey the areas and implement conservation measures to secure these key stopover sites.

Based on available literature and the results from the satellite telemetry, we have plotted all known localities back to the 1950s in Figure 2. These plots includes both areas utilised during migration and in winter. According to type and coverage (for details on the sites see Aarvak et al. 1997, Lorentsen et al. MS, 1998), the plots are given different shades. The localities in grey, are the areas where there are written sources stating that Lesser White-fronted Geese has been seen in significant numbers (not single individuals mixed in flocks of other goose species). Some of these areas have also been confirmed by the satellite telemetry locations, and no other information exists. Areas marked with black are localities where good data exist about both numbers and area use. Out of 47 localities, maximum nine can be judged as well surveyed. Most of these poorly known localities are areas with huge concentrations of other goose species, especially White-fronted Goose. This creates considerable problems, since very few observers are able to identify Lesser White-fronted Geese, and in mixed flocks with White-fronted Geese it is extremely difficult.

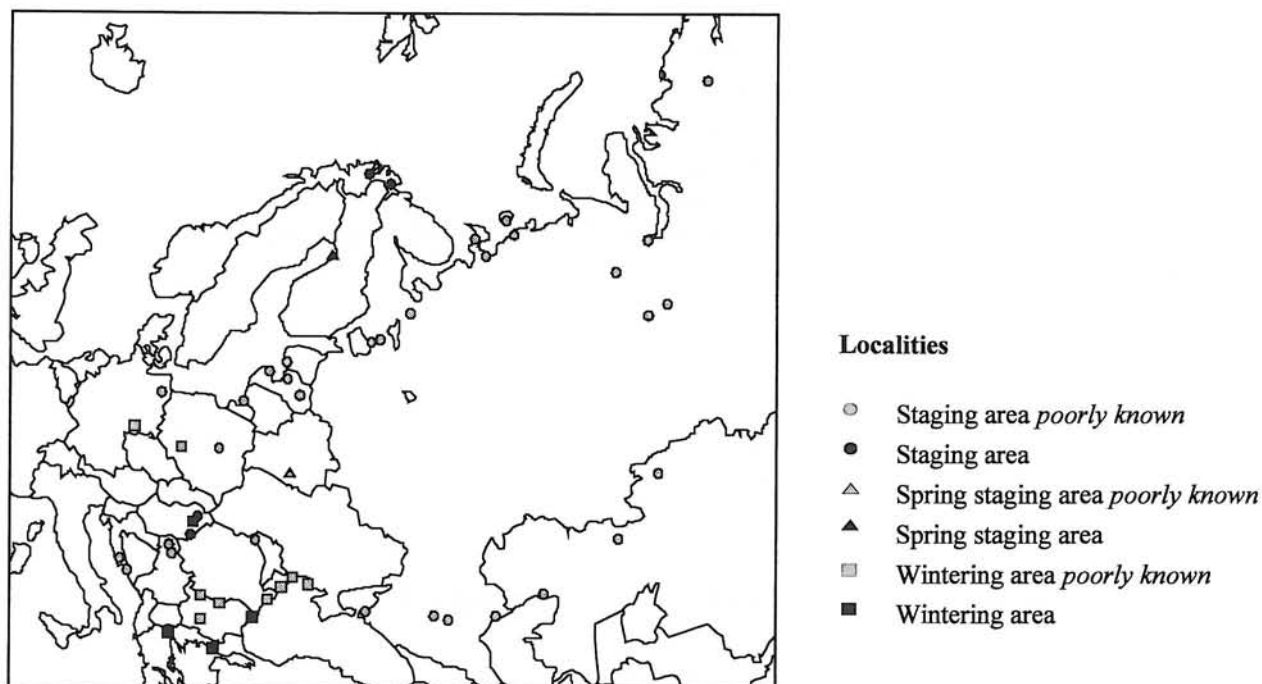
Based on observations conducted after 1990, the localities are classified after importance. Here, observations of 20 individuals or more are considered to be the lower limit for an area to be classified as important. Scott and Rose (1996) provided an estimate for the Northeast Europe/Black Sea area of 3000-5000 individuals and with a 1% level of ca. 40 individuals as a lower limit to qualify as a BirdLife International Important Bird Area (IBA). However, this

estimate is likely to be far too high, and we here use a lower limit of 20 birds. This number is chosen on the basis of the species' threatened status and that no good estimates exist for these areas. The highest count in recent times is some 500 individuals. This number gives a 1% criteria of five birds, which at present would give wrong results, since Lesser White-fronted Geese are known, as most other goose species, to follow other species to areas not traditionally used.

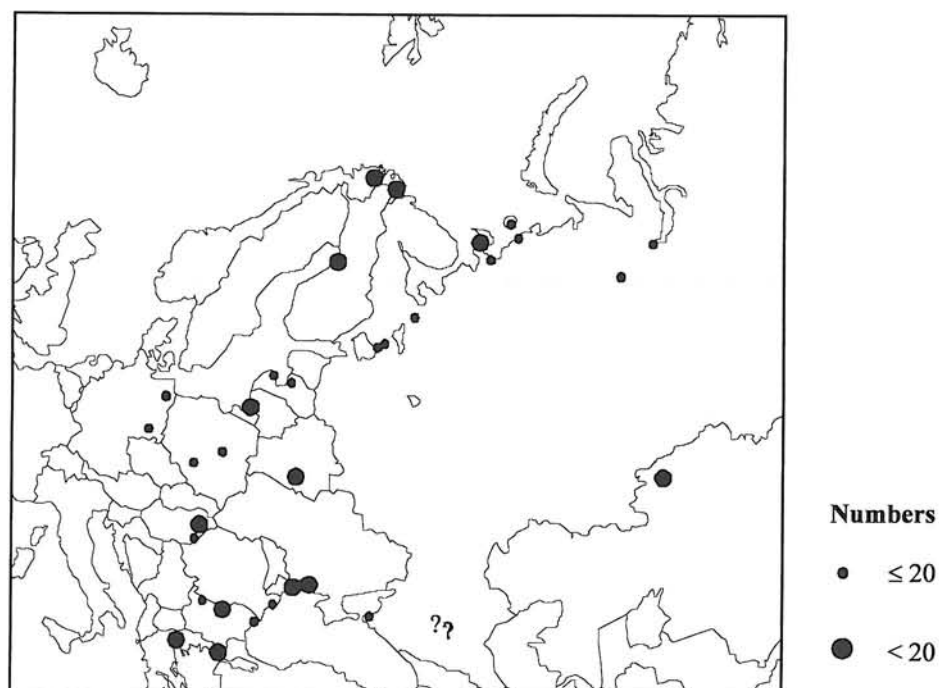
Out of 32 localities, 13 have recently had observations of 20 Lesser White-fronted Geese or more. However, six out of the 19 remaining localities classified as less important have only been surveyed briefly, and the rest has never been surveyed. In order to protect the Lesser White-fronted Goose effectively, all these areas should be targeted for extensive surveys over longer time intervals. Not only is it important to gain knowledge about the different areas, but crucial information in this respect is also occurring numbers, time of occurrence and their utilisation of the areas (roosting lakes and feeding areas).



*Night roost for the Lesser White-fronted Goose in the fishponds at Biharugra in Eastern Hungary in November 1995. Photo: Ingar J. Øien.*



**Figure 2.** Staging and wintering localities of Lesser White-fronted Geese utilised back to the 1950s.



**Figur 3.** Localities with records of Lesser White-fronted Geese during migration or in winter after 1990, classified after importance.



### 3.1 STAGING AND WINTERING LOCALITIES ON THE WESTERN ROUTE

Of the staging areas known on the western route, five areas has been surveyed by specialists on Lesser White-fronted Geese (Skjåholmen in Finnmark, the Kanin Peninsula, Hortobágy in Hungary, Lake Kerkini and the Evros Delta in Greece). We will here briefly give a summary of this work. Both a literature review and ground surveys remain to be carried out for the other areas. Further work on locating spring migration routes by use of satellite telemetry still remains on the western route. The Kanin Peninsula staging area is described in chapter 3.2 on the eastern route.

#### 3.1.1 Hungary

In the first half of this century the Lesser White-fronted Goose used to be present in Hungary in much higher numbers than nowadays. According to Sterbetz (1982) 80 000-120 000 Lesser White-fronted Geese used to stage or winter in Hungary. However, in the period 1971-1980, its numbers amounted only 3-5% of those recorded earlier, and the proportion of the species amongst other geese was as small as 1%. In the mid 1980s the number of staging Lesser White-fronted Geese was only about 400-500 individuals and it has decreased further by the end of the decade up to 120-130 (Farago et al. 1991). The Lesser White-fronted Goose appears almost exclusive in Eastern Hungary, although, due to more intensive observations, some few individuals were recorded at Lake Fertő (near to the Austrian border and Kelemszék in the Kiskunság) amongst other geese (*Anser albifrons* and *A. fabalis*). However, the main staging area is on the Great Plain (Puszta).

In the 1960s and 1970s **Kardoskút** Nature Reserve was one of the most important areas for the species. This nature reserve was established in 1965 and it was designated as Ramsar site in 1979. Due to its strictly protected status (waterfowl hunting was banned) waterfowl have accumulated here in huge concentrations afterwards. The Kardoskút Nature Reserve is a relatively small area, only 486 hectares. About 100 ha is made up of a natron lake and the rest is mainly grassland or extensive arable land. The nature reserve is situated in the middle of a approximately 6000 ha large complex of saline grasslands and arable lands. An extension of the protected area status on these land are in process.

The annual peaks of Lesser White-fronted Geese have changed according to the water conditions at the patron lake and its surrounding. At Kardoskút the Lesser White-fronted Geese use the natron lake for roosting and the saline grasslands with short vegetation for feeding. In the 1960s and 1970s the peak numbers often exceeded 2000 individuals. However, in the 1980s it was always under 50 with culmination in November. In the late 1980s, the appearance of the species has become rather sporadic. This decline was caused, on one hand, by the overall decline of the species, on the other hand, by adverse changes in the local ecological conditions due to severe drought in the decade. After the establishment of an artificial water supply system, the species again occur more regularly. However, habitat management according to the requirement of the species is obstructed by a debate on the ecological consequences of this management and by the lack of money for water and fuel for pumps.

Since the 1980s, the **Hortobágy** became the most important staging area of the species in Hungary. The Lesser White-fronted Goose regularly occur here, mainly on Hortobágy fish-ponds which is a Ramsar site. The Hortobágy fish-ponds is a 1200 ha large system inside of

the Hortobágy National Park. Two ponds are owned by the National Park, the rest by the Hortobágy Fish Farm (HAG), a state owned company. Although the Hortobágy National Park elaborated a management methodology which would provide optimal conditions for the Lesser White-fronted Geese in order to localise them in the protected area, however, it is only a part of a much larger complex of fish-ponds which are not protected. These non-protected ponds are also managed by the HAG, but hunting is not restricted. Important to note, that the highest bag pro ha is shot in the surroundings of the Hortobágy area. The privatisation of the HAG is in process and there is a threat that, the fish-farming company will be bought by consortiums which are interested in hunting and tourist development.

The third most important site for Lesser White-fronted Geese is the fish-ponds at **Biharugra**, although it was intensively used for hunting. This is a approximately 2000 ha large fish-pond system, managed by a limited company, in which MME/BirdLife Hungary has majority share. The ponds and their surroundings are protected as a part of Biharugra Landscape Protected Area. Since 1992 the hunting of waterfowl is prohibited by the hunting legislation. Although Faragó (1995) refers that the species occurs here in relatively large numbers (100-200 individuals), the regular observations conducted by MME/BirdLife Hungary does not verify this statement.



*Grazing fields for the Lesser White-fronted Goose in Hortobágy National Park, Hungary in November 1995. Photo: Ingar J. Øien.*

### 3.1.2 Greece

The Lesser White-fronted Goose occurs mainly in Lake Kerkini in Northern Greece and in the Evros Delta at the Greek-Turkish border area.

**Lake Kerkini** is a freshwater reservoir used for irrigation and flood control, fed by the river Strymonas. The **Evros Delta** is a nature reserve with a diversity of habitats as sandy offshore islands, sand dunes, halotypic marshes, saline lagoons, saltpans and scattered freshwater areas fringed with reed-swamp (Grimmet & Jones 1989).

Old records indicate that the Lesser White-fronted Goose was fairly common, with the highest number registered in 1963; totally 1630 individuals (Handrinos 1991). Since the 1980s, the numbers have varied between 1 and 142 individuals (Lorentsen et al. MS). During the winter 1995-96, a flock of 43 individuals was seen in Lake Kerkini on 12, 14 and 17 November (T. Naziridis pers. comm.). In this flock a male carrying satellite transmitter (Red-Black-Yellow - see box in section 2.2) was observed. The satellite transmitter signals revealed that the bird moved further to the Evros Delta in the end of November, where it stayed until the signals ceased because the transmitter fell off (Lorentsen et al. 1998). On 5 January 1997 a pure flock of 21 Lesser White-fronted Geese was seen in the Drana Lagoon area of the Evros Delta. Approximately 25% were juveniles. None of the individuals were ringed (Y. Tsougraksi pers. comm.).

Counts conducted in the Evros Delta in the winter 1996/1997 by the Finns Petri Lampila and Ville Kälviäinen gave observations of mostly single birds or pairs (P. Tolvanen pers. comm.). On 21 February a pure flock of 63 Lesser White-fronted Geese came from south-east (from the Turkish side of the border) at 16<sup>40</sup> and landed near Drana Lagoon. On the next day this flock had disappeared. A family consisting of 2 adults and 3 immatures observed 24 February possibly was part of this flock. One adult individual with green neck-collar was observed 10 February. This bird was probably one out of two females ringed in Finnish Lapland in 1995 and 1996 respectively (P. Tolvanen pers. comm.).

Based on these observations, one may conclude that probably all of the Lesser White-fronted Geese wintering in Greece belong to the Fennoscandian breeding population. In addition to the demonstrated movements inside Greece from Lake Kerkini in early winter to the Evros Delta in mid-winter, there are movements between the Greek and the Turkish parts of the Evros Delta. Studies should be conducted to obtain more exact information about habitat utilisation and movements in Greece in order to implement management measures to secure this highly vulnerable wintering population of Lesser White-fronted Geese.

All hunting of geese was prohibited in Greece in 1997. However, in the adjacent areas of the protected areas the hunting pressure on waterfowl is considerable, and illegal hunting inside the protected zones is still a problem. Other threats include drainage by farmers and overgrazing by cattle that severely deteriorates the area as a goose habitat.

### 3.1.3 Skjåholmen in East Finnmark, Norway

The island Skjåholmen situated near the bottom of the Varangerfjord in Finnmark County (70°08'N 28°45'E) is at present one of two remaining important autumn staging places for the Lesser White-fronted Goose population in Northern Fennoscandia. Skjåholmen is utilised particularly by Lesser White-fronted Geese breeding in the eastern part of Finnmark and in Northern Finnish Lapland. The island is quite small approximately 3.5 km long and 500 meters at its broadest. Skjåholmen was re-discovered as a staging area for Lesser White-fronted Geese in August-September 1994, when an adult male tagged with a satellite transmitter in Northern Finnish Lapland was located (and later found dead) here (Lahti & Markkola 1995, Aarvak & Øien 1994). Also in August-September 1995 a male Lesser White-fronted Goose, tagged with a satellite transmitter in Northern Finnish Lapland, was located by satellite plots (and later also observed) here. However, Skjåholmen was known as a spring staging area at least back to the 1970s, when Johansson (1974) reported the Lesser White-fronted Goose to occur regularly in spring from the middle of May. In 1973 two individuals were observed 31 May and 1 June.

Based on two shorter visits during spring it has been estimated that 1-5 pairs utilise the island during spring migration (Aarvak et al. 1997). During spring 1998, our Finnish colleagues observed only one pair during most of the spring staging period (ca 20 May - 1 June).

The autumn monitoring carried out by WWF Finland in the years 1995 to 1997 (Tolvanen et al. 1997) revealed that good numbers of Lesser White-fronted Geese utilise the island regularly during autumn staging. Observations and estimates of numbers show that at least 3-7 pairs with young stage at the island before continuing the migration eastwards to the Kanin Peninsula in autumn. In 1995 only four pairs staged on the island post-moulting, but this year, very few individuals also staged at the Valdak Marshes in the same period. This was probably due to the unfavourable breeding conditions in 1995, which lead to a general low production. Only some few pairs bred successfully, and even the successful breeders produced small clutches. The knowledge on the behaviour of failed breeders and non-breeders are quite fragmentary, but it seems that at least the non-breeders start the migration already in early July to moulting places in Northern Russia (see chapter 2.2). Whether the non-breeders and failed breeders utilise Skjåholmen as a pre-migratory staging ground is unknown, but it seems as they migrate directly from the mountain areas.

**Table 1.** *Estimated (minimum) total numbers of Lesser White-fronted Geese at Skjåholmen during autumn staging in 1995-1997 (data from Tolvanen et al. 1997). The final results from 1998 was not available when this report was compiled.*

Year	Total	Number of subad / ad	Number of immatures
1995	50	c. 15	c. 18
1996	13	8	5
1997	30	18	12

Even if Skjåholmen already is stated as one of the very few remaining staging places for the globally threatened Lesser White-fronted Goose in Fennoscandia, landing, hiking, gathering of gulls eggs and Cloudberries and even hunting is still allowed at Skjåholmen during the staging periods of the Lesser White-fronted Goose. This may incur considerable disturbance to the Lesser White-fronts occurring at the island.



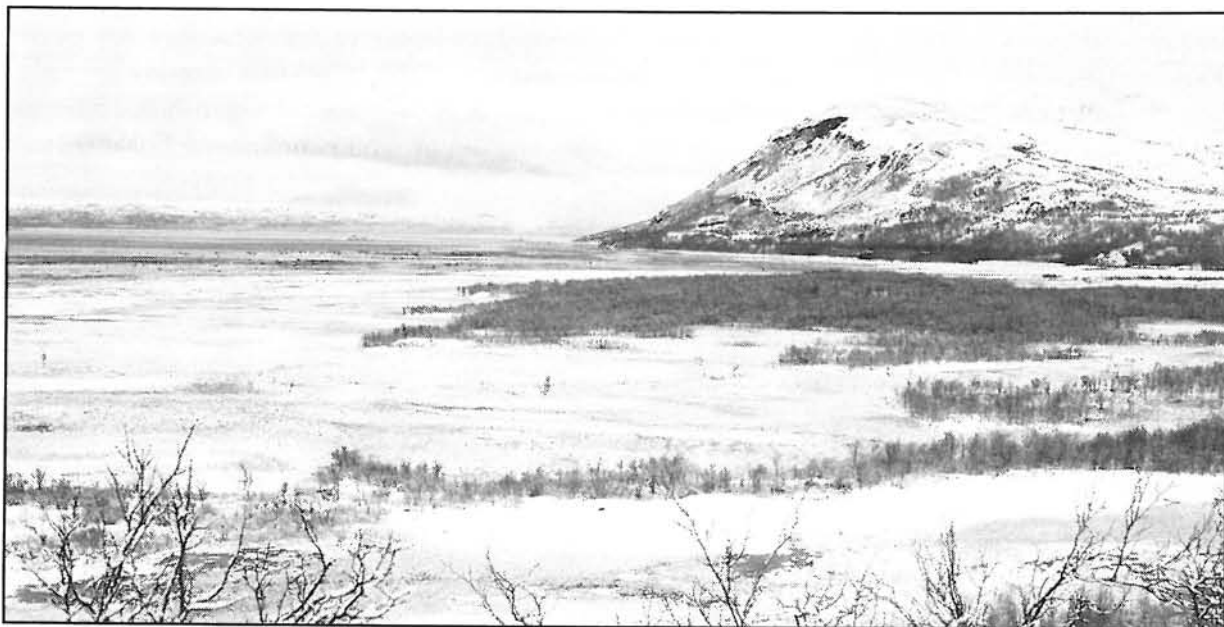
### 3.1.4 The Valdak Marshes in West Finnmark, Norway

The Valdak Marshes is one of the largest salt- and brackish marshes in Northern Norway and is composed of peat-bogs and salt-marshes with many arctic plant communities. The arctic grass *Puccinella phryganodes* dominates the vegetation and Valdak has probably the largest population of this species in Norway (Elven & Johansen 1982). The area has a very typical zonation with *Puccinella phryganodes* closest to the seashore. The zone is followed by a taller species *Carex subspathacea*, and further inwards *Carex hirta* and *Festuca rubra*. The whole marsh is scattered with small ponds and pools with brackish water, and the vegetation is also here in a clear zonation with *Hippurietum tetraphylla* in the outermost pools, followed by *Carex mackenziei* and *Potamogeton filiformis*.

During spring staging the Lesser White-fronted Goose feeds almost exclusively on *Puccinella phryganodes*, but in very late springs also on *Hippurietum tetraphylla*. In autumn the geese feeds on a variety of plant species such as *Festuca rubra*, *Puccinella phryganodes*, *Eleocharis uniglumis*, *Agrostis stolonifera*, *Juncus gerardi* and *Elymus arenarius*.

The Valdak Marshes was declared part of a nature reserve in 1983 (Stabbursnes Nature Reserve). It covers 16.2 km<sup>2</sup> of which 14.2 km<sup>2</sup> are tidal flats and water. All human traffic is prohibited at the Marshes from 1 May to 30 June. However, partly due to the disturbance by people picking Cloudbberries *Rubus chamaemorus* in autumn, the geese spends most of their time on the adjacent islands where they could be subject to hunting. A proposal has been put forward to the environmental authorities to ban human traffic also during the autumn so the geese can forage undisturbed. Helicopter traffic from the nearby airforce station at Banak also sometimes disturb the geese.

The results of the monitoring and research carried out at the Valdak Marshes are described in chapter 4.



*The Valdak Marshes viewed from the headland Stabbursnes towards south. The picture is from the end of May 1996. The salt marshes are all still covered by ice and snow. Photo: Ingar J. Øien.*

### 3.1.5 The Baltic republics

The occurrence of the Lesser White-fronted Goose in Baltic states has previously only been described for Lithuania (Svazas 1996). From the satellite telemetry study conducted in 1995 there is some evidence that Fennoscandian Lesser White-fronted Geese migrating south-westwards from the Kanin Peninsula follows the Eastern Baltic Sea Coast. In May 1998 it was confirmed that Lesser White-fronted Geese from the Fennoscandian breeding population utilise an area in Estonia during spring migration. A survey of the wetlands in Estonia, Lithuania and Latvia should be carried out, and a regular monitoring of the confirmed spring staging place in Estonia is necessary. Here we present the observations from the Baltic states known to the Lesser White-fronted Goose Monitoring Programme by October 1998.

The Lesser White-fronted Goose is stated as an irregular migrant in **Estonia**. Until the 1960s, the Lesser White-fronted Goose occurred regularly in small numbers. Most records were from the western part of the country during spring migration, whereas the Lesser White-fronted Goose occurred both in the western and eastern part during autumn. The highest number seen was 346 individuals in the Matsalu Nature Reserve (Leibak et al. 1994).

No records were confirmed in the 1970s. Since 1985, single birds have been observed in Western Estonia, mainly in flocks of Barnacle Geese. Single observations of geese with Swedish colour leg rings has been reported since 1985. The seemingly re-establishment of Lesser White-fronted Goose migration through Estonia could possibly be due to a Swedish re-introduction programme run since the early 1980s (Leibak et al. 1994, see von Essen 1996 for details on the re-introduction project).

However, recent observations from Haeska in Northern Matsalu Bay reveal that small numbers of Lesser White-fronted Geese occur here regularly during spring, and that at least some of these birds belong to the Fennoscandian breeding population. At 1st of May 1998, the Red-Black-Yellow individual was seen in a flock of ten Lesser White-fronted Geese at this locality (see box on page 8). Observations made by Finnish ornithologists gave the following numbers in spring 1998: 31 unringed individuals 26-27 April, 10 individuals 1 May and 29 individuals 2 May. Unconfirmed information from Finnish ornithologists indicate that 37-39 Lesser White-fronted Geese were seen in this area in the end of April. In spring 1997, two Lesser White-fronted Geese were seen in the same place (all records: Petteri Tolvanen pers. comm.).

The species is at present a rare migrant in **Latvia**. Single individuals are seen during the migration periods. The largest flock reported formerly is from 22 September 1958 when 90 individuals was flying south-west along the Baltic Sea Coast, at the village Ovisi at the Kurzeme Peninsula (Mihelsons et al. 1960). However, due to identification problems, Lesser White-fronted Geese could easily be overlooked in flocks of other goose species. It is said that the majority of the geese present in Bog Ozolu (where two individuals were shot in 1996, see Table 2) are Lesser White-fronted Geese, but this has not been confirmed so far.

**Table 2.** *Records of Lesser White-fronted Geese in Latvia (M. Strazds & E. Razinskis pers. comm.).*

Dates	Year	Number	Locality	Comments
9 October	1902	1	Gulf of Riga	Found in the market, prob. shot near at Jurmala
5 May	1910	1	Dviete	Shot
25 October	1925	1	Riga	Found in the market
April	1927	3	Lake Babites	Shot
Autumn	1927	1	Lake Engures	Shot
20 September	1937	2	Lake Kaniera	Shot out of a flock
22 September	1958	90	Kurzeme Peninsula	(Mihelsons et al. 1960)
April	1980	1	Fishpond of Nagli	Seen in flock of other geese (J. Baumanis)
29 September	1984	100	Lake Kaniera	Two flocks of 40 and 60 ind. seen in flight
7 October	1985	2	Lake Murmastienes	Bergmanis & Avotins 1990
27 September	1989	3	Lake Engures	
20 October	1991	4	Riga	
1 May	1994	3	Coast near Berzciems	
4 October	1996	43	Bog Ozolu	Two ind. shot out of the flock. This flock was first seen 26 September.

Very little is known about **Lithuania**, but Svazas (1996) states that large flocks of Lesser White-fronted Geese have been recorded in the wetlands around the Nemunas River Delta in recent years, with highest number of 200-230 individuals. According to Svazas (1996) the migratory passage of the Lesser White-fronted Goose takes place in March-April and late September- early October, where small flocks of 20-30 individuals are recorded almost annually in the Zuvintas Reserve in the years 1966-1986. Raudonikis and Svazas (1991) mention that the Lesser White-fronted Goose is present in small numbers. These numbers have not been confirmed in recent years by field ornithologists in these areas. 20 000-40 000 geese passes the country both during spring and autumn, and White-fronted Geese makes 10-30% of the total numbers. As for the other Baltic States, it is reasonable to assume that the Lesser White-fronted Goose could occur in small numbers and be overlooked in the flocks of White-fronted Geese. It is however possible that both Fennoscandian Lesser White-fronted Geese, and birds breeding in Northwest Russia could utilise these areas.

### 3.2. STAGING AND WINTERING LOCALITIES ON THE EASTERN ROUTE

Of the staging areas known on the eastern route (from the Kanin Peninsula and eastwards), only two areas has been surveyed. We will here briefly give a summary of this work. We have also added some words about Azerbaijan since it is, both formerly and today, a very important wintering area. Both a literature review and ground surveys remain to be carried out for the other areas. Further work on locating wintering and spring migration routes by use of satellite telemetry still remains on the eastern route.

#### 3.2.1 Staging at the Kanin Peninsula

This area was first described as a staging ground for Lesser White-fronted Geese in 1994 (Vinogradov 1995). The use of satellite transmitters on Fennoscandian geese has, however, revealed that this area is used as a gathering area for probably the whole Fennoscandian post-



breeding population (Lorentsen et al. 1998). The Finnish Lesser White-fronted Goose Working Group (WWF-Finland) visited the area between 24 August and 12 September in 1996. On arrival they found only nine Lesser White-fronted Geese, but the numbers of staging geese increased throughout the period and when they left the area, approximately 100 individuals were present (Tolvanen 1996, Luukkonen & Tolvanen 1996). Two of the observed geese were marked individuals caught in Finnish Lapland in 1995: One adult female had a neck collar (green "02") and the other (a 2Y bird) had a colour leg ring (yellow-black-yellow) which was the offspring of a female caught in Finnish Lapland in 1995. This female was also observed on the Skjåholmen Island in the Varangerfjord in August 1995 and in August 1996 (Tolvanen 1996, see also Aarvak et al. 1997). Vinogradov (1995) carried out studies during summer in 1994 at the Torna River mouth. Small groups of two to six Lesser White-fronted Geese were seen in flocks of up to 80 000 migrating geese in early June. Flocks of 150-250 Lesser White-fronted Geese were seen on 6 June (five flocks), 6 July and 7 August. He estimated the total number of Lesser White-fronted Geese migrating over the western side of the Kanin Peninsula to be no less than 1500. From the eastern coast of the peninsula, recent breeding records are known (Vinogradov 1995). According to older local hunters the Lesser White-fronted Goose was common here in the 1950s (Vinogradov 1995).

The main staging area is situated between the mouths of the rivers Mesna and Torna on the western coast of the Kanin Peninsula. This is a huge marshland (c. 50 km<sup>2</sup>) comprised of salt tolerant vegetation which is called *laidas*, and the dominating plant species are: *Puccinella phryganodes*, *Carex subspathacea*, *Calmagrostris* sp. and *Plantago* sp. The Lesser White-fronted Geese grazed mainly in the stands of *Hippuris tetraphylla*, *Puccinella phryganodes* and *Carex subspathacea*. Most of the Lesser White-fronted Geese spent all day on the *laida* meadows, unlike the Bean Geese and White-fronted Geese which left the *laidas* in the morning to spend the day grazing on the surrounding *palsa mires* before returning in the evening (Tolvanen 1996).

### 3.2.2 Staging in Northern Kazakhstan

The northern part of Kazakhstan is known as a very important staging area for White-fronted and Red-breasted Geese (Scott & Rose 1996). The area forms the northern part of the Turgay Depression leading from the West Siberian Plain to the Aral and Caspian seas. Two extensive surveys has been carried out by WWF Finland, to assess the numbers and distribution of Lesser White-fronted Geese during autumn and spring. In the period 4-15 October 1996 they observed totally 7900 Lesser White-fronted Geese, which represented 2.8% of all the geese observed in this area (total 280 000). Lake Kulykul turned out to be the most important roosting lake visited by the survey team, with 3400 Lesser White-fronted Geese. Other important lakes were Koybagar (340), Bis-Saigan (1700), Tjuntjugur (230), Syptykul (1400), Druzba (130), Babatkul (620) and Kulykul (3400) (Tolvanen & Pynnönen 1997).

In the period 3-14 May 1997, totally 2001 Lesser White-fronted Geese were seen. This figure was quite low compared with the number observed during autumn. This was believed to be connected with the extremely early peak of the migration, in that most of the geese had already passed. The highest numbers of Lesser White-fronted Geese were found in the Lakes Tjuntjugur and Bis-Saigan (468), Novoye Zalivnoye (436), Lebyazev (374) and Koybagar (129) (Markkola et al. 1997).

In the Action Plan published by the Council of Europe (Madsen 1996) it was claimed that the Lesser White-fronted Goose is fully protected in Kazakhstan. Unfortunately, the only protected goose species in Kazakhstan is the Red-breasted Goose. Unconfirmed information however, states that the Lesser White-fronted Goose was protected in 1997. The Lesser White-fronted Goose is hunted in the same way as the White-fronted Goose, and it was found that it was shot in proportion to its occurrence. According to the local hunting inspection in the area, there are some 10 000 hunters in the Kustanai Oblast, of which ca. 2000 are active. Altogether 111 geese were observed shot during the survey, consisting of 96 White-fronted Geese, 6 Lesser White-fronted Geese and 10 Greylag Geese *Anser anser* (Tolvanen & Pynnönen 1997). Measures to protect Lesser White-fronted Geese in Kazakhstan should be carried out immediately.



*Waterfowl hunting is extensive in both Kazakhstan and Azerbaijan. It is crucial for the survival of the Lesser White-fronted Goose population to reduce the impact of hunting in these areas. Photo: Ingar J. Øien.*

### **3.2.3 Wintering areas in Azerbaijan**

Azerbaijan was visited in January and February 1996 in connection with a waterbird survey conducted through a programme for conservation of wetland reserves in the country (see Paynter et al. 1996 and Aarvak et al. 1996 for further details). During these surveys, special attention was given to areas which potentially could hold Lesser White-fronted Geese. During the survey a total of 1085 was found, of which 1058 were in the Kizil Agach Nature Reserve. In the past, the estimates of the world population was based on old figures of 35 000-40 000 individuals wintering here. However, based on this survey and interviews of staff of the reserve together with other more recent observations, it was shown that no more than 5000-6000 individuals regularly wintered in the area. Except for the wintering area along the Yangtze River in China, no other areas are known to hold such huge numbers during winter. It is therefore necessary to follow up with new surveys and mapping of area use with the main focus on the Lesser White-fronted Goose. This should also be carried out since the subsistence hunting pressure is very high and has probably a significant influence on the negative population development in the Lesser White-fronted Goose.

## 4. RESEARCH CONDUCTED WITH RELEVANCE TO THE SATELLITE TELEMETRY

### 4.1 POPULATION TRENDS IN NORWAY

A monitoring program on the population development in northern Norway is run parallel to the satellite telemetry studies. Here it has been shown that the spring population numbers utilising the Valdak Marshes decreases with 5% annually, as estimated by Monte Carlo Simulation (Øien et al. 1996, Aarvak et al. 1997).

### 4.2 BREEDING SUCCESS IN NORWAY

Breeding success is monitored post breeding at the Valdak Marshes, which represent the first staging area before the autumn migration. These observations of brood sizes may give an understanding of the variation in breeding success between years. Mean brood size observed at the Valdak Marshes in the years 1994 to 1997 is as high as 3.4 (sd=1.4, n=41), although it varies significantly from year to year (Aarvak et al. 1997). It is thus likely to assume that the production is generally high, when based only on the individuals seen post-moult.

Estimates on brood size can be derived in different ways. The probably best estimate is based on number of juveniles compared to the number of pairs observed (potential breeders) in the pre-breeding period (Mean brood<sup>3</sup> in Aarvak et al. 1997), which yields an estimate for 1997 of 1.23 goslings per potential breeding pair. The estimated 1.23 goslings fledged per potential breeding pair yield a ratio of 38.1% immatures in the autumn population (second calendar year birds omitted). For the years 1994, 1995 and 1996 we obtain an estimated proportion of 38.8%, 57.3% and 33.3% respectively, with a mean for all years of 41.9% (sd=10.6). Many studies on arctic breeding geese like Barnacle Goose, Brent Goose, White-fronted Goose and Tundra Bean Goose use the age composition (first-winter individuals and adults) during mid winter counts as a measure of the breeding success of the preceding breeding season (e.g. Ebbsinge 1991). These studies show that the age composition varies between 0 to 60% for the Brent Goose, 5-30% for the Barnacle Goose and 2-50% for the White-fronted Goose (Ebbsinge 1989, Ebbsinge 1991, Fox & Gitay 1989).

If these estimates reflect the breeding success, the variation in breeding success of the Lesser White-fronted Goose as seen on the Valdak Marshes is quite small. A likely explanation could be that the time-series is too short to reflect the actual variation in reproductive success. The small observed variation in brood size may on the other hand mirror the real variation in reproductive success. The principal factors determining the highly variable reproductive success in the Brent Goose at Taimyr seem to be caused by the physical condition of the individuals when they arrive at the breeding areas and the predation pressure by Arctic Foxes *Alopex lagopus*. Also wind conditions during migration seem to play an important role in some years (Ebbsinge 1989). A principal difference in the ecology of the Brent Goose breeding on Taimyr and the Lesser White-fronted Goose breeding in Finnmark is the availability of food resources close to and in the breeding areas when the geese arrive in spring. It is shown for the Brent Goose that much of its energetic stores is accumulated in the staging area in the Wadden Sea area, probably with a refuelling in the White Sea area. The spring staging areas of the Lesser White-fronted Goose are almost unknown, but the Valdak



Marshes, which is situated close to the breeding areas, provides good feeding opportunities (own data), which could diminish the energetic bottleneck of migration.

For the White-fronted Goose *A. a. albifrons* and Tundra Bean Geese *A. f. rossicus* wintering in Zeeland (The Netherlands) it was in a long-term study shown that the White-fronted Goose had a higher reproductive success in terms of both brood size and percentage first-year birds, a higher variation in these parameters, and showing a three year cyclical variation with two good and one poor year. A cyclical variation was not found in the Bean Goose and this was thought to be related to a more southern breeding range for this species, then being less vulnerable to predation from Arctic Fox.

### 4.3 MORTALITY RATES OF NORWEGIAN BREEDING BIRDS

Mortality rates are difficult to obtain as very few Lesser White-fronted Geese have been ringed. However, assuming that the individuals utilising the Valdak Marshes during spring and autumn staging makes a closed breeding population or that immigration and emigration rates are negligible, estimates can be derived since quite exact numbers on the age composition can be gained. Based on the difference between the number of immatures in the autumn one year and the following spring for the years 1994-1997 we estimated an mean mortality of 78.2% (sd=9.9) for the immatures (Aarvak et al. 1997). This is assumed to be related to the high hunting pressure along the migration routes and in the wintering areas. Totally six goslings have been ringed in the moulting period, and three of them have been reported shot in the same year as they were ringed. This yields a immature death rate of 50% based on reported kills (Lahti & Markkola 1995, Aarvak & Øien 1995, J. Markkola pers. comm.). However, probably not all recoveries are reported. Taking into account that the most important migration routes and wintering areas are situated in Russia and Western Asia, it is likely that this figure represents a to low estimate. Ebbinge (1991) describes estimated non-return rates of rings as high as 75-80%, for the White-fronted Goose in The Netherlands, and an increase of such a rate from 50,9% to 66.8% in another study (Henny 1967 cited in Ebbinge 1991).

An adult mortality rate was calculated for the years 1993-1997 by the formula given by Ebbinge (1982)  $m = 1 + i (j-1)$ , where  $m$  = mean annual mortality rate,  $j$  = mean proportion of first-year birds,  $i$  = infinite rate of increase. Assumed that the estimated decrease of the population of 5.2% (by Monte Carlo simulation, see section 2.1.1) is actual, we get an estimated annual mortality rate for adults of 0.165 ( $i = 0.948$ ,  $j = 0.118$ ), e.g. 16.5% per year (Aarvak et al. 1997). Based on the 9 adults ringed in 1994 and 1995 only one has been reported shot in the course of the following year of ringing. However, circumstantial evidence suggest that some of the ringed individuals were shot during early migration in Russia.

These quite crude estimates of mortality reveals that the mortality of adults in general is high, whereas the mortality of immatures is very high. Ebbinge (1991) estimates and describes the lowering of mortality rates for several goose species wintering in Western Europe after regulations and ban of hunting occurred during the 1970s. He reports mortality rates of 25% to 31% in the first period, and 9-27% in the second, where 5-6% represents the annual rate of natural mortality for these species. The lowering of mortality rates facilitated the recovery of all goose populations traditionally wintering in Western Europe.

Schmutz et al. (1997) conducted a sensitivity analysis on Emperor Geese *Chen canaglia* breeding in Alaska. This population experienced a huge decline sometime between the mid-1960s and mid-1980s, and has been low since. To promote recovery of this arctic breeding population, managers had to know how perturbations of survival and / or reproduction would affect the population. They found that varying adult survival rates consistently had the highest relative effects on population growth whereas varying reproductive parameters had the lowest. These results were also in general agreement with other recent studies on comparatively long-lived waterfowl species (Harlequin Ducks *Histrionicus histrionicus* and Snow Geese *Chen caerulescens*).

Also the Pacific Brant *Branta bernicla nigricans* population in Alaska has experienced a huge decline. Ward et al. (1997) estimated mean monthly survival of the adults from resightings of leg-banded birds. They found the lowest monthly survival rate during late spring migration (15 April-1 March), the period of greatest subsistence harvest on the breeding grounds, and highest in winter. They concluded that the subsistence harvest was likely the most important factor controlling the size of the population.



*The juveniles usually keep together in small flocks during spring staging. The picture shows a flock of juvenile Lesser White-fronted Geese at the Valdak Marshes in May 1995. Photo: Ingar J. Øien.*

## 5. CONSERVATION WORK

### 5.1 PROTECTION OF THE STAGING AREA AT KANIN PENINSULA

For a general description of the area, see section 3.2.1. Until recently, the area had no formal protection, and goose hunting was performed by locals from the village Shoina. Conservation measures were proposed in 1995 in order to protect a colony of 1000-2000 breeding pairs of Barnacle Goose. Based on the results from the satellite telemetry carried out in 1995 and the expedition in 1996 (Tolvanen 1996), which showed that Lesser White-fronted Geese occurred here in significant numbers, WWF International - Russian Programme started the work on the establishing a protected area at this site. By a decree given by the Governor of the Nenets Autonomous Okrug in agreement with Russian Federal law, the Shoininski State Nature Reserve was established 15 January 1997. This decree stated that regulations ensure conservation of the natural conditions of the habitats as well as protection of fauna and flora.

No, ground surveys has been carried out afterwards. This should be done to further assess the importance of this area, as well as assess the effect of the hunting ban. Hopefully, the protection will be an important step towards the goal: saving the Lesser White-fronted Goose from extinction.



*Air view of the palsa marshes on the Kanin Peninsula. Photo: Petteri Tolvanen.*

## 5.2 INTERNATIONAL AND NATIONAL ACTION PLANS

In response to the many initiatives and need for efficiency in research and conservation, was it necessary to develop specific action plans for the Lesser White-fronted Goose. The first was the **International Action plan** published by the Council of Europe (Madsen 1996). This Action Plan was developed as an response to the work conducted by BirdLife International on threatened and endangered species in Europe, which numbers 23 species. The action plans are compiled to facilitate research for conservation of this species in the countries managing populations of either of the species guide implementation of legal provisions for the conservation of this species. However, the plans are only the start of a process, and they need to be translated into real conservation actions if they are to achieve their objective. That is the challenge we have met, and by the financial support from SFT and MD, we have brought both the knowledge and conservation status of one of these species a major step forward.

The first International workshop on the situation for the Lesser White-fronted Goose was accomplished in France in 1995 (Anatidae 2000). Since then, annual meetings of the Goose Specialist Group of Wetlands International have been held in Poland in 1995, England in 1996 and Bulgaria in 1997. A formal International Lesser White-fronted Goose Research Group was founded during the Poland meeting, with goose experts from all countries managing the Lesser White-fronted Goose. An important matter in these meeting was the concern for the fast accumulation of information and the need for an yearly updated action plan. In 1995 the first *Urgent Action Plan* was made. This has since been updated yearly at the meetings of the Wetlands International Goose Specialist Group Meeting.

One of the most important conclusion and recommendation from the meeting in England in December 1996 was: *The workshop recommends that the most urgent and effective conservation measure to be implemented is the creation of shooting-free zones in key staging, wintering and breeding areas of Lesser White-fronted Geese.*

In 1997, NOF took over the chairman role of this group. A synopsis of the meeting and workshops held in 1997 can be found in the official homepages of Wetlands International at: [http://www.wetlands.agro.nl/news/wetl\\_news\\_feb27.html](http://www.wetlands.agro.nl/news/wetl_news_feb27.html).

In **East Asia** a first draft of an *Action Plan* was prepared in 1998 by the Japanese Association for Wild Geese Protection (JAWGP). This is facilitated by the newly established Conservation Project for Lesser White-fronted Goose in East Asia, with members from Russia (Yakutia, Magadan and Kamchatka), China (Central, Southern, Middle and North-east), South Korea and Japan. The Action Plan is developed in response to the *Kushiro Initiative* and follows the *Asia-pacific Migratory Waterbird Conservation Strategy 1996-2000*. The main aims in the plan are:

1. to provide full legal protection to populations with least favourable status.
2. to encourage the undertaking and publishing of national inventories of the habitats in each country which are important to LWfG.
3. to ensure that the hunting regulation implements the principle of sustainable use in the flyway
4. to carry out survey work in poorly known area
5. to encourage countries to arrange for training programs for implementation of this Action Plan.



6. to develop programs, information materials and mechanisms to improve the level of awareness of the general public with regard to the objectives, provisions and contents of this Action Plan.
7. When implementing this Action Plan, priority is given to populations with the least favourable conservation status.
8. When implementing this Action Plan, involvement of local people, government agencies and non-governmental organisations shall be encouraged.

*The Geese and Swans Study group of Eastern Europe and North Asia* has also made a draft for a Action Plan for conservation and research on Lesser White-fronted Goose in the **C.I.S. countries**, comprising Russia, Kazakhstan, Azerbaijan, Ukraine, Belarus and Turkmenistan. The main aims of the action plan: \*Intensification of inventory of distribution and research on ecology of the species. \*Recommendations and possible creation of network of protected areas in the breeding, stopover and wintering sites and development of regional conservation schemes. \*Attraction of attention of public to the problem. \*Creation of monitoring schemes in the key sites.

In addition to the annual meetings of the Goose Specialist Group of Wetlands International, the Lesser White-fronted Goose was one of the main subjects during the conference on Protected Areas in the **Barents Region** in 1995 (Strøm & Prokosch 1996). This conference gathered management authorities and conservation experts from the Russian Federation, Norway and Finland representing both governmental institutions and non-governmental organisations. Of particular interest in the context of research and protection of Lesser White-fronted Goose is the *Memorandum of Understanding* achieved during the conference which has the following main statements:

(1) realise the urgency of protecting the endangered Lesser White-fronted Goose, and in this context:

(a) acknowledge and support the Lesser White-fronted Goose Urgent Action Plan recently produced by the Wetlands International-Goose Research Group to protect the species. In particular, by: \*evaluating and initiating immediate protection measures in areas identified as important wintering and staging sites; \*continuing, in parallel, research work in order to identify more key areas for the species;

(b) support the idea to join forces of the governmental authorities of the Archangelsk Oblast and the Nenets Autonomous District, the All-Russian Research Institute for Nature Protection and specialists from Norway, Finland and The Netherlands as well as other countries and WWF. Studies should be increased to evaluate the importance of the Kanin Peninsula for waterfowl with special focus on the Lesser White-fronted Goose;

(c) recommend that joint field work start during the migration and breeding season in 1996;

(d) acknowledge the important studies on wildfowl performed in recent years by Krivenko, Vinogradov and Avdanin on the Kanin Peninsula and support of the All-Russian Research Institute for Nature Protection and their recommendation to set up a protected area on the Kanin Peninsula between the Torna and the Mesna rivers.

Few countries have so far made national action plans to facilitate the recovery and management of the vulnerable Lesser White-fronted Goose population. In 1996 the **Norwegian** Directorate for nature management published an *Action Plan* for the management

of the Norwegian goose species (Direktoratet for naturforvaltning 1996). This plan discuss the present knowledge and outlines the main goals and means in the management of the goose species in Norway. It will be an important incentive to the work in the forthcoming years. The main goals for the Lesser White-fronted Goose outlined in the plan are:

- The Lesser White-fronted Goose shall be managed as a particularly vulnerable species which need to be managed with special thoughtfulness. The considerations for the species' continued survival in Norway require special attention and particular actions both on the species and the habitat level.
- Norway should actively work to reach the goals set by the International Action Plan for the Lesser White-fronted Goose.
- It is important to protect both existing and former staging, breeding and moulting areas for the geese.

Accumulation of new data has taken place so quickly that both the *Urgent Action Plan* and the more comprehensive *International Action Plan* for the Lesser White-fronted Goose should be updated soon. In an updated *International Action Plan*, the whole distribution area should be implemented, comprising the whole Palearctic Region including the Far East breeding areas in Yakutia and Anadyr and the wintering areas in China. This is also facilitated by the newly established *Conservation Project of Lesser White-fronted Goose in East Asia* by the society *Japan Association for Wild Geese Protection* (JAWGP).

Through the work of the Lesser White-fronted Goose Monitoring Programme, several of these actions have been implemented. In 1999 the project will continue the work on implementing the actions in the *International Action Plan*, the *Urgent Action Plan* as well as reaching the goals in the *National Action Plan* of the Norwegian Directorate for nature management.

### 5.3 INTERNATIONAL PUBLIC INFORMATION

Hunting has turned out to be an important factor contributing to the negative population development in the Lesser White-fronted Goose (see chapter 4). It is therefore necessary to reduce the impact of this activity in the key staging and wintering areas. Raised awareness among hunters, and a shift of the hunting pressure away from the Lesser White-fronted Goose, to a sustainable hunting on the more numerous goose species (e.g. Greylag Goose and White-fronted Goose) is one way to reach this aim. Another management option is to create buffer zones around known roosting lakes as well as a introduction of delayed onset of the hunting in the morning in order to prevent the huge loss of Lesser White-fronted Geese while leaving the roosting sites. By focusing on identification cues and behavioural aspect, awareness will be raised among hunters societies and regional management authorities. This is also one of the main conservation priorities as stated by Council of Europe in "*Globally threatened birds in Europe - Action Plans*" (Madsen 1996). Quote: "It is a high priority to raise public awareness of the species, particularly amongst hunters and landowners".

To accomplish this, NOF in close co-operation with MME/BirdLife Hungary, Bulgarian Society for the Protection of Birds (BirdLife Partner) and Russian scientists, are producing a **poster** and a **sticker** to be distributed in Ukraine, Bulgaria, Hungary, Romania, Kazakhstan, Russia and Azerbaijan in their respective languages. The production and distribution is partly financed by the Secretariat of the Bonn Convention.

In the co-operation with BirdLife International, Wetlands International (Goose Research Group) and especially with MME/BirdLife Hungary and Bulgarian Society for the Protection of Birds (BirdLife Partner), the amount of information brought out to the public is ever increasing. BirdLife International have through their magazines and newsletters regularly published status reports about the project, especially describing the link between species conservation and conservation of Important Bird Areas (IBA's) (see Table 3). This is valuable from the point of view of making the gathered information public available. BirdLife International's magazine *World BirdWatch* is published in all countries with BirdLife Partner organisations or countries with partner designates. Currently this covers 87 countries in all parts of the world.

In 1994 the regional environmental management authorities in Finnmark County, initiated a **film** project focusing on the problems this species is facing and the work undertaken to save it from extinction. Kåre Tannvik Film A/S started the production of a documentary during spring 1995. The documentary film was finished in May 1996, and it was shown on Norwegian television channel NRK 1, entitled "*Man - my worst enemy...*". The film received positive critics in Norwegian newspapers afterwards (see Aarvak et al. 1996), and have so far been distributed to television companies in the Nordic countries. Field workers from the project were also interviewed about the project on Greek regional television in January 1996 during the field work in the Evros Delta.

In Norway, two pages in a **leaflet** distributed to all hunters in Norway (follows the bill for renewal of the official hunting licence) focused on the Lesser White-fronted Goose and addressed the problem of misidentification and vulnerability of this species. The circulation of this is ca. 300 000 copies. The Lesser White-fronted Goose project of WWF Finland has also been working intensively to raise the public awareness on the Lesser White-fronted Goose, with the most important work, an article about identification and general information, published in the Journal *Metsästäjä* (the journal of the Hunters' Central Organisation in Finland) and its correspondent in Swedish, the journal *Jägare*. The circulation of these two journals are 290 000 and 18 000 copies respectively (Markkola & Niittyvuopio 1997).

In 1997 an **ambulant exhibition** about the Lesser White-fronted Goose and the biodiversity in Finnmark, Norway, was launched 7 October at Varanger Samiske Museum. It has later visited the Nordic Museum Festival in Bergen 13-15 May, Stabbursnes Naturhus og Museum 16 May to 31 July, Alta Museum 1-31 August (13 352 visitors, including 13 school classes) and Nordkappmuseet 9-18 September (275 visitors, including 5 school classes). This exhibition was produced by Stabbursnes Naturhus & Museum in co-operation with NOF, and will hopefully give the local inhabitants and tourists a possibility to learn about the biology of, and the threats which the Lesser White-fronted Goose is facing both in Finnmark and abroad. During 1999 this exhibition will be translated to both Finnish and Sami languages.

An **identification article** has been written which deals with the problem of identifying Lesser White-fronted Geese in flocks of White-fronted Geese (Øien et al. MS). The article is written in English, but the intention is also to translate it into Russian in order to distribute it to Russian speaking hunters and game wardens. It is well known that many Lesser White-fronted Geese are shot each year both intentionally and because most hunters are unable to distinguish it from other goose species.

Due to the relatively high media profile the last years, a number of **popular informative publications** have been written about the Lesser White-fronted Goose, both by media and the persons involved in the project. Those that could be traced, are listed in Table 3 and 4.

**Table 3.** Overview of media coverage on the project and the Lesser White-fronted Goose in the period 1995-1998.

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- Anonym 1995. Dverggåsa borte i Nordland. Adresseavisen, 28 desember 1995.
- Anonym 1996. Også dverggåsa drar mot sør. Løvebrølet 2/96:2. (internblad hos Fylkesmannen i Finnmark)
- Anonymous 1997. Lesser Whitefronts racing to extinction. Birding World 10:120.
- Arkiomaa, A. 1997. As a prisoner of the nature of Siberia – with Lesser White-fronted Geese in Taimyr. WWF Uutiset 4/97:4-5. (In Finnish).
- BirdLife International 1996. Tracking success with geese. World Birdwatch 18 (1):3.
- BirdLife International 1996. Radio-tagged birds show the value of the IBA network. European IBA News 7(15):1.
- BirdLife International 1996. Lesser White-fronted Goose. BirdLife in Europe 7(16):2.
- BirdLife International 1997. Bulgarian search for Lesser White-fronts. BirdLife in Europe 2 (1):3.
- BirdLife International 1997. Reserve for Lesser White-fronted Goose. BirdLife in Europe 2 (2):5.
- Bondesen, K.J. 1996. Gåssen som tystnade. Göteborgs-posten 3 april 1996. (Utebilaget)
- Fox, T., Madsen, J., Phil, S. & Clausen, P. 1996. Latest news on radio-tagged Lesser White-fronted Geese. Progress report. Wetlands International Goose Specialist Group Bulletin 7:26.
- Friberg, U. 1997. Habitat selection of the Lesser White-fronted Goose *Anser erythropus*, during the breeding season in Northern Finland and Norway. 28pp. Thesis in Forest Zoocology. Institutionen för skoglig zooekologi. 1997:4. Sveriges Lantbrukuniversitet, Umeå.
- Guldberg, T.-I. 1995. Den siste dverggåsa. Verdens Natur 10:8-11.
- Guldberg, T.-I. 1997. Satellittgjess sørget for vern i Russland. Dagens miljø (<http://login.eunet.no/~thorguld/>).
- King, J. 1997. Lesser White-fronts: problems and solutions. Birding World 10:2.
- Kristoffersen, T.K. 1996. Truet fugleart i sentrum for begivenheter for Stabburnes: dverggåsa på film. Sagat 29 mai 1996. Årg.40:10.
- Lorentsen, S.-H. 1997. The globally threatened Lesser White-fronted Goose. WWF Arctic bulletin No.3.97:16-18.
- Luukkonen, J. & Tolvanen, P. 1996. Species and spaces protection join forces. Lesser White-fronted Goose (*Anser erythropus*) expedition to the Kanin Peninsula in August-September 1996. WWF Arctic Bulletin No.4.96:21.
- Muheim, R. 1998. Mit Satelliten den Zugvögeln auf der Spur. Kontakte ins All. Ornis 2/98:11-15. (In Swiss)
- Prokosch, P. 1997. Detected by satellite and protected within 16 months: Shoininski Reserve established on Kanin. WWF Arctic Bulletin No.1.97:16.
- Salomonsen, S.T. 1996. Siste dverggåsa skutt. Finnmark Dagblad 21 mars 1996. s.11.
- Salomonsen, S.T. 1996. Unik film om den siste dverggåsa. Finnmark Dagblad 31 mai 1996. s.4.
- Salomonsen, S.T. 1996. Gåsejakt med kanon og not. Finnmark Dagblad 2 september 1996. s. 4.
- Schandy, T. 1996. Dverggåsa truet av utryddelse. Villmarksliv 24:87.
- Taskinen, J. 1997. The Lesser White-fronted Goose *Sibyako* migrating towards the Caspian Sea. Linnut 6/1997:11. (In Finnish).
- Tolvanen, P. 1997. Clearing up the migration routes of the Lesser white-fronted Geese of Yamal. WWF Uutiset 4/97:5-6.
- Tveteraas, A. 1995. Dverggås - på vei mot utryddelse. Finnmark Dagblad 29 juli 1995. s.14-15.
- Tveteraas, A. & Stabburnes Naturhus & Museum 1996. Dverggåsa et truet vårtegn i Porsangers natur. S. 46-49 i : Andersen, M.A., Jørgensen, A., Mikkelsen, A. & Petterson, A. (red.). Porsangerfolket. Årbok for Porsanger 1996.
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**Table 4.** Overview of scientific, popular informative articles and reports from the project in the period 1995-1998.

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- von Essen, L., Markkola, J., Aarvak, T. & Øien, I.J. 1996. The Lesser White-fronted Goose in Fennoscandia - past and present distribution. Poster abstract. In: Birkan, M., van Vesseem, J., Havet, P., Madsen, J., Trolliet, B. & Moser, M. (eds.). Proc. of the Anatidae 2000 Conference, Strasbourg, France, 5-9 Dec. 1994. *Gibier faune Sauvage, Game and Wildlife* 13:1313-1314.
- Lorentsen, S.-H., Øien, I.J., Aarvak, T. 1998. Migration of Fennoscandian Lesser White-fronted Geese *Anser erythropus* mapped by satellite telemetry. *Biological Conservation* 84:47-52.
- Øien, I.J. & Aarvak, T. 1995. Kan dverggåsa reddes som norsk hekkefugl?. S. 109-122 i: Brox, K.H. (red.). *Natur* 1995. Tapir Forlag, Trondheim.
- Øien, I.J. & Aarvak, T. 1996. Fjällgåsen snabbt på väg mot utrotning. *Vår Fågelvärld* 55:6-10.
- Øien, I.J. & Aarvak, T. 1997. Satellites track Russian Lesser White-fronts. *WWF Arctic bulletin* No.3.97:17.
- Øien, I.J. & Aarvak, T. 1997. Secrets of the Lesser White-fronted Goose. *World Birdwatch* 19:9-12.
- Øien, I.J. & Aarvak, T. 1997. Første stopp sikret for dverggåsa. Shoininski naturreservat er et faktum. *Vår Fuglefauna* 20:86-87.
- Øien, I.J. & Aarvak, T. 1998. Satellitt-telemetri gir ny kunnskap om dverggåsa. *Vår Fuglefauna* 21:88-89.
- Øien, I.J., Lorentsen, S.-H. & Aarvak, T. 1995. Scary percentage lost of satellite tagged Lesser White-fronted Geese. The dangerous journey to the winter-land. *Vår Fuglefauna* 18:244-246. (In Norwegian with English summary)
- Øien, I.J., Aarvak, T. & Lorentsen, S.-H. 1995. The Lesser White-fronted Goose migration route is revealed - now ! *Vår Fuglefauna* 18:154-156. (in Norwegian with English summary)
- Øien, I.J., Aarvak, T., Lorentsen, S.-H. & Bangjord, G. 1996. Use of individual differences in belly patches in population monitoring of Lesser White-fronted Goose *Anser erythropus* at a staging ground. *Fauna norv. Ser. C, Cinclus* 19:69-76.
- Aarvak, T. & Øien, I.J. 1995. Recovery of Lesser White-fronted Goose *Anser erythropus* from Southern Russia. *Vår Fuglefauna* 18:112-113. (In Norwegian with English summary)
- Aarvak, T. & Øien, I.J. 1997. Survey of Lesser White-fronted Goose in Bulgaria 1996. *Za ptizite* 2:8. (In Bulgarian).
- Aarvak, T. & Øien, I.J. 1998. Ringmerking av dverggås *Anser erythropus* i Norge og Russland i 1997, samt noen hyperlinker til informasjon om gjess. *Ringmerkaren* 10:155-159.
- Aarvak, T., Øien, I.J. & Lorentsen, S.-H. 1996. Ringing of Lesser White-fronted Goose *Anser erythropus* in Norway. *Ringmerkaren* 8:199-201. (In Norwegian with English summary).
- Aarvak, T., Øien, I.J., Lorentsen, S.-H. & Brøseth, H. 1995. The Lesser White-fronted Goose monitoring programme. Annual report 1995. Norwegian Ornithological Society, Report no. 4-1995, Klæbu.
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## 6. MAIN CONCLUSIONS AND FUTURE PRIORITIES

From the work conducted on the Lesser White-fronted Geese until 1998, it has been revealed that the different breeding populations from Fennoscandia as far as Taimyr, stage together during autumn migration and probably also in the wintering quarters. It has been shown that there exists two autumn migration routes, one passing the Baltic Countries, through Hungary, to Greece and Turkey, and another further east from the Kanin Peninsula, along the eastern side of the Ural Mountains through Northern Kazakhstan. The Lesser White-fronted Geese make couples in the winter quarters, and the Fennoscandian and the Western Russian populations should therefore be regarded as one population. Recent genetic studies (by mtDNA-analyses), where the preliminary results show that the females from the Fennoscandian population is to some degree distinct from the Siberian breeding group, supports this conclusion. The study also shows that the populations are mixed in Kazakhstan during autumn staging (Lumme 1997).

The satellite telemetry studies provide evidence for a flexible choice of wintering areas, while the main flyways during autumn seems relatively fixed. It is, however, quite likely that the choice of staging areas in the different regions varies between years.

Studies conducted on the Fennoscandian breeding population proves that the mortality rate is very high for the immatures during their first winter. The mortality rate of adults is also high compared with other goose species wintering in Western Europe. Measures to lower the mortality should be implemented. A sensitivity analysis conducted by Schmutz et al. (1997) on the Emperor Goose, is probably directly transferable to the situation of the Lesser White-fronted Goose population. Lowering of the mortality rate of adults, especially during spring have a greater impact on the population development than any other fixed effort.



*The Fennoscandian breeding Lesser White-fronted Geese which stage in Hungary during migration, winter relatively safe in the Evros Delta in Greece, after a hunting ban of geese was introduced in 1997. Photo: Ingar J. Øien.*

Since many of the Fennoscandian geese utilise the safer western route and the breeding population in Norway experiences only a weak decline, it is likely that breeding populations further east in the breeding distribution area experience much higher mortality rates than what is sustainable.

Much work remains to uncover the whole complex of migration routes and wintering areas for the Lesser White-fronted Goose. Special attention should in the future be paid to the following:

### **Monitoring**

- \* Surveys and monitoring of the known and potential spring staging areas in the Baltic Republics (especially the Haeska area in Estonia and the Nemunas Delta and Zuvintas Reserve in Lithuania).
- \* Surveys and monitoring of the known and potential spring staging areas in Belarus (Pripyat' River Flood-plain).
- \* Surveys and monitoring of the known and potential spring staging areas in Ukraine.
- \* Surveys and monitoring of the wintering areas in Azerbaijan.

### **Satellite tracking**

- \* Satellite tracking of Lesser White-fronted Geese from the Taimyr breeding population.
- \* Satellite tracking of Lesser White-fronted Geese from the Far Eastern breeding population, wintering in China.

### **Influence of hunting**

- \* Map the extent of spring hunting in Russia.
- \* Establish a regular monitoring program in Northern Kazakhstan to follow the migration and staging of Lesser White-fronted Goose in these areas.

### **Protection measures**

- \* Raise awareness on the species' situation among management authorities, and especially among hunters in the countries hosting staging or wintering populations of the species, i.e., Russia, Kazakhstan, Azerbaijan, Hungary, Romania and Bulgaria.
- \* Implement regulations to make a shift in the hunting of Lesser White-fronted Geese to goose species with sustainable populations.
- \* Establish protected areas in the key sites along the migration route and in the wintering areas.

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# Appendix I.

*Co-operation partners and contacts along the proposed migration routes and wintering areas.*

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