

Monitoring of Lesser White-fronted Goose in Norway in 2006



Ingar Jostein Øien & Tomas Aarvak

Norsk Ornitologisk Forening

© Norwegian Ornithological Society

E-mail: nof@birdlife.no

URL: www.birdlife.no

Report to the Directorate for nature management and the County Governor of Finnmark,
Environmental department

Publication: Digital document (PDF)

Front page picture: Male Lesser White-fronted Goose (Imre) caught at the Valdak Marshes 23. May
2006 © Ingar J. Øien

Line drawing: © Evgeny Koblik

Colour painting: © Jari Kostet

Editor: Ingar J. Øien

Recommended citation: Øien, I.J. & Aarvak, T. 2007. Monitoring of Lesser White-fronted Goose in
Norway in 2006. NOF report 1-2007. 15pp.

ISSN: 0805-4932

ISBN: 978-82-7852-082-6

This report can be freely downloaded at the official web-page of the Norwegian Ornithological Society
(NOF): www.birdlife.no/fuglekunnskap/prosjekter/rapportserie.php



SUMMARY

The Lesser White-fronted Goose project of the Norwegian ornithological Society continued the monitoring of the staging Lesser White-fronted Goose at the Valdak Marshes, Porsanger Municipality, Finnmark County also in 2006. During spring totally 43 LWfG were staging, distributed as 16 adult pairs, one single ad and 10 young birds (2-3 cy). Four LWfG that were caught and colour ringed in earlier years were re-sighted. In autumn a total of 43 individuals staged during a period of two weeks. These were distributed as 7 pairs and 2 single females with 9 clutches of totally 23 goslings, and 2 adult pairs without goslings. The breeding success was on average, while the population development has been stable since 2001. The numbers are down 40% since the early 1990s.



CONTENTS

SUMMARY	2
1. INTRODUCTION	4
2. STUDY AREA AND METHODS	4
3. RESULTS	5
3.1 SPRING STAGING.....	5
3.2 AUTUMN STAGING	7
3.3 CATCHING AND COLOUR RINGING	7
3.4 BREEDING SUCCESS	8
3.5 COLOUR RING OBSERVATIONS	11
3.6 POPULATION DEVELOPMENT	11
3.7 TRACKING OF MIGRATION ROUTES THROUGH SATELLITE TELEMETRY	11
4. CONSERVATION ACTIONS IN NORWAY	13
5. ACKNOWLEDGEMENTS	14
5. REFERENCES	14

1. INTRODUCTION

The Lesser White-fronted Goose (*Anser erythropus*) is the most threatened arctic goose species of the Palearctic region, and the populations throughout the range from Fennoscandia to easternmost Siberia are still declining (Lorentsen et al. 1999). At the Valdak Marshes (Finnmark, Norway), the most important staging area in the Nordic countries, the spring staging population has decreased by approximately one third since 1990 (Aarvak & Øien 2004, Øien & Aarvak 2006). The other traditionally important spring staging area of the Fennoscandian population, the Bothnian Bay coast in Finland, has experienced a decrease by more than 85% since 1990 and this site hosted less than 10 individuals in spring 2003 (Markkola et al. 2004). Part of the decrease at the Bothnian Bay coast may be due to the changing migration pattern of the LWfG: it seems that more individuals than earlier simply pass the Bothnian Bay coast and continue straight to Lapland after a staging period in western Estonia. A possible explanation for this could be that springs have become earlier and enabled an earlier arrival of the LWfG in the staging and breeding areas in Lapland.

The current estimate for the Fennoscandian population (excluding the Russian Kola Peninsula) is 15-25 breeding pairs. This estimate is up-dated and based the annual monitoring at Valdak Marshes, the Bothnian Bay coast in Finland and in Estonia. The most important threat for all LWfG populations is assumed to be high mortality due to hunting and poaching. Also, loss of habitats on the staging and wintering grounds and disturbance are serious threats for the species all over the distribution range (Tolvanen et al. 2004).

The Fennoscandian LWfG project run by WWF-Finland and NOF has monitored the two staging areas Skjåholmen and Valdak annually since 1995 and 1990 respectively. The results of the monitoring work from spring and autumn 2006 at the Valdak Marshes are reported here. The report reiterates results presented in earlier yearly reports (see Aarvak et al. 1996, 1997, Aarvak & Øien 1999, 2000, 2001, 2004, Øien & Aarvak 2006) from the monitoring and research work, but more comprehensive discussions are omitted. This summary is restricted to short comments on the results from 2006. Results from the monitoring work at Skjåholmen will be published elsewhere.

2. STUDY AREA AND METHODS

The Valdak Marshes (N 70°09', E 24°54') is part of the Stabbursnes Nature Reserve, which is a Ramsar site and a BirdLife International Important Bird Area (Norwegian IBA 012, Lislevand et al. 2000). It is one of the largest salt and brackish marshes in northern Norway (Elven & Johansen 1982), and represents an extremely important feeding/fattening area for the LWfG in Fennoscandia. For diet preferences, see Aarvak et al. (1996).

Valdak is demarcated inwards from the fjord by Stabbursnes, which is a headland made up of glaci-fluvial depositions. It constitutes a natural watching point with a height of approximately 25 metres above the wet mires and the salt marshes of Valdak. During the studies, the observers sit close to the edge of the headland. Under such circumstances, the foraging birds can easily be studied at a distance of 250-500 metres without any disturbance to the birds by use of a telescope (20-60 X magnification).

From 1998 on we have used a video camera (Sony Handycam) to film the geese through the telescope, and in 2005 we renewed this equipment to a digital video camera Sony DCR-PC350E PAL. This method increased the possibilities for accurate individual identification (Øien et al. 1996) and age determination of the staging geese significantly. By this method it is possible to distinguish subadult pairs from adult pairs, and to more securely separate single subadults from immatures and subadult pairs from adult ones. Subadults are here defined as birds in their third calendar year, while immatures are in their second calendar year (see Øien et al. 1999 about details on ageing).

The aim of the spring monitoring (8 May - 4 June) was to follow the progress of migration and register the total number of staging LWfG in the area. As in former years, the individuals were identified by the individual uniqueness of the belly patches. A thorough description of the method is given by Øien et al. (1996). We monitored the number of staging individuals and staging time for the pairs (turnover rates).

During autumn (20 August - 2 September) emphasis was put on carrying out counts of families and social groups in order to obtain estimates on brood size, productivity and proportion of immatures in

the population. In addition, the plan was to record the staging geese by video camera to increase the efficiency of identification, but the conditions did not allow video filming during autumn staging.

Since 1995 a number of LWfG has been caught, both in Norway, Finland and Russia to map the migration routes by use of satellite telemetry. A few individuals have also been colour ringed. This has added further knowledge to the results obtained by the satellite telemetry (see Aarvak et al. 1999, 2000). In spring 2006 considerable effort was spent in order to catch more geese for colour ringing and for satellite telemetry. We used two cannon-nets each covering an area of 300 m² (25 x 12 m) and one larger cannon-net covering an area of 1100m² (50 x 22m).



View of the salt marshes at Valdak from the north. These outermost ponds and grass areas are the most important areas for staging Lesser White-fronted Geese. © Ingar Jostein Øien, May 2006.

3. RESULTS

3.1 Spring staging

In spring 2006, the first LWfG (1 pair) arrived on 12 May. Thereafter the numbers increased, reaching a peak of 20 individuals on 19 May. Thereafter the numbers decreased (**figure 1**) until 23 May, when only two individuals were present. The numbers then increased, reaching 11 ind. at 28 May, and again decreasing until the end of the monitoring period. One pair and three single individuals were still present at the end of the monitoring period on 4 June (**figure 1**).

In spring 2006, also a total of 43 individuals were staging at the Valdak Marshes, distributed as 16 ad pairs, one single ad and 10 young birds (2-3 cy) (**table 1**). In Table 1, percentages of immatures and subadults are given. However, these percentages are not directly comparable between the periods 1993-1997 and 1998-2006, since subadults were registered as adults before 1998. 7 LWfG were caught during spring staging in 2006. Four LWfG that were caught and ringed in the years 2000, 2002 and 2004 were re-sighted (see **table 4, chapters 3.3 and 3.5**).

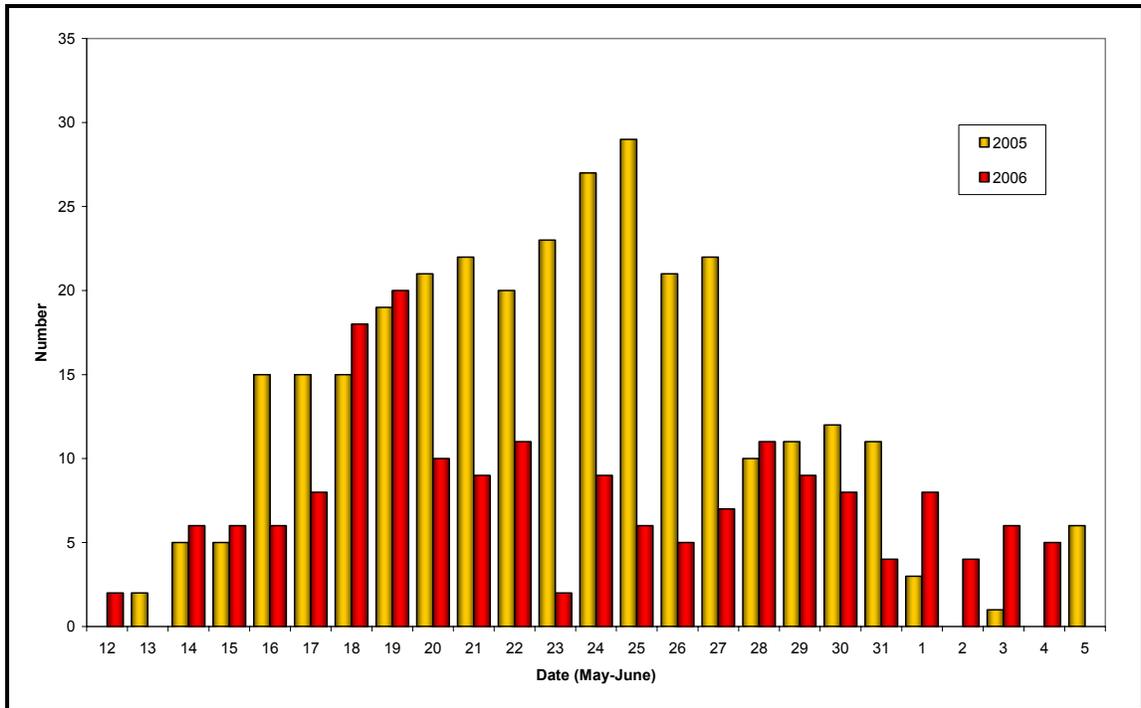


Figure 1. Maximum daily numbers of Lesser White-fronted Geese observed in the period May-June in 2005-2006.

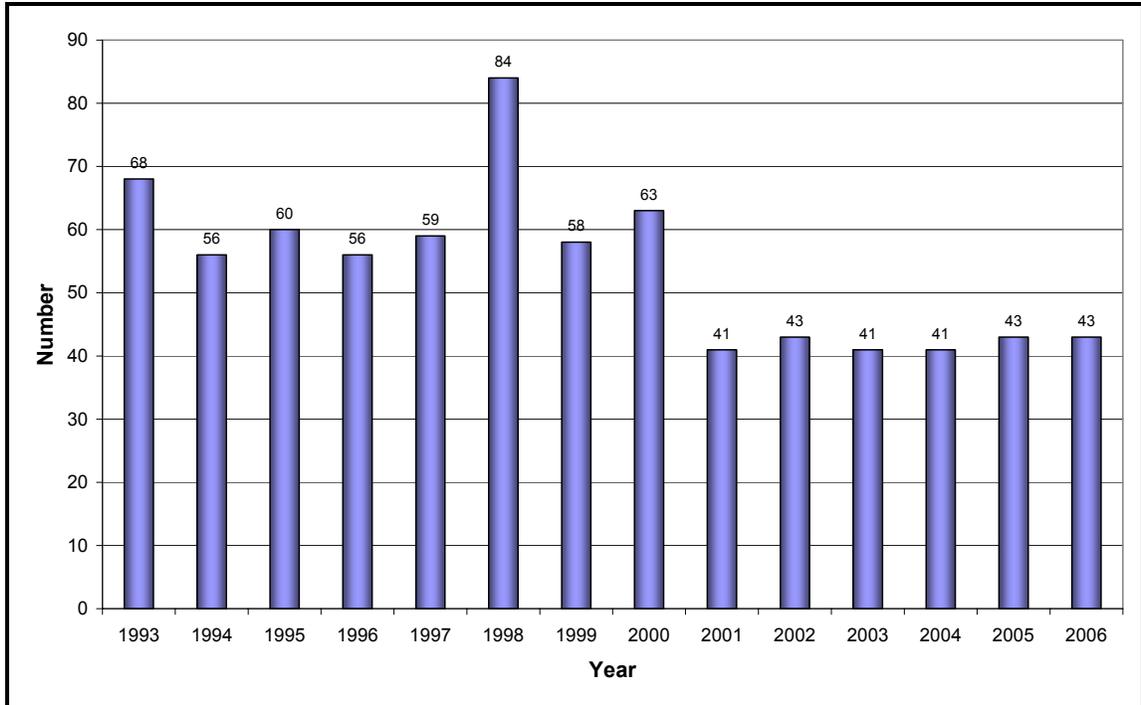


Figure 2. Total number of spring staging Lesser White-fronted Geese at the Valdak Marshes in the period 1993 - 2006 derived from drawings and video of belly patches.

Table 1. Numbers of Lesser White-fronted Geese at the Valdak Marshes during spring staging in the years 1993-2006. The table shows the maximum number of staging geese at the best day, distribution of adult pairs, subadult pairs, single subadults, single adults and immatures, as well as total number of staging individuals each spring.

Year	Max on one day	# ad. pairs	# subad. pairs	# imm.	# single subadults	# single adults	% imm./ subad	Total no. of ind.
1993	32	32		4			5.9 %	68
1994	24	26		4			7.1 %	56
1995	48	> 25		> 10			> 16.7 %	> 60
1996	31	23		10			17.9 %	56
1997	32	26		7			11.9 %	59
1998	37	33	5	5	3		21.4 %	84
1999	35	22	3	7* ¹		1	25.9 %* ²	58
2000	44	25	2	6* ³	3		23.8 %* ⁴	63
2001	22	18	1	0		3	7.3 %* ⁵	41
2002	29	13		14	1	2	34.9%	43
2003	25	14	5	9			34.1%	41
2004	18	9	2	13	5	1	53.7%	41
2005	29	18	1	3	1	2	13.6 %	43
2006	20	16		10* ⁶		1	23.3%	43

*1 Not including two immatures in pair with adults which is included in the "no. of ad. pairs" column.

*2 Also including two immatures in pair with adults which is included in the "no. of ad. pairs" column.

*3 Not including two immatures in pair with subadults which is included in the "no. of subad. pairs" column.

*4 Including two immatures in pair with subadults which is included in the "no. of subad. pairs" column. Three subad. are included in the ad pairs column, and not in the subad pair column.

*5 Including one subadult in the "ad. pairs" column.

*6 Distribution of these 10 ind. between 2cy and 3cy birds need to be checked more carefully from notes and video tapes.

3.2 Autumn staging

The year 2006 was the 12th consecutive year when continuous monitoring during the LWfG autumn staging at the Valdak Marshes was accomplished. A flock of 43 individuals staged there during a period of three weeks (see **tables 2 and 3**).

During the autumn staging in 2006, the LWfG spent almost all the time in the islets in the Porsangen Fjord and at Cape Oldereidet in the bottom of the Porsangen Fjord. The flock was only observed once at the Valdak marshes; on the 21 August. During the staging period, the LWfG flock spent most of the time on the islets in the innermost part of the Porsangen Fjord. On 30 August, we surveyed the Porsangen Fjord, and localized the LWfG flock on the cape Oldereidneset. The flock then consisted of 23-25 ind. On 31 August, one pair without goslings was observed at the Valdak Marshes.

3.3 Catching and colour ringing

Altogether six Lesser White-fronted Geese were caught and colour ringed in spring 2006 in addition to a re-trapping of the 'Red White' (left leg) that was caught and ringed at Valdak on 27.05 2002. In the first catch on 18 May, the female Red White (left leg) was caught together with its male. As part of the ongoing LIFE-EU project both birds were provided with satellite transmitters (the male with a unit that have GPS-plotter integrated). The second catch was carried out on 23 May, where 5 LWfG were caught. One of these was a 2cy bird, while the others were 2 ad. pairs. The male in one of these pairs was also provided with a satellite transmitter with GPS plotter. In the second catch we also got one 2cy White-fronted Goose as by-catch.



Tomas Aarvak preparing the cannon-net for catching at the Valdak Marshes in May 2006. © Ingar Jostein Øien

3.4 Breeding success

A total of 20 adults and 23 (53.5 %) juveniles were registered during the autumn monitoring period. These birds were distributed as seven pairs and two single females with nine broods consisting of 23 goslings, and 2 adult pairs without goslings. The nine broods yielded a mean brood size of 2.6 (**tables 2 and 3**).

Breeding success is monitored during the post breeding period at the Valdak Marshes, which represent the first staging area before the onset of autumn migration. Mean brood size observed at the Valdak Marshes in the years 1994 - 2005 is 3.0 (SE=0.19, n=12), although it fluctuates significantly between years (Aarvak et al. 1997).

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 brood³ - cf. Aarvak et al. 1997), which yields an estimate of 1.4 (goslings per potential breeding pair) in 2006. Based on the number of juveniles produced during summer in relation to all birds present at Valdak the previous spring we get an expected ratio of 26.7 % juveniles in the autumn/winter population. The mean expected juvenile proportion in the autumn for all years (1994-2005) is 32.9 % (SE=3.8, n=12).

Table 2. Autumn age ratio and annual brood sizes of Lesser White-fronted Geese in the years 1994-2006, based on counts during autumn migration at the Valdak Marshes (see also **table 3** for distribution of broods and number of pairs with broods).

Year	n adults	n juveniles	n total	% juveniles	n flocks	Mean brood ¹	Mean brood ²	Mean brood ³
1994	31	33	64	51.6*	3	2.4	2.2	1.3
1995	61	67	128	52.3	3	3.9	2.2	2.7
1996	16	23	39	59.0	1	2.6	2.9	1.0
1997	25	32	57	56.1	1	4.0	2.6	1.2
1998	29	31	60	51.6	3-1	2.8	2.4	0.9
1999	26	17	43	39.5	6	2.8	1.3	0.8
2000	8	2	10	20.0	1	2.0	0.7	0.04
2001	24	38	62	61.3	3	3.2	3.2	2.0
2002	28	34	62	54.8	2	3.1	2.4	2.6
2003	20	27	47	57.4	1	3.9	2.7	1.9
2004	15	12	27	44.4	1	2.4	1.7	1.3
2005	16	16	32	50.0	1	3.2	2.0	0.8
2006	20	23	43	53.5	1	2.6	2.1	1.4

¹) Counts of pairs with broods in autumn. ²) Number of juveniles divided by number of adults (pairs) in autumn.

³) Number of juveniles in autumn divided by number of pairs in spring * Assumed that the observations are three independent flocks.

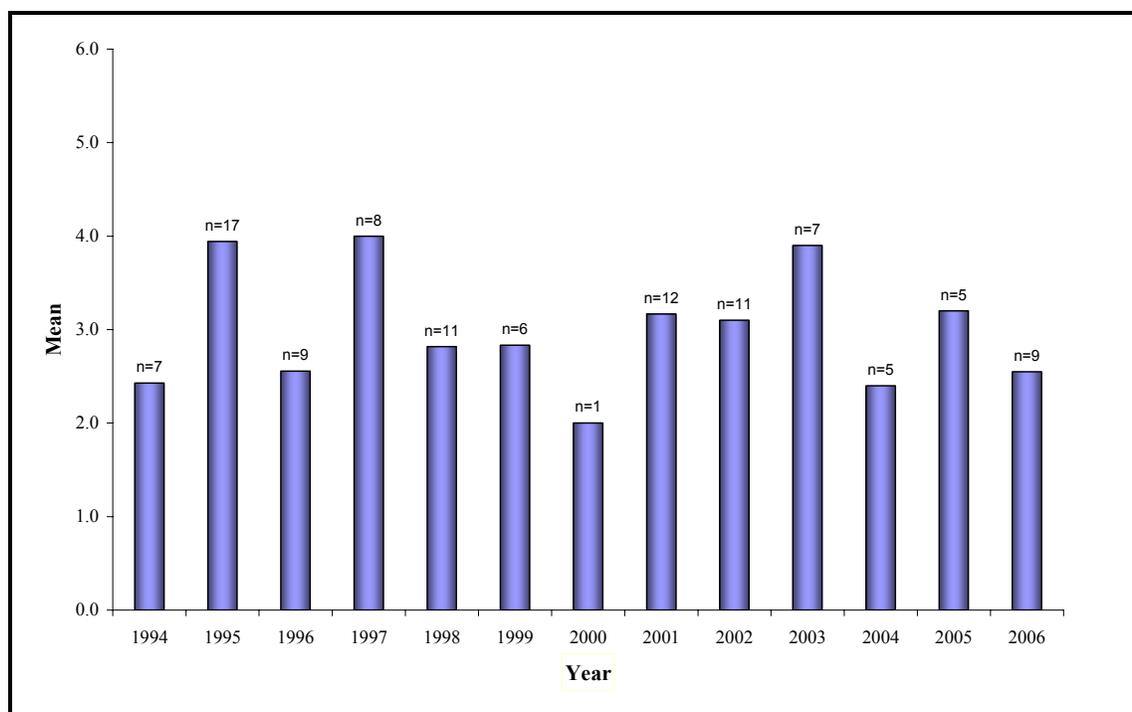


Figure 3. Annual registered production of goslings as seen in the flock of autumn staging Lesser White-fronts in the Porsangen Fjord in the period 1994 – 2006.

Table 3. Distribution of brood sizes (post-moult) at the staging areas of Valdak Marshes in 1994-2006, Skjåholmen Island in 1995-1999 (see also Table 2).

Area	Brood allocation						Mean brood size	SD	n broods	Year
	1	2	3	4	5	6				
Valdak Marshes	1	2	4				2.43 *	0.79	7	1994
Skjåholmen		2					2.0	0	2	1995
Valdak Marshes		4	3	2	6	2	3.94	1.43	17	1995
Skjåholmen					1		5.0	-	1	1996
Valdak Marshes	1	3	4	1			2.56	0.88	9	1996
Skjåholmen		2	1				2.33	0.58	3	1997
Valdak Marshes		2	1		5		4.00	1.41	8	1997
Skjåholmen			3				2.0	0	3	1998
Valdak Marshes	2	4	2	1	1	1	2.82	1.60	11	1998
Skjåholmen		2					2.0	-	1	1999
Valdak Marshes	1	1	2	2			2.83	1.12	6	1999
Valdak Marshes		1					(2.0)	-	1	2000
Valdak Marshes	3		3	5		1	3.2	1.5	12	2001
Valdak Marshes		5	1	4	1		3.1	1.1	11	2002
Valdak Marshes		1	2	1	3		3.9	1.2	7	2003
Valdak Marshes	2	1		2			2.4		5	2004
Valdak Marshes	1		2	1	1		3.2		5	2005
Valdak Marshes	4	1	2		1	1	2.6		9	2006

* One flock of 32 individuals (16 goslings) has been omitted, because the distribution of broods is unknown.



During autumn staging, the flock of LWfG spent most of the time on the islets in the fjord and at the cape Oldereidneset. This picture shows the location at Oldereidneset, where the LWfG-flock was found during the survey at 30 August 2006. © Ingar J. Øien, 30 August 2006.

3.5 Colour ring observations

Four colour-ringed LWfG were seen at the Valdak Marshes during the spring staging period in 2006. The re-sighted individuals were caught and ringed in the years 2000, 2002 and 2003 (see **table 4**). In autumn 2006, two colour-ringed LWfG were seen in the flock on 21.08. These two birds were both ringed on 23 May 2006.

Table 4. Observed colour-ringed Lesser White-fronted Geese at the Valdak Marshes, Porsangen Fjord, in 2006. S=spring, A= autumn.

Colour code	Sex	Season	Ringed date
*Red-White (left)	F	S	27.05.2002
Orange-Yellow (right)	M	S	28.05.2004
Black-Red (left)	M	S	28.05.2004
**Yellow (right)	F	S	25.05.2000
Red-White (right)	F	A	23.05.2006
Red-Orange (right)	M	A	23.05.2006

* re-captured and provided satellite transmitter (named as Nieida)

** this is Yellow-Red (right) that has lost the red ring (confirmed by the belly patches)

3.6 Population development

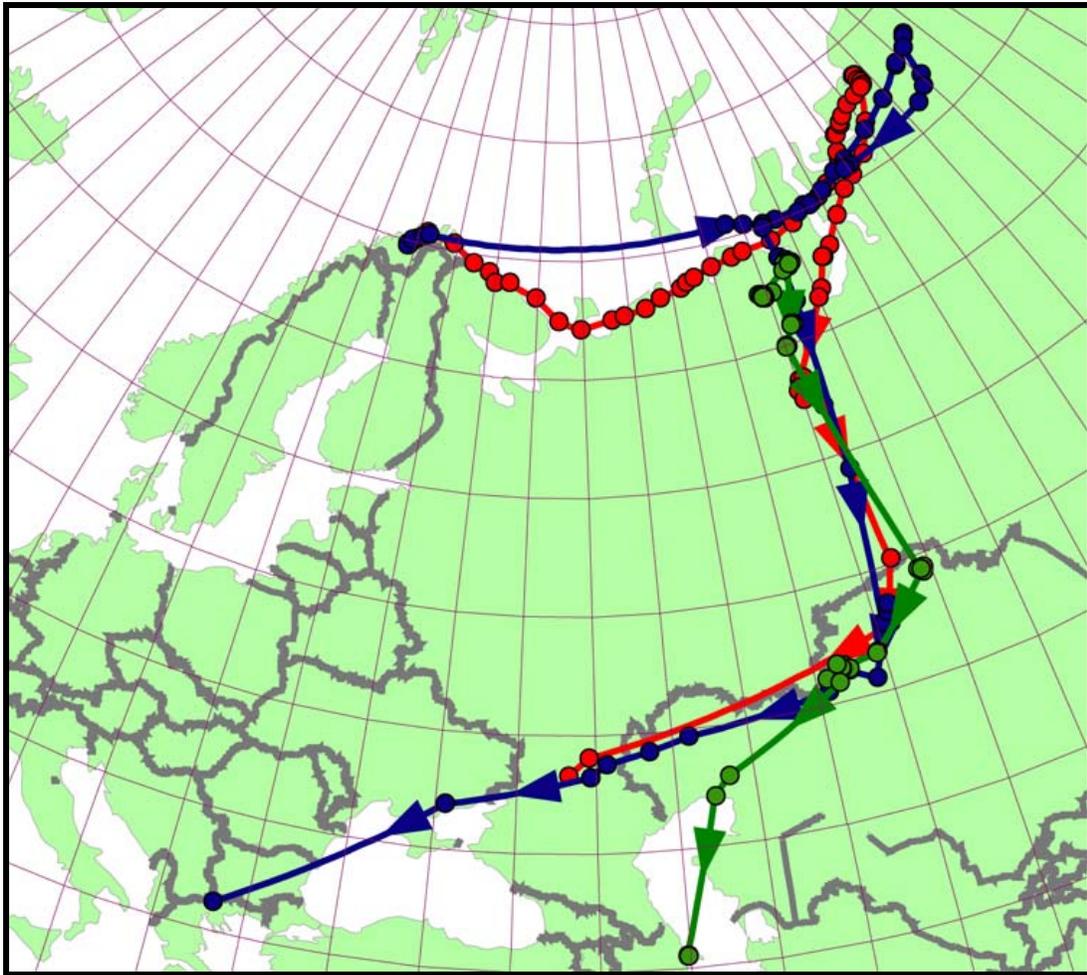
The population have decreased with -40.4 % in the monitoring period 1993-2006 (-3.9 % per year, $p=0.040$). However, most of this decrease is due to the large drop in numbers (35 %) between 2000 and 2001 (accounting for 87 % of the total decrease). From 2001 onwards, the total number of staging individuals have been stable (overall increase of 3.5 %, 0.7 % per year, with the probability for either a positive or negative trend being non significant) (**figure 2**).

3.7 Tracking of migration routes through telemetry

Through the satellite tracking of the three LWfG that was instrumented with satellite transmitters at the Valdak Marshes, further light has been shed on the migratory movements of the highly-threatened Fennoscandian LWfG population. Previous satellite tracking studies had shown that the Fennoscandian population had two different migratory routes, but the final destinations for some of these populations were largely unknown. In this early study, satellite-tracking showed that the main flyway for the geese went from their breeding area in the Fennoscandian mountains, through the Kanin Peninsula in Russia, south through eastern Hungary and finally to wintering grounds in the Evros River Delta, on the border of Greece and Turkey (Lorentsen et al. 1998).

Some Fennoscandian Lesser White-fronts were found to take a different route from the Kanin Peninsula on to northern Kazakhstan, but then on to unknown wintering grounds. It was assumed that this part of the Fennoscandian population migrated further south to the Caspian Sea region and possibly into the Mesopotamian Marshes of Iraq (Øien et al. 2005).

However, the new satellite tracking results from the three Lesser White-fronted Geese tagged this year at the Valdak Marshes show that, on the contrary, these two flyways are not separate - the birds rejoined with the other Fennoscandian Lesser White-fronts in northern Greece after undertaking an impressive 'loop-migration' via the Russian Taimyr Peninsula in northern Siberia, northern Kazakhstan and the Black Sea.



Map showing the whole autumn migration of the satellite tagged Lesser White-fronted Geese caught at the Valdak Marshes in May 2006. Red line shows the migration route of Imre (tagged 23 May) and the blue line shows the migration route of Finn and Nieida (tagged 18 May). Green lines show the migration of a pair of Lesser White-fronted Geese caught and tagged during moult in the Polar Ural (Russia) in July 2006. © Norwegian Ornithological Society.

With this improved understanding of the flyways, NOF work closely together with several other BirdLife Partners as well as WWF-Finland and other institutions in the five countries that are now co-operating on the EU-LIFE project, working together to secure stopover sites along the migratory route of the geese. This study is important, since finding new routes and information on stopover sites gives us the tools to start conserving the sites on which the Fennoscandian LWfG may depend.

The international project team visited the wintering grounds in Greece in November 2006 and had the opportunity to observe Finn and Nieida, the satellite tagged pair, in a flock of 42 Lesser White-fronted Geese at Lake Kerkini. The satellite-tracking also revealed that the threat from illegal hunting is imminent: Imre, the other adult goose that was equipped with a satellite transmitter during spring 2006, was shot during the last days of October 2006 in the Volgograd region, Russia.



The pair Finn and Nieida in the Evros Delta 5 January 2007. Colour rings are well visible as well as the satellite transmitter on the back of the male (at right) © Didier Wangeluvs

4. CONSERVATION ACTIONS IN NORWAY

In addition to the new and important findings along the migratory route, the satellite-tracking has provided invaluable data on the habitat use of the Fennoscandian LWfG's in the breeding grounds in Finnmark. On the background of these data, the core breeding area for LWfG in Norway was reconfirmed when 11 pairs were localized in a limited area in Central Finnmark. Conservation actions are already planned for the spring 2007 in this area.

The data provided from the satellite tracking, combined with earlier observations of the colour-ringed female Nieida, showed that she use the European migration route when having had successful breeding (2003 and 2005). These years she have been observed both in Valdak during autumn monitoring, in Hungary and finally in Greece during winter. In years with failed breeding (2002, 2004 and 2006), she has not showed up at Valdak in autumn, nor in Hungary, but have been observed in Greece during winter. If this pattern is common for a large part of the Fennoscandian Lesser White-fronted Goose population, it implies that they will chose the much safer European migration route to the wintering areas in Greece when they have bred successfully.

This may in turn have a huge impact on the priorities for conservation actions, and incur that efforts to ensure a successful breeding in Finnmark will have an effect not only on the reproductive success of the population, but also on the crucial survival rate of the adults during autumn migration. This secondary effect of reproductive success on adult survival, may also explain the drop in numbers between 200 and 2001, since only one clutch was produced in 2000, and only 10 individuals were observed at Valdak during autumn monitoring. Thus a major part of the Fennoscandian population probably followed the central Asian migration route and more individuals than usual became subject to the heavy hunting pressure along this route.

Red fox (*Vulpes vulpes*) is shown to be the most significant nest predator on the Swedish free-flying introduced population of Lesser White-fronted Geese (L. von Essen pers. comm.). It is therefore quite probable that a culling of red foxes in the breeding areas could decrease nest predation, thereby increasing the production of Lesser White-fronted Goose broods. This would in turn lead to a subsequent increase in adult survivals as an effect of use of the safer autumn migration route through central Europe instead of the route through Russia and central Asia.

A new hunting regulation valid in the period 2007-2112 will not allow goose-hunting in the inner part of the Porsangen Fjord. This is an important change, since some Lesser White-fronted Geese possibly are shot in the area during the hunting season.

5. ACKNOWLEDGEMENTS

Many persons have been involved in the project during 2006. Special thanks are due to Torkjell Morset at Statskog, Mountain Service in Lakselv for his outstanding logistic- and personal assistance during the fieldwork. We are further indebted to Ari Leinonen, who contributed a lot to the monitoring in spring and also in monitoring of the cannon nets, thus securing successful catch of LWfG. We would also like to thank Gry Ingebretsen and Tove Persen at "Stabburnes Naturhus og Museum" for various help and good co-operation, and Morten Ekker from the Directorate for Nature Management for good co-operation and help with the field work. The good help and cooperation from Stig Sandring from the Department of Environmental Affairs – Office of the County Governor of Finnmark is also appreciated. Financial support was provided by the Department of Environmental Affairs – Office of the County Governor of Finnmark and the Directorate for Nature Management, Norway. The monitoring and catching efforts in Porsanger are part of a LIFE-EU project, which is also co-funding this work. We like to thank all the dedicated people working in this project in Greece, Hungary, Estonia, Finland and Norway for good cooperation and or great inspiration for carrying on with LWfG conservation work. Special thanks go to Petteri Tolvanen of WWF-Finland for outstanding efforts on coordinating the work

5. REFERENCES

- Aarvak, T., Timonen, S., Øien, I.J., Tolvanen, P. & Markkola, J. 2000. Spring migration of Lesser White-fronted Geese in north-western Europe – an analysis from individual markings. In: Tolvanen, T., Øien, I.J. & Ruokolainen, K. (eds.). Fennoscandian Lesser White-fronted Goose conservation project. Annual report 1999. WWF Finland Report 12 & Norwegian Ornithological Society, NOF Rapportserie Report no. 1-2000: 32-33.
- Aarvak, T., Øien, I.J. & Nagy, S. 1996. The Lesser White-fronted Goose monitoring programme. Annual report 1996. Klæbu, Norwegian Ornithological Society. NOF Rapportserie. Report No. 7-1996.
- Aarvak, T., Øien I.J., Syroechkovski Jr., E.E. & Kostadinova, I. 1997. The Lesser White-fronted Goose monitoring programme. Annual report 1997. - Norwegian Ornithological Society, Klæbu. NOF Rapportserie. Report No.5-1997. 68s.
- Aarvak, T. & Øien, I.J. 1999. Monitoring and catching of staging Lesser White-fronted Geese at the Valdak Marshes in 1998. - In: Tolvanen, P., Øien, I.J. & Ruokolainen, K. (eds.). Fennoscandian Lesser White-fronted Goose conservation project. Annual report 1998. WWF Finland Report 10 & Norwegian Ornithological Society, NOF Rapportserie Report no. 1-1999: 22-27.
- Aarvak, T. & Øien, I.J. 2000. Monitoring of Lesser White-fronted Geese at the Valdak Marshes in 1999. In: Tolvanen, T., Øien, I.J. & Ruokolainen, K. (eds.). Fennoscandian Lesser White-fronted Goose conservation project. Annual report 1999. WWF Finland Report 12 & Norwegian Ornithological Society, NOF Rapportserie Report no. 1-2000: 24-27.
- Aarvak, T. & Øien, I.J. 2001. Monitoring of staging Lesser White-fronted Geese at the Valdak Marshes, Norway, in 2000. In: Tolvanen, T., Øien, I.J. & Ruokolainen, K. (eds.). Fennoscandian Lesser White-fronted Goose conservation project. Annual report 2000. WWF Finland Report 13 & Norwegian Ornithological Society, NOF Rapportserie Report no. 1-2001: 17-22.
- Aarvak, T. & Øien, I.J. 2004. Monitoring of staging Lesser White-fronted Geese at the Valdak Marshes, Norway, in the years 2001-2003. In: Aarvak, T. & Timonen, S. (eds.). Fennoscandian Lesser White-fronted Goose conservation project. Annual report 2001-2003. WWF Finland Report No 20 & Norwegian Ornithological Society, NOF Rapportserie Report no. 1-2004: 19-24.
- Aarvak, T., Øien, I.J., Tolvanen, P. & Markkola, J. 1999. Two pieces of the spring migration puzzle of the Fennoscandian Lesser White-fronted Goose population in place. - In: Tolvanen, P., Øien, I.J. & Ruokolainen, K. (eds.). Fennoscandian Lesser White-fronted Goose conservation project. Annual report 1998. WWF Finland Report 10 & Norwegian Ornithological Society, NOF Rapportserie Report no. 1-1999: 27-30.
- Elven, R. & Johansen, V. 1982. Seashore in Finnmark. Flora, vegetation and botanical protection values. Institute of biology and geology, University of Tromsø, report T-541 (In Norwegian with English summary).

- Lislevand, T., Folvik, A. & Øien, I.J. 2000. Norway. Pp. 509-531 in: Heat, M.F. & Evans, M.I. eds. *Important Bird Areas in Europe: Priority sites for conservation*. 1: Northern Europe. Cambridge, UK: BirdLife International (BirdLife Conservation Series No. 8).
- Lorentsen, S.-H., Øien, I.J., Aarvak, T., Markkola, J., von Essen, L., Farago, S., Morozov, V., Syroechkovsky Jr., E. & Tolvanen, P. 1999. Lesser White-fronted Goose *Anser erythropus*. Pp.: 144-161 in: Madsen, J., Cracknell, G. & Fox, A.D. (Eds.) *Goose populations of the Western Palearctic. A review of status and distribution*. – Wetlands International Publ. No. 48, Wetlands International, Wageningen, The Netherlands. National Environmental Research Institute, Rønde, Denmark. 344pp.
- Lorentsen, S.-H., Øien, I.J., Aarvak, T. 1998. Migration of Fennoscandian Lesser White-fronted Geese *Anser erythropus* mapped by satellite telemetry. *Biol. Cons.* 84: 47-52.
- Markkola, J., Luukkonen, A. & Leinonen, A. 2004. The spring migration of the Lesser White-fronted Goose on Bothnian Bay coast, Finland, in 2001–2003. In : Aarvak, T., Timonen, S. & Ruokolainen, K. (eds): Fennoscandian Lesser White-fronted Goose conservation project. Report 2001–2003. – WWF Finland Report No 20 & Norwegian Ornithological Society, NOF Rapportserie report no. 1-2004: 14-18.
- Tolvanen, P., Aarvak, T., Øien, I.J. & Timonen, S. 2004. Introduction. In : Aarvak, T., Timonen, S. & Ruokolainen, K. (eds): Fennoscandian Lesser White-fronted Goose conservation project. Report 2001–2003. – WWF Finland Report No 20 & Norwegian Ornithological Society, NOF Rapportserie report no. 1-2004: 5-8.
- Øien, I.J. & Aarvak, T. 2006. Monitoring of Lesser White-fronted Goose in Norway in 2005. NOF report 1-2007. 12pp.
- Øien, I.J., Aarvak, T. & Morozov, V. 2005. A wild goose chase across Central Asia to the Middle East. *World Birdwatch* 27:No.2.97: 24-26.
- 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.
- Øien, I.J., Tolvanen, P., Aarvak, T. & Markkola, J. 1999. Occurrence and identification of Lesser White-fronted Goose. *Alula* 5: 18-23.

