

Occurrence of the Lesser White-fronted Goose *Anser erythropus* in Latvia: linking migration to conservation

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Abstract

This report compiles data about the Lesser White-fronted Goose *Anser erythropus* in Latvia and links its occurrence to breeding, staging and wintering areas. An average of at least 30 000 birds migrated through Latvia in both autumn and spring in the first half of the 20th century, before declining to about 125 to 175 birds nowadays. Almost all birds occurring in Latvia originated from the Scandinavian and North Fennoscandian populations. The main migration route has for two and a half centuries gone west of Riga, southwards in autumn and northwards in spring. Nowadays, about 15 birds from the Scandinavian population stage for about one month in spring, while North Fennoscandian birds only make occasional stop-overs. During the last decade, the species was found staging in a total of 14 staging areas but regularly only in the Important Bird Area Svēte lower reaches. Based on the current staging patterns, suggestions of conservation actions are given for this threatened species.

Key words: *Anser erythropus*, North Fennoscandian population, passage migrant, Scandinavian population, spring staging, Svēte floodplain.

Abbreviations: HKP, Hakon Kampe-Persson; IBA, Important Bird Area; ISAAP, International Single Species Action Plan; LMNH, Latvian Museum of Natural History

Introduction

In the early 20th century, the Lesser White-fronted Goose *Anser erythropus* bred from northern Scandinavia to north-eastern Siberia. Since, the breeding range has contracted into five areas: northern Sweden, northernmost Fennoscandia, an area from the White Sea to Ural/Yamal, southern Taimyr and north-eastern Siberia (Lorentsen et al. 1999). The World population has decreased markedly, especially in the 1950s. The decline was largest in the western part of the range, and the number of individuals in Fennoscandia decreased by more than 99%.

The number of Lesser White-fronted Geese was estimated at 80 000 to 120 000 birds in the species' most important autumn-staging areas, situated in eastern Hungary, in the first half of the 20th century (Sterbetz 1982). High numbers were recorded in 1898, 1911, 1916, 1920, 1922, 1930, 1935, 1945 and 1949 (Sterbetz 1968). These large concentrations disappeared abruptly in the mid-1950s and during the period 1971 to 1980, an annual average of 3620 birds were seen, a decline by 95 to 97% (Sterbetz 1982). The decline continued, and in the autumns of 1984 to 1988, a maximum of 500 birds staged (Faragó et al. 1991) and in the period 2004 to 2008 only 31 to 54 birds (Tar et al. 2009). The winter quarters of these large concentrations are

unknown, but they were probably in steppes south-east of Hungary (Sterbetz 1968; 1990). Large flocks were reported wintering in north-eastern Greece in the early 20th century (Harrison 1918; Kattinger 1934). However, there are only four accepted records in Greece from the first half of the 20th century. Three of these refer to a total of seven shot birds, while the fourth refers to “many” birds (Handrinos, Goutner 1990).

As both Fennoscandian populations crashed in the mid-1950s, it seems likely that it happened, when most individuals in these populations were in about the same area during the non-breeding season. The species is known to be able to feed and roost in dense flocks. Peter Scott found, for instance, a flock numbering 30 000 to 60 000 birds in a marsh measuring 3 × 16 km in northern Persia (Scott 1939; 1961). Candidates for having caused the crashes are poisoning, freezing rain, cold winters, serious droughts, heavy hunting pressure, starvation and military weaponry tests, or a combination of factors. The species is easy to hunt due to its “irrepressible curiosity” (Zhitnikov 1900, cited by Alphéraky 1905). Noise made by hunters are approached by Lesser White-fronted Geese, also when occurring in large flocks on migration. The same behaviour is typical also during spring staging and on the breeding grounds, and might be one of the reasons the species is extremely

vulnerable to hunting (Lorentsen et al. 1999). Large-scale transformation of the steppes, the former wintering habitat of the birds (Sterbetz 1968; 1990), into cultivated land may have caused mass starvation, if the geese were reluctant to leave their traditional wintering ground (cf. Fog et al. 1984).

The decline in the two populations since the 1950s, partly also up to the 1950s is, on the other hand, probably the result of a combination of factors (Ahlén 1977). Among these factors, hunting along the migration routes has been singled out as the most important cause of death in the North Fennoscandian population during the last decades (Riihimäki 1999; Lampila 2001; Tolvanen et al. 2004; Øien et al. 2007). Hunting affects also the Scandinavian population, especially when severe winter weather forces birds south to France, when birds take the route through Belarus in spring, or when young males during exploration trips visit North Norway.

To save the Lesser White-fronted Goose from extinction in Sweden, Lambart von Essen initiated a project, supported by WWF-Sweden, in the mid-1970s (von Essen 1982). The plan was to release captive-bred goslings with Barnacle Geese *Branta leucopsis* as foster parents. The foster parents should guide the goslings along a safe route to winter quarters in the Netherlands (von Essen 1999). When releases of goslings started in 1981, a small number of Lesser White-fronted Geese were still breeding in and around the release area (Andersson, Holmqvist 2010). Thus, according to IUCN (1998), the Swedish project was a reinforcement project (see also Seddon 2012). In 2000, after having released a total of 348 goslings (Andersson, Larsson 2006), releases stopped due to concerns about the genetic purity of the captive stock (Andersson 2004). After having built up a new captive stock, based on wild-caught birds from Russia, releases of Lesser White-fronted Geese were resumed in 2010 (Liljebäck et al. 2019). Foster parents were not used any more, as some of the released males had hybridised with Barnacle Geese (Andersson 2019). Instead, goslings and 2nd-calendar-year birds were released at the breeding lakes in Swedish Lapland. All released birds were marked with engraved plastic leg-bands and some of them were fitted with satellite transmitters.

The Norwegian Lesser White-fronted Goose project, in which field-work started in 1987, aims at monitoring the remaining individuals and identifying their migration routes and sites used for moulting, staging and wintering (Øien, Aarvak 1993). A plan to re-stock the Norwegian population was prepared (Lee et al. 2010) but releases ceased after two seasons (2010 and 2011), after it was found out that the released birds did not join the flock of wild birds as hoped (Øien et al. 2017). Among the birds caught for ringing, some were fitted with satellite transmitters, while the others were colour-ringed (Aarvak, Øien 2001; 2004; 2009).

In a Finnish re-stocking project, a total of 143 captive-bred Lesser White-fronted Geese were released in Northern

Finnish Lapland in 1989 to 1997 (Markkola et al. 1999). In most years, two adults and three to 26 goslings were released quite near the breeding sites of the remaining wild Lesser White-fronted Geese, and the released birds were expected to join and follow the wild ones. However, it seems that they instead followed Taiga Bean Geese *Anser fabalis fabalis* in the south-westerly direction to the East Atlantic Flyway. Some of the birds followed this flyway to south-western Spain (Kampe-Persson 2004). Small-scale releases were carried out from 2004 onwards (Kahanpää, Haapanen 2009). There are no breeding records of released birds in Finland, and the last breeding pair of the original population was observed in the mid-1990s.

In a French project, 30 Lesser White-fronted Goose goslings of Belgian origin, released close to Öster-Malma in central Sweden in 1999, were guided by ultra-light aircrafts from the release site to Xanten in Germany (Mooij 2001). Most of these birds were later recaptured and held in captivity, but one project bird was observed at Villafáfila in north-central Spain on January 28, 2002 (Kampe-Persson, unpublished results). A German project, using micro-light aircraft, was postponed due to an outbreak of bird flu (Mooij et al. 2008).

Owing to its threatened status, an International Single Species Action Plan (ISSAP) for the Lesser White-fronted Goose was established under AEWA (The African-Eurasian Migratory Waterbird Agreement) (Jones et al. 2008). Unfortunately for the Lesser White-fronted Goose, the action plan promoted the conservation of the birds breeding in Norway at the sacrifice of those breeding in Sweden. The term “Fennoscandian population” was first used to depict, correctly, the birds breeding in Sweden, Norway, Finland and the Kola Peninsula but later was restricted to the remnant population in Norway. By that, this term lost its scientific significance, as it nowadays is unclear what it refers to, and it should for that reason be avoided, also as there are two well defined populations in Fennoscandia – the Scandinavian (or Scandian) and the North Fennoscandian (Kampe-Persson 2010b).

As the species occurred with regularity in Latvia, Collar et al. (1994) listed Latvia as one of twenty Range States worldwide for the Lesser White-fronted Goose. In spite of that, Latvia was omitted in the European Action Plan for the species (Madsen 1996). The Lesser White-fronted Goose was, as an endangered species, added to the Latvian Red Data Book in 1997 (Andrušaitis 2000). As no Important Bird Area (IBA) for the Lesser White-fronted Goose had been identified within its territory, Latvia was not included among the Principal Range States in the ISSAP (Jones et al. 2008).

In Latvia, owing to a low number of accepted records, the Lesser White-fronted Goose is regarded as a very rare transit migrant (Andrušaitis 2000). There are only ten accepted records of sixteen individuals in the 20th century (www.putni.lv). The scientific view is quite different. Based

on data from mainly the 1920s and 1930s, von Transehe (1965) described the species as a transit migrant. Few birds were reported shot, but von Transehe supposed that many birds were shot, but not recognised and reported. Furthermore, he assumed that most staging birds were to be expected at coastal lakes. As the Lesser White-fronted Goose often was confused with the Greater White-fronted Goose *Anser albifrons* (for a summary, see Mooij et al. 2007), older literature must be used with caution. The specimen from 1860 in the collection of the LMNH was originally labelled *Anser albifrons* (Dmitrijs Boiko, *in litt*). The Greenland White-fronted Goose *Anser albifrons flavirostris* was not described until 1948 (Dalgety, Scott 1948). Before then, it was believed that the Lesser White-fronted Goose was breeding also in Greenland (Salomonsen 1950), even though it was noted already in 1883 that the species was the Greater White-fronted Goose (Kolthoff 1914). However, after taking this confusion into account, it seems as the Lesser White-fronted Goose has been a regular transit migrant in Latvia ever since the late 18th century (Beseke 1792; Meyer 1815; Lichtenstein 1829; Russow 1880). The species' Latvian name in the 18th century was *ezeru zoss* (Lake Goose) (Beseke 1792), indicating that the Lesser White-fronted Goose very likely was a quite common staging bird at that time.

Along the spring migration route from Greece to Norway, five staging areas were thought to exist in the Baltics, three of them in Latvia (Aarvak et al. 1999). The Latvian Red Data Book's suggestions for study and protection of the species were "Careful registration should be taken in case this species appears in Latvia during its transit migration. To locate the potential resting and feeding sites." (Andrušaitis 2000). That triggered off my checks of staging and migrating goose flocks in Latvia for occurrence of Lesser White-fronted Geese (Kampe-Persson 2014a).

Due to extremely low numbers of individuals in the two Fennoscandian populations, it is of utmost importance to obtain information about every single part of the annual cycle of the birds, especially about factors that can be harmful to the species. In the spring of 2020, a new threat was added, when Latvia for the first time ever issued licenses to shoot geese for mitigation of crop damage (www.daba.gov.lv). The aim of this report is to put all available information about the Lesser White-fronted Goose in Latvia, historical and more recent, into an international context, linking the occurrence in Latvia to breeding, staging and wintering areas.

Materials and methods

Searches by the author for staging Lesser White-fronted Geese were carried out in Latvia in the springs 2007 to 2020, mainly on the feeding grounds but in some staging areas also at the day roost. Most of the field-work was done during one-day trips. One or more multi-day trips

were realised to staging areas situated further away from home in 2013 and from 2017 to 2019. In 2020, the field-work was geographically restricted by the Covid-19 pandemic. Field-work in the autumns 2007 to 2019 was of an occasional character. Migrating geese were checked for the occurrence of Lesser White-fronted Geese, whenever geese passed close enough to be checked individually. All encountered goose flocks were carefully checked for the occurrence of Lesser White-fronted Geese. In feeding and roosting flocks, the birds were scanned with a telescope 20 to 60 × 60, by moving the telescope at a speed that allowed the birds to be checked one by one. When checking feeding flocks in high vegetation, on uneven ground or when there were also sleeping individuals in the flock, more than one scan was performed. The telescope was also used for checking geese flying to or from their roosting site. When the geese were too close for the telescope to be used, 10 × 40 binoculars were used instead. Both individual variation and occurrence of hybrids were taken into account when identifying the target species. Body size, head form, neck length and bill size as well as the colouration of bill, head, neck and orbital ring were among the features checked. Vocalisation also helped. The long and pointed wings of the Lesser White-fronted Goose, making the species able to fly fast and far (Beseke 1792), were not used for identification, even though this feature quite often was obvious. When a Lesser White-fronted Goose was found on the ground, the utmost was done to reveal if the individual was ringed. Efforts that were in vain occurred in cases when the bird was feeding in high vegetation, in depressions or standing in water until taking off.

Latvian and international publications from the late 18th century onwards as well as the home pages www.piskulka.net, www.putni.lv, www.dabasdati.lv and www.birdlife.no were thoroughly searched for published information about the Lesser White-fronted Goose in Latvia. Dmitrijs Boiko was contacted for supplementary data about Lesser White-fronted Geese in the collection of the Latvian Museum of Natural History, and Niklas Liljebäck for data about leg-ringed and satellite-tagged Lesser White-fronted Geese from the breeding population in Sweden that had been recorded in Latvia.

After each spring, the total number of grey geese *Anser* sp. checked for the occurrence of Lesser White-fronted Geese was reduced by those individuals that already had been checked that spring. In that way, estimates of the total number of grey goose individuals checked each spring were obtained.

For Lesser White-fronted Geese staging in Latvia, the staging area was given when known. Each staging area consists of a night roost and all feeding areas used by geese from that night roost. In some staging areas, also alternative and/or temporary night roosts are used.

The staging area Svēte flood-plain was the area in which the geese were most frequently checked. The night roost is

situated at the confluence of the rivers Svēte and Lielupe (56°43'N, 23°39'E), in a 931 ha nature park (Račinskis 2004). The geese mainly fed in the protected area and the surrounding fields but other feeding grounds were situated up to 30 km from the night roost (Kampe-Persson 2014b). Due to no admittance during the period March 1 to June 1, feeding and day roosting geese in the protected area could only be checked, when the geese were close to the dyke. For that reason, most field checks were carried out either when the geese moved between the roost and the feeding grounds or at the feeding grounds.

For the sake of completeness, all known observations in Latvia of hybrids between any two of the three species Lesser White-fronted Goose, Greater White-fronted Goose and Barnacle Goose were listed.

Results

The number of grey geese *Anser* sp. checked for the occurrence of Lesser White-fronted Geese varied markedly among years (Table 1). On average, one staging Lesser White-fronted Goose was found for each 18 100 grey geese checked.

Except for the birds found during the period March 21 to April 17 in 2008 to 2020, the time windows during which Lesser White-fronted Geese were observed in Latvia are quite similar before and after the turn of the century (Tables 2, 3). Overall, these time windows were September 15 to October 25 and March 21 to May 13.

Migrating flocks numbered 40 to 90 birds in the 20th century ($n = 3$, Table 2) and three to 13 birds in 2001 to 2020 ($n = 5$, Table 3).

Observations of staging Lesser White-fronted Geese during the period 2013 to 2020 were well distributed over the country (Fig. 1), while all observations in 2001 to 2012 were from the staging area Svēte flood-plain. North Fennoscandian birds were only found west of Riga and Scandinavian birds mainly east of the North Fennoscandian. The Svēte flood-plain made up the border line, where birds from both populations were found.

The five migrating flocks in the springs 2015 to 2018 were all single-species flocks (Table 3). All flocks followed an extremely narrow flight corridor over the eastern parts of Nākotne, Glūda pagasts. Dates (ranging April 18 to May 11) and time of day (ranging 8:10 to 21:20), on the other hand, varied greatly. Although large numbers of geese annually pass Glūda pagasts on spring migration, no other species was ever seen following this flight corridor or a track parallel to this one in the years 2007 to 2020.

Most staging Lesser White-fronted Geese were associated with either Greater White-fronted Geese or Tundra Bean Geese *Anser serrirostris rossicus* (Table 3). Most individuals were found in mixed flocks of Greater White-fronted and Tundra Bean Geese, the normal species composition of staging goose flocks in Latvia (Kampe-Persson 2010a), but sometimes in flocks of either of the two species. Only the largest flock, of 23 individuals, staged as a single-species flock. Staging birds were found in permanent grasslands, temporary grasslands, winter cereals, cereal stubbles, maize stubbles and newly-sown fields.

Seven transmitter-tagged individuals, three Swedish and four Norwegian, have been recorded in Latvia, one Swedish twice and one Norwegian four times (Tables 2, 3). Swedish-tagged birds migrated through Latvia only in

Table 1. Number of visited staging areas, number of checked grey geese *Anser* sp. (separate columns show figures including and excluding multiple counts, respectively) and number of staging and migrating Lesser White-fronted Geese (LWfG) *Anser erythropus*, respectively, found during field-work in Latvia in the springs 2007 to 2020. All field-work done by the author

Year	No. of visited staging areas	No. of checked grey geese		No. of staging LWfG	No. of migrating LWfG
		Multiple counts			
		Included	Excluded		
2007	4	4 000	2 000	0	0
2008	2	57 200	36 000	1	0
2009	3	7 275	7 275	1	0
2010	1	6 658	6 000	1	0
2011	2	34 900	17 520	0	0
2012	1	139 100	52 150	0	0
2013	35	60 000	55 600	1	0
2014	5	35 500	19 700	1	0
2015	5	155 000	76 000	2	7
2016	7	72 257	36 850	28	6
2017	28	211 000	169 640	3	3
2018	16	80 904	62 000	1	13
2019	23	288 000	170 000	1	0
2020	13	248 000	50 010	2	0
Total:	102	1 399 794	760 745	42	29

Table 2. Observations of Lesser White-fronted Geese *Anser erythropus* in Latvia, up to 2000

No.	Date	Observation	Source/observer
1	Before 1792	One adult hunted in Courland	Beseke (1792)
2	April 22, 1860	One adult from the neighbourhood of Riga.	LMNH
3	October 10, 1902	One juvenile was found in Riga market	Stoll (1904)
4	May 5, 1910	One bird was shot at Dviete	Grosse, von Transehe (1929)
5	1920 to 1940	One adult was shot at Bulduri, Sala pagasts	LMNH
6	October 25, 1925	One shot bird was found in Riga market	Grosse, von Transehe (1929)
7a	1926 to 1928	In spring, Lesser White-fronted Geese were seen migrating at high altitudes over Cena bog, Livbērze and Lake Babīte. Of about 400 geese hunted and bagged in these areas in the years 1926 to 1928, three were Lesser White-fronted Geese	Hans Staack in von Transehe (1965)
7b	April 1927	Aforementioned three birds were shot at Lake Babīte	Grosse, von Transehe (1929)
8	May 6, 1927	Two adults were found and bought by Stoll in Riga market	LMNH
9	Autumn 1927	One bird was shot at Lake Engure	Grosse, von Transehe (1929)
10	September 20, 1937	One adult and one juvenile were shot at Lake Kaņieris	Pētersons (1938)
11	September 22, 1958	A flock of 90 birds migrated south-westwards along the Baltic Sea coast at Oviši, Tārgale pagasts	Mihelsons et al. (1960)
12	April 1980	One bird was seen together with other geese in Nagļi fish-ponds, Nagļi pagasts	Mednis (1983)
13	September 29, 1984	Two flocks of 40 and 60 birds, respectively, migrated southwards at Lake Kaņieris	Strazds, Ūze (2006)
14	October 7, 1985	Two birds were seen in Lake Murmastiene, Murmastiene pagasts	Bergmanis, Avotiņš (1990)
15	September 27, 1989	Three birds were seen in Lake Engure	Aarvak et al. (1997)
16	October 20, 1991	Four birds were seen at Riga's Hydroelectric Power Plant	Aarvak et al. (1997)
17	May 1, 1994	Three adults were seen at the coast at Bērciems, Engure pagasts	Celmiņš, Baumanis (1997)
18	September 15, 1995	An unpaired male, fitted with a satellite transmitter at a moulting site in northernmost Norway on July 27, 1995, migrated in south-westerly direction over Latvia	Lorentsen et al. (1998)
19	September 15, 1995	A paired female, fitted with a satellite transmitter at the Valdak Marshes, Norway on May 24, 1995, migrated in south-westerly direction over Latvia	Lorentsen et al. (1998)
20	September 26 to October 4, 1996	Forty-three birds staged in Ozoli Bog, Dikļi pagasts; two of the 43 birds were shot on October 4	Aarvak et al. (1997)
21	October 7, 1997	A paired adult male, fitted with a satellite transmitter at the Valdak Marshes, Norway on May 27, 1997, migrated in south-westerly direction over Latvia	Aarvak, Øien (2003)
22	October 3, 1998	One juvenile was shot at Lake Kaņieris	Strazds, Ūze (2006)

spring. Their arrival dates ranged from April 8 to 16 and their departure dates from May 8 to 13, and they stayed on average 29 days (range 23 to 35 days). Two of the birds used two staging areas the same spring, the second area situated north of the first one. The bird recorded two consecutive springs used a total of four staging areas.

One of the Norwegian birds (Mr Blue) made two short stop-overs in spring. That Mr Blue in the spring of 2019 had arrived together with the un-ringed bird, which was

observed the day after he had left Lake Laidze, is taken for granted. This Norwegian bird had passed Latvia also in the preceding autumn, then without stopping. Whether or not Mr Blue stopped when passing Latvia in September 2019 and April 2020, respectively, has not been published yet.

Only one of the seven transmitter-tagged birds were checked in the field in Latvia (Table 3). This bird, marked in Sweden, was not in company with conspecifics.

Half of the published observations of Lesser White-

Table 3. Observations of Lesser White-fronted Geese *Anser erythropus* in Latvia, January 2001 to August 2020

No.	Date	Observation	Source/observer
1	May 2, 2006	One adult in a migrating flock of Greater White-fronted Geese at Kolka Cape, Kolka pagasts	D.B. Wooldridge on www.putni.lv
2	October 2, 2007	One adult migrated southwards in a flock of about 100 Greater White-fronted Geese and about 100 Tundra Bean Geese at Zāgkalni, Lake Usma at 11:00, during a day with very intense goose migration. Calls of the bird identified the species long before the individual came into view	HKP
3	March 21, 2008	One adult staged in a flock of 51 Tundra Bean Geese and two Greater White-fronted Geese in staging area Svēte flood-plain	HKP
4	October 23, 2008	One adult staged in a mixed flock of Greater White-fronted Geese and Tundra Bean Geese in staging area Svēte flood-plain	HKP
5	March 26, 2009	One adult staged in a mixed flock of about 100 Greater White-fronted Geese and Tundra Bean Geese in staging area Svēte flood-plain	HKP
6	March 23, 2010	One adult staged in a flock of 50 Greater White-fronted Geese and one Tundra Bean Goose in staging area Svēte flood-plain	HKP
7	April 18, 2013	One adult staged in a flock of 475 Tundra Bean Geese, 175 Greater White-fronted Geese and 125 Whooper Swans in a maize stubble at Kaķenieki, Annenieki pagasts	HKP
8	April 24 to 26, 2014	One adult staged in a flock of 1700 Tundra Bean Geese and 170 Greater White-fronted Geese in staging area Svēte flood-plain	HKP
9	October 23, 2014	Two un-ringed adults were seen together with 48 Greater White-fronted Geese in winter cereals at Spurģi, Zaļenieki pagasts in staging area Svēte flood-plain	HKP
10	April 9 to May 8, 2015	Rosa, a female fitted with a satellite transmitter and released as newly-fledged gosling in the Swedish breeding area on August 1, 2014, staged in staging area Riga's Hydroelectric Power Plant	Niklas Liljebäck (<i>in litt</i>)
11	April 10 to May 10, 2015	Blā, a female fitted with a satellite transmitter and released as newly-fledged gosling in the Swedish breeding area on August 1, 2014, staged in staging areas Kačori and Taure Bogs	Niklas Liljebäck (<i>in litt</i>)
12	April 12, 2015	One un-ringed adult was drinking together with 40 Tundra Bean Geese and 175 Greater White-fronted Geese in a ploughed field at Dorupe, Glūda pagasts in staging area Svēte flood-plain	HKP
13	April 24, 2015	Four adults in a single-species group migrated northwards over Nākotne, Glūda pagasts at 14:35	HKP
14	April 24, 2015	Three adults in a single-species group migrated northwards over Nākotne, Glūda pagasts at 20:30	HKP
15	April 27 to May 1, 2015	One adult staged together with two Greater White-fronted Geese in a flock of about 5 000 Greater White-fronted Geese and just over 500 Barnacle Geese in a temporary grassland in staging area Svēte flood-plain	HKP
16	May 1, 2015	One 2 nd -calendar-year bird staged together with 31 Tundra Bean Geese in staging area Svēte flood-plain	HKP
17a	April 16 to May 1, 2016	Blā, a female fitted with a satellite transmitter and released as newly-fledged gosling in the Swedish breeding area on August 1, 2014, staged in staging area Lakes Višķi and Lukna	Niklas Liljebäck (<i>in litt</i>)
17b	May 1 to 9, 2016	Blā staged at Rudzāti, Rudzāti pagasts	Niklas Liljebäck (<i>in litt</i>)
18	April 18, 2016	Six adults in a single-species group migrated northwards over Nākotne, Glūda pagasts at 8:10. Most likely, the very same six adults had been observed in the Nemunas River Delta, Lithuania on April 16 to 17 (Seppo Ekelund, <i>in litt</i>)	HKP
19	April 30, 2016	Twenty-three birds in a single-species flock left Svēte flood-plain on a feeding flight at 19:55	HKP
20	May 5, 2016	Five birds staged in a flock of Tundra Bean Geese and Greater White-fronted Geese in staging area Svēte flood-plain	HKP

Table 3. continued

No.	Date	Observation	Source/observer
21a	April 8 to 12, 2017	Femina, a female fitted with a satellite transmitter and released as gosling in the Swedish breeding area in 2016, staged at Punduri, Bērziņi pagasts	Niklas Liljebäck (<i>in litt</i>)
21b	April 12 to May 13, 2017	Femina staged in staging area Lake Tiskādi	Niklas Liljebäck (<i>in litt</i>)
21c	May 2, 2017	Femina roosted in Lake Tiskādi together with Greater White-fronted Geese in a flock numbering 30 150 Greater White-fronted Geese, 6000 Tundra Bean Geese and six Barnacle Geese. Calls of the bird identified the species before the individual was spotted	HKP
22	April 6 to 26, 2017	One 2 nd -calendar-year bird staged together with a Tundra Bean Goose in staging area Svēte flood-plain	HKP
23	April 10, 2017	One adult staged in a flock of 2000 Greater White-fronted and Tundra Bean Geese at Ūdrupe, Variņi pagasts	Gaidis Grandāns (<i>in litt</i>)
24	April 21, 2017	One un-ringed adult male staged in a flock of 2300 Greater White-fronted Geese and 150 Tundra Bean Geese in a temporary grassland in Gauja National Park, north-west of Bērzkrogs	HKP
25	May 11, 2017	Three adults in a single-species group migrated northwards over Nākotne, Glūda pagasts at 21:20	HKP
26	April 11, 2018	One singly 2 nd -calendar-year bird staged in staging area Svēte flood-plain	HKP
27	April 17, 2018	One 2 nd -calendar-year bird staged in a flock of Tundra Bean Geese and Greater White-fronted Geese in staging area Svēte flood-plain	HKP
28	April 30, 2018	13 birds in a single-species flock migrated northwards over Nākotne, Glūda pagasts at 18:45	HKP
29	September 19, 2018	Mr Blue, a male caught and equipped with a gps-gsm collar at the Valdak Marshes, Norway on May 24, 2018, migrated southwards through east-central Latvia in the afternoon; he was in Estonia at 12:00 and in Lithuania at 18:00	www.piskulka.net
30	March 21, 2019	One adult staged in a flock of 25 Tundra Bean Geese in staging area Svēte flood-plain	HKP
31a	April 18 to 19, 2019	Mr Blue (see above) was at Lake Ķikuri at 7:00 on the 18 th , at Lake Engure at 13:00 on the 18 th and in Lake Laidze at 19:00 on the 18 th and at 7:00 on the 19 th	www.latvijasputki.lv
31b	April 20, 2019	One un-ringed adult (not Mr Blue) was seen in a flock of 200 Greater White-fronted Geese, one bean goose and one Barnacle Goose at Lake Laidze	Esa Aalto, Risto Karvonen on www.piskulka.net
32	Mid-September 2019	Mr Blue (see above) and his family arrived in Lake Kerķini National Park, Greece on September 20. Details about his passage of Latvia are not published yet	www.piskulka.net
33	Mid-April 2020	Mr Blue (see above) arrived in the Kāina Bay, Island of Hiiumaa, Estonia in the early morning of April 17, after having been re-sighted in the Nemunas River Delta, Lithuania on April 14 to 15. Details about his passage of Latvia are not published yet	www.piskulka.net
34	May 1, 2020	One singly bird was seen in a flock of Tundra Bean Geese, Greater White-fronted Geese and Barnacle Geese in staging area Svēte flood-plain	Ritvars Rekmanis on www.putni.lv
35	May 3 to 7, 2020	One singly leg-ringed adult from the Scandinavian population was feeding in a flock of Greater White-fronted Geese in a permanent grassland in staging area Svēte flood-plain. Calls of the bird identified the species before the individual was spotted	HKP
36	May 5 to 7, 2020	One singly leg-ringed 2 nd -calendar-year bird from the Scandinavian population was feeding in a flock of Tundra Bean Geese and Greater White-fronted Geese in a permanent grassland in staging area Svēte flood-plain. Calls of the bird identified the species before the individual was spotted	HKP

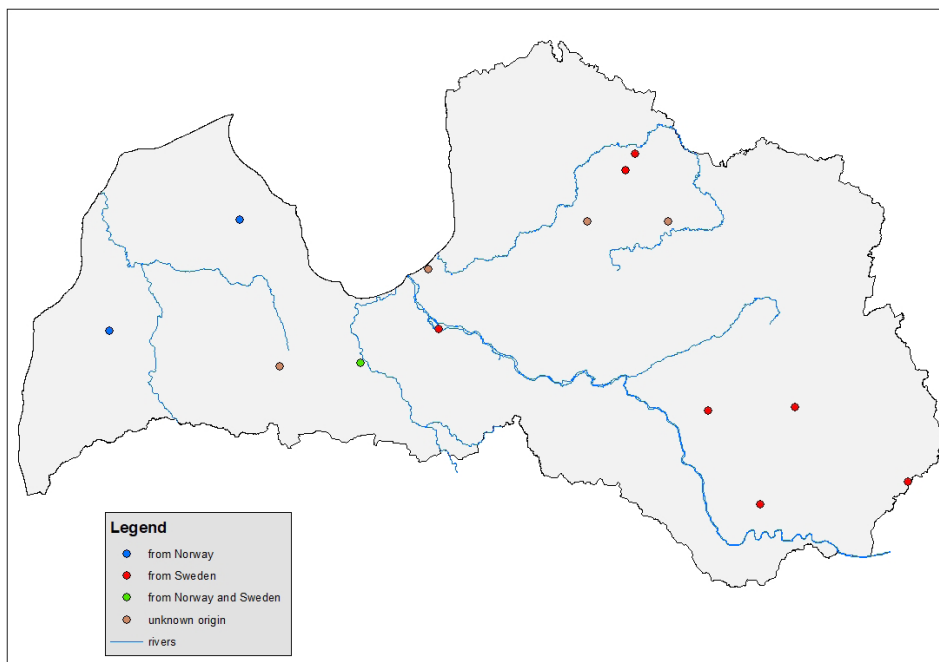


Fig. 1. Sites in Latvia where Lesser White-fronted Geese *Anser erythropus* from Sweden, Norway, both countries or of unknown origin were found staging in the springs 2013 to 2020.

fronted Geese in Latvia in the 20th century refer to shot birds (Table 2). In all cases, 1 to 3 birds were shot. Of about 400 geese hunted and bagged in an area west of Riga in the years 1926 to 1928, 0.75% were Lesser White-fronted Geese (Hans Staack in von Transehe 1965). No Lesser White-fronted Goose was reported shot in Latvia in the autumns 2001 to 2019 (Table 3) or in the spring of 2020 (Jēkabs Dzenis, *in litt*).

Of staging Lesser White-fronted Geese in the years 2007 to 2020, 85% ($n = 55$) were found in Important Bird Areas (IBAs) (Table 4). No less than 96% ($n = 47$) of those found in IBAs were found in the Svēte lower reaches. All individuals found in an IBA were roosting in the IBA, but most of the feeding took place outside the IBA. The species was listed as migrant in Lake Pape Nature park (www.pdf-pape.lv), a 10 416 ha IBA situated in south-westernmost Latvia. However, it is unknown in which numbers and how frequently the species has been observed, as no details were

Table 4. Number of staging Lesser White-fronted Geese *Anser erythropus* (LWfG) in Latvia in the years 2007 to 2020, recorded in different Important Bird Areas (IBAs) and outside IBAs, respectively. Račinskis (2004) was used for list of IBAs

Important Bird Area (IBA)	Size (ha)	No. of staging LWfG
Svēte lower reaches	932	45
Gauja National Park	92 322	1
Teiči and Pelečāre Bogs	26 263	1
Outside the IBAs	–	8
Total:	–	55

given.

In Latvia, there are three observations of hybrids between Lesser and Greater White-fronted Goose (Table 5), of which two were of the same individual, and four observations of hybrids between Greater White-fronted and Barnacle Goose (Table 6). Of the last-mentioned ones, the three observations made at Lubāns most likely, and that at Gulbene maybe, refer to the same individual. All hybrids were seen in flocks of Greater White-fronted Geese and one of the hybrids was even paired to a Greater White-fronted Goose (Table 6). Another hybrid between Lesser and Greater White-fronted Goose was probably seen at Svēte flood-plain on May 5, 2006 – yellow eye-ring, white front up on the head and body size as a Greater White-fronted Goose (www.putni.lv) – but no certainty can be reached due to an incomplete description.

Discussion

Fennoscandia has undoubtedly been the main origin of Lesser White-fronted Geese occurring in Latvia. Hence, to facilitate putting the Latvian observations into an international context, a description of the two Fennoscandian populations, the North Fennoscandian and the Scandinavian, is given.

Two populations in Fennoscandia

Before the crash, the North Fennoscandian population bred north of latitude 68°N in Norway, Sweden and Finland (Munsterhjelm 1911; 1913; 1916; Rosenius 1937; Hortling 1929) but in the Kola Peninsula also further south (Aikio

Table 5. Observations of hybrids between Lesser White-fronted Goose *Anser erythropus* and Greater White-fronted Goose *Anser albifrons* in Latvia, up to August 2020

No.	Date	Observation	Observer
1	May 1 to 2, 2013	One adult in a flock of Greater White-fronted Geese at Druvenieki in staging area Lubāns	HKP
2	April 17, 2015	One adult male in a flock of 4 000 Greater White-fronted Geese in staging area Svēte flood-plain	HKP
3	April 25, 2019	One adult in a flock of Greater White-fronted Geese at Druvenieki in staging area Lubāns. The same individual as six years earlier	HKP

et al. 2000). The Scandinavian population bred south of the aforementioned population in Sweden and Norway, from the Torne River Valley (Gyldenstolpe 1911; Rosenius 1937) southwards to Lake Ånn (62°27'N, 12°57'E) (Persson 1930; 1943; 1946). In 1962 and 1963, the species also bred at Fokstumyra, Dovre (62°12'N, 9°27'E) (Haftorn 1971).

Migrations of the remaining individuals in the North Fennoscandian population have been well studied during the last few decades. Despite the fact that the results of these studies never have been put into any historical context, there are good reasons to accept them as representative of also the situation before the population crash. The only recovery of a leg-ringed bird from northernmost Sweden is, for instance, a bird that was ringed at River Lainio (68°24'N, 21°30'E) on July 15, 1953 and recovered at Stavropol (45°56'N, 43°15'E) on September 1, 1957 (Höglund 1962).

In the North Fennoscandian population, the birds after breeding move northwards to the Valdak Marshes (70°09'N, 24°54'E) in northernmost Norway for a short stop-over, then eastwards to the Kanin Peninsula (Lorentsen et al. 1998). After three to four weeks in the Kanin Peninsula, the birds split up; families leave in a south-westerly direction while the others leave in an east/south-easterly direction, heading for North-west Kazakhstan. Gradually, both groups reach their winter quarters in Greece (Tolvanen et al. 2009). In spring, the geese follow a more direct route, usually with stop-overs in Hungary, Estonia and at Oulu (65°00'N, 25°28'E) in Finland. From the Oulu region they make a non-stop flight to the Porsanger Fjord (70°12'N, 25°05'E). From the coast they return to their breeding grounds as these areas lose snow cover (Norderhaug,

Norderhaug 1984). In that way, Lesser White-fronted Geese that bred in northernmost Sweden arrived to their breeding grounds from the north in spring and started their autumn migration by flying northwards (Munsterhjelm 1911, 1913; 1916; Rosenius 1937). Earlier, when the birds were numerous, a substantial part of the population followed a route east of Finland, along Ladoga and Onega to the White Sea, and then further to the breeding areas (Munsterhjelm 1911; 1913; Hortling 1929; Norderhaug, Norderhaug 1984).

In the Scandinavian population, the geese after breeding and moulting followed the large river valleys that run in south-easterly direction, down to the coast (Palmén, Sahlberg 1868; Rosenius 1937; Hansson 2005). After staging for some time at the coast, the majority of the birds continued to Finland, most of them north of the Bothnian Bay or over Kvarken (Kampe-Persson 2009). When reaching Finland, the birds turned southwards in the direction of eastern Hungary. In spring, the birds followed the same route, but in the opposite direction. The only recovery of a bird ringed on the breeding grounds of this population before the releases of captive-bred birds started is of a bird ringed at Sitojaure (67°18'N, 18°11'E) on July 22, 1955 and recovered in Macedonia, Greece on February 7, 1956 (Höglund 1960).

The two Fennoscandian populations differ markedly in their choice of moulting sites. In 2006, three satellite-tagged Norwegian birds that failed their breeding attempts in Finnmark migrated 2800 km directly eastwards and moulted in the Taimyr Peninsula (Øien et al. 2009). In a similar study in 1997, three failed breeders migrated eastwards to moult, two in the area of Kolguyev Island and

Table 6. Observations of hybrids between Greater White-fronted Goose *Anser albifrons* and Barnacle Goose *Branta leucopsis* in Latvia, up to August 2020

No.	Date	Observation	Observer
1	April 28 to 30, 2017	One bird in a flock of Greater White-fronted Geese south-east of Gulbene, Stradi pagasts	HKP
2	April 24 to 25, 2019	One adult male paired to an adult Greater White-fronted Goose at Druvenieki in staging area Lubāns	HKP
3	March 29, 2020	One bird in a flock of Greater White-fronted Geese at Lake Zvidze in staging area Lubāns	Andris Klepers on www.dabasdati.lv
4	April 5, 2020	One bird in a flock of Greater White-fronted Geese at Lake Zvidze in staging area Lubāns	Andrejs Jesko on www.dabasdati.lv

Kanin Peninsula, and the third in the Taimyr Peninsula (Aarvak, Øien 2003). Although the material is limited, it seems safe to assume that most non-breeding individuals in the North Fennoscandian population carry out a longer eastward moult migration. In the Scandinavian population, on the other hand, the non-breeders have moulted in flocks numbering 20 to 1000 birds within or close to the breeding range (Löwenhjelm 1845; Nilsson 1858; Cnattingius 1868; Alphéraky 1905; Ekman 1922; Hortling 1929; Swanberg 1936; Rosenius 1937; Curry-Lindahl 1959; Scott 1961; Rudebeck 1962; Haftorn 1971; Rosenberg 1972; von Essen 1982; Svensson et al. 1999; Øien, Aarvak 2002; Ryd, Ryd 2017; Andersson 2019). There is only one known case of moulting outside Scandinavia (Andersson 2019). Since 1992, Lillfjärden (61°49'N, 17°06'E) in Hälsingland (Helsingia) has developed into the most important moulting site for this population (Fagerström 1992; Liljebäck et al. 2020). Formerly, the species was known in Sweden as *hälsinggås* / *helsingia* (Linnaeus 1758) due to its occurrence in Hälsingland, documented since May 1695 (Tyrberg 1993). Thus, the occurrence at Lillfjärden might be seen as a resumption of ancient traditions (Tyrberg 1995).

Presumably, the two populations immigrated from different directions, the North Fennoscandian from the east and the Scandinavian from the south-east (Curry-Lindahl 1959). A recent study, using samples from birds caught in the years 2004 to 2010, supports that view by showing no genetical differences between North Fennoscandian and Russian birds, while the Scandinavian birds differed from the others (Diez-del-Molino et al. 2020). In consequence, North Fennoscandian birds can be viewed as the westernmost part of the Russian population while the Scandinavian birds make up a separate management unit. The result is not without demur however, as the study lacked tests of samples from Scandinavian birds caught before any captive-bred birds were released.

The main migration direction in autumn mirrored the immigration route. However, in both populations, a part of the population left in a different direction, deviating about 90 degrees from that of the majority, already at the start of the first main leg. In the North Fennoscandian population, some birds head south already when leaving the Porsanger Fjord (Seppo Ekelund, personal communication). In September 2018, for instance, a transmitter-tagged bird covered in a more or less straight flight a distance of 3445 km between the Valdak Marshes and the wintering grounds in Greece in less than 84 h (Aarvak, Øien 2018). This is apparently not a new behaviour, because the species passed over all Finland more than a century ago (Alphéraky 1905). In the Scandinavian population, an unknown part of the birds did not cross over to Finland when leaving the autumn staging areas. Instead, they moved southwards to winter in the East Atlantic flyway (Kampe-Persson 2008). In the Netherlands, the species was regarded as a regular guest in small numbers in the 19th century (Schlegel 1878;

Snouckaert van Schauburg 1908), and rare in 1900 to 1968 with a total of 41 official records during the years 1908 to 1968, and at least 26 during 1969 to 1980 (Eykman et al. 1941; Kist et al. 1970; Van Impe 1982; van den Berg, Bosman 1999). Overall, historical data suggest that small numbers were present in December to February (Koffijberg et al. 2006). According to goose catchers (Polderdijk 2008), they did not appear to associate with Greater White-fronted Geese but arrived together with bean geese (Blaauw 1923). The species was regarded as a big nuisance by the goose catchers (Johan Mooij, *in litt*), indicating that the species must have been quite common in earlier times. Hunting bag statistics in Denmark in the 1960s (Fog 1977) indicate that the relative importance of this migration route markedly increased after the population crash in the 1950s (Kampe-Persson 2008). Very likely, all, or almost all, of the Scandinavian birds used this migration route when releases of captive-bred birds started in Sweden.

Occurrence in Latvia

Latvia has since long been situated along a main migration route for the Lesser White-fronted Goose, in both autumn and spring (Norderhaug, Norderhaug 1984). However, to get a picture of the migration through Latvia, it is necessary to make an outlook to other parts of the migration route. In addition, it sounds logical to present the data divided into three periods of time. (1) Up to the population crashes in the 1950s – the period of abundance. (2) The second part of the 20th century – the period of decline. In Finland, the last breeding pair was seen in the mid-1990s (Kahanpää, Haapanen 2009) and in Sweden, the last signs of breeding outside the release area were reported in 1996 and 1998 (Andersson 2019). (3) The last two decades – the period of recovery.

The period of abundance

In autumn, large-scale migrations of Lesser White-fronted Geese were noted along the western coast of Finland (Hortling 1929), over the Estonian islands and along the western coast of Estonia (Kumari, Jõgi 1972), over the eastern parts of East Prussia (Bauer, Glutz von Blotzheim 1968), over eastern Poland (Tomiałojc 1972) and over eastern Slovakia (Bauer, Glutz von Blotzheim 1968). Obviously, the Scandinavian birds, after arriving to Finland, flew more or less straight to their autumn staging areas in eastern Hungary. The geese must in such case have passed Latvia west of Riga. The distance from Oulu, the main staging area in Finland, and eastern Hungary is about 1900 km. Very likely, most birds covered this distance in a non-stop flight, as larger numbers of staging Lesser White-fronted Geese never were reported along this route. Narrow migration corridors as this one between Oulu and eastern Hungary are known for several goose populations (Freuchen, Salomonsen 1959; Andersson et al. 2001).

Most likely, large numbers of North Fennoscandian

birds, maybe also Russian, passed Latvia in autumn. Alphéraky (1905) reported autumn migration of this species also from the regions of Arkhangelsk, Olonets, St. Petersburg and Novgorod. These regions agree well with the route Norwegian transmitter-tagged birds followed in September 1995 and October 1997 (Lorentsen et al. 1995; Aarvak, Øien 2003). While the species was mainly observed in western Estonia in spring, autumn migration was observed also in the eastern part of the country (Leito 1994). Migration through eastern Estonia fits with a route starting in either North Norway or the Kanin Peninsula.

The migration route through western Latvia was used also in spring, at least by the Scandinavian birds, most of the North Fennoscandian birds and some Russian birds. Spring migration lasted in western Estonia from the last ten days of April until the second half of May, and the autumn migration from the beginning of September until the middle of October (Kumari 1954), with late migrants turning up until the end of November (von Toll 1987). All Latvian observations during the 20th century fell within these time windows.

Merikallio (1915) estimated that tens of thousands of Lesser White-fronted Geese passed Finnish Oulu in autumn. Add Scandinavian birds that crossed over to Finland south of Oulu, North Fennoscandian birds that followed a western route and some Russian birds and one gets a figure of the number that passed Latvia in autumn. Nobody knows how many they were, but Estonian estimates range from 10 000 to 50 000 birds (Onno 1965; Toming 2012). Without referring to a specific period, Kumari (1971) stated that the species migrated through the Baltics in some tens of thousands of birds. Of the 80 000 to 120 000 Lesser White-fronted Geese that staged in Hungary in autumn (Sterbetz 1982), some might have been North Fennoscandian and Russian birds that had migrated along an eastern route. However, it still sounds likely that the number passing Latvia could have been in excess of 50 000 birds, at least after good breeding seasons. Totals in spring were probably of the same magnitude as in autumn. It was, for instance, estimated that 10 000 to 20 000 birds staged annually during spring migration in the Finnish island of Hailuoto (65°01'N, 24°43'E) in the 1930s (Riihimäki 1999). Large numbers staged at this site also in the 19th century (Sandman 1892). Estimates of numbers are lacking altogether for North Fennoscandian birds following the spring-route via the White Sea. Based on the figures given above, the average number of Lesser White-fronted Geese passing Latvia in autumn and spring, respectively, in the first half of the 20th century must have been at least 30 000 birds.

Notwithstanding that tens of thousands of Lesser White-fronted Geese passed Finland in autumn and around 100 000 birds staged in eastern Hungary in the first half of the 20th century, the migrating flocks were quite small. Hortling (1929) reported the migrating flocks in Finland to vary

between some tens and 100 birds. In Hungary, most flocks numbered 10 to 20 birds, while an exceptionally large flock amounted to 200 birds (Sterbetz 1968). Migrating flocks in Latvia in the 20th century were of a similar size, while flocks seen during the last two decades were smaller (this study).

Though nothing is known about the numbers involved, the general pattern of occurrence in Latvia, with the main passage migration going west of Riga, as described above for the first half of the 20th century, was obviously the same from the late 18th century to the end of the 19th century (Beseke 1792; Meyer 1815; Lichtenstein 1829; Plater 1852; Russow 1880; Sawitsky 1899).

The period of decline

The population crashes in the 1950s were immediately noticed in the breeding areas (Ryd 2009). In a breeding area in the Westrobothnian mountains, where pre-nuptial flocks earlier numbered between several hundreds and almost one thousand birds, only some tens of birds were found during a special survey in 1956 (Delin et al. 1957). In the early 1970s, the species had become so rare that it was not covered by the large survey of breeding waterfowl in northern Fennoscandia (Haapanen, Nilsson 1979).

After having migrated through Latvia in five-digit numbers in both autumn and spring up to the mid-1950s, the number of Scandinavian birds passing Latvia quickly declined during the following decades. Very low numbers were probably reached already in the 1980s, maybe earlier, as not all Scandinavian birds migrated east of the Baltic Sea (Kampe-Persson 2008). The autumn migration through southern Finland ceased altogether after the 1950s (Haapanen 2012). In Estonia, the Lesser White-fronted Goose was a regularly passing spring and autumn migrant up to the 1960s but not a single bird was noted in the 1970s (Toming 2012). The number of North Fennoscandian birds passing Latvia also declined markedly after the population crash. However, for this population we can assume that Latvia was passed by most families in autumn and by almost the entire population in spring. The total number of Lesser White-fronted Geese staging at the Valdak Marshes in the springs 1990 to 2000 fluctuated around 60 birds, except in 1991 and 1998 when 97 and 84 birds, respectively, were found (Aarvak, Øien 1994; 2001). The Latvian passage migrants very likely also included Russian birds, migrating together with Greater White-fronted Geese and Tundra Bean Geese to wintering areas in North-West Europe (Koffijberg et al. 2006; Mooij, Heinicke 2008), or together with Greater White-fronted Geese to the Great Hungarian Plain (Tar, Hadarics 2009). In Lithuania, staging Lesser White-fronted Geese were mainly recorded in the Curonian Lagoon and the Nemunas River Delta area (55°18'N, 21°20'E) (Švažas 1996; Švažas et al. 1997; Stončius, Markkola 2000). Staging flocks numbering up to 800 birds were recorded in the 1960s. Three-digit flocks were recorded also in the 1990s, including 200 to

230 birds for about two weeks in autumn 1995. Inland, a flock of 107 birds was found 100 km east of the Nemunas River Delta on September 21, 1994 and a flock of 22 birds in the District of Kaunas on April 2, 1997. In Kaliningrad, 100 migrating birds were recorded in the spring of 2000 (Bulgakov, Grishanov 2001). These observations give an idea of the numbers passing Latvia. Overall, the number of Lesser White-fronted Geese annually passing Latvia in the 20th century declined from tens of thousands to only a few hundreds.

The 43 birds seen in Ozoli Bog (57°38'N, 25°00'E) on September 26 to October 4, 1996 were very likely North Fennoscandian. In such a case, they might have consisted of the successful part of the North Fennoscandian population that year. In late August, a total of 16 adults and 23 juveniles had been found staging at the post-breeding area in the Valdak Marshes (Aarvak et al. 1996). All transmitter-tagged North Fennoscandian birds that migrated through Latvia in autumn have passed next to Ozoli Bog (Lorentsen et al. 1998; Aarvak, Øien 2003; 2018). The three birds that passed Latvia in the 1990s, two in September 1995 and one in October 1997, might have made stop-overs, as the data of their passages of Latvia were undetailed. The first two, very likely migrating in the same flock together with 12 conspecifics, migrated from the Kanin Peninsula to Galenbecker See, north-eastern Germany (53°40'N, 13°45'E) (Aarvak et al. 1996; Lorentsen et al. 1998), while the third bird migrated from an area between Lakes Onega and Ladoga (61°28'N, 33°52'E) to a place north-west of Warsaw (Aarvak, Øien 2003).

The period of recovery

After a low in the 1980s, the Scandinavian population increased to about 120 birds and 15 to 25 breeding pairs in 2010. In 2012, half of the adults died during the breeding season due to heavy predation caused by White-tailed Eagle *Haliaeetus albicilla* and a high density of Red Fox *Vulpes vulpes* (Liljebäck, Andersson 2012). At the pre-nuptial counts in the Valdak Marshes, numbers decreased to about 30 birds in the years 2006 to 2010, before increasing to about 100 birds in 2016 (Aarvak et al. 2017). More than 100 birds were recorded on several occasions along the flyway from the wintering area in Greece (Vangeluwe 2005) to the Valdak Marshes in the years 2017 to 2020, with a maximum of 134 birds in Hortobágy National Park on March 27, 2017 (www.piskulka.net).

A marked change in the migration pattern of Lesser White-fronted Geese through Latvia took place in the last decade. The North Fennoscandian birds seem to have continued to migrate in about the same way as just before the turn of the millennium but in increasing numbers. A novelty is that a part of the Scandinavian population migrates east of the Baltic Sea in spring (Kampe-Persson 2015). The high number of re-sightings in the Nemunas River Delta (www.birdlife.lt), individuals shot in Belarus

in spring (Niklas Liljebäck, *in litt*) and the satellite-tagged and leg-ringed birds staging in Latvia (this study) indicate that the proportion of the Scandinavian population using this route might be quite large. Moreover, for those making stop-overs in Latvia, the period of stay lasts about one month (this study). In the traditional spring staging areas in Estonia, few North Fennoscandian birds ever arrive before the 18th of April, except in 2020 when 86 birds were observed on April 17 (www.piskulka.net). So, there are good reasons to assume that individuals turning up in Latvia before the 18th of April are either Scandinavian or Russian. In total, about 125 to 175 Lesser White-fronted Geese are passing Latvia in spring nowadays.

Determination of origin of Lesser White-fronted Geese in Latvia is a challenge when the birds are unmarked or only seen in flight. It is tempting to count all single birds as either Scandinavian or Russian and all others as North Fennoscandian. However, observations in Poland and Lithuania show that the spring-migration route through the Baltics is used by flocks of up to at least seven Scandinavian birds. Single-species flocks, on the other hand, seem to always be North Fennoscandian.

Svēte flood-plain is the only Latvian staging area where birds from both the North Fennoscandian and the Scandinavian populations have been observed. It is also the only staging area where the species was observed regularly during the last decade. However, except in 2016, the numbers were low. There are indications, however, that another staging area may have been used by birds from the North Fennoscandian population, at least during the years 2015 to 2018. The reason for the extremely narrow migration corridor used by the flocks seen passing Nākotne in 2015 to 2018 might be that the birds were heading for a specific stop-over site. The most likely destination in such a case would have been Ķemeri Bog (56°53'N, 23°28'E), situated 25 km north of Nākotne. It is a 6192 ha large raised bog with numerous small lakes (Račinskis 2004). The bog is part of the 38 165 ha large Ķemeri National Park. No field-work was carried out in that bog, as the central part of the bog has an extra high protection level (Strazds, Ķuze 2006). The fact that only a few Lesser White-fronted Geese staged in Estonia in the springs 2015 to 2018 (www.piskulka.net) immediately suggests that most North Fennoscandian birds may have stayed in Latvia those springs. During spring-staging, Lesser White-fronted Geese can alternate between two neighbouring staging areas (this study). Svēte flood-plain and Ķemeri Bog were maybe used in such a way.

Latvian bogs seem to be attractive to staging Lesser White-fronted Geese. In Ozoli Bog, a flock of 43 birds staged during more than a week in the autumn of 1996 (Aarvak et al. 1997). The species has on several occasions been reported from Teiči Bog (Avotiņš 2005). One Swedish transmitter-tagged bird used three different bogs as night roosts, maybe also for feeding, during two springs of staging in Latvia (this study). In Latvia, the species is, in

fact, counted among the bog species (Strazds 1996).

Spring-migration strategies through the Baltics differed markedly between the two Fennoscandian populations. The North Fennoscandian birds followed a more or less straight route from Hortobágy National Park in Hungary to Oulu in Finland with only short stop-overs, regularly in Estonia (www.piskulka.net), irregularly in Lithuania (www.piskulka.net) and Latvia (this study). The Scandinavian birds, on the other hand, made much longer stop-overs, often lasting about one month (this study). Therefore, it seems that these birds selected staging areas offering the best feeding conditions. The species has a very short bill and grazes efficiently on very short swards (Owen 1980). When Scandinavian birds arrived in Latvia in the second or third week of April, suitable vegetation to graze was much easier to find in the eastern part of the country, as the spring is much later there than in the western part (Draveniece 2007). This difference in spring-migration strategy explains why North Fennoscandian birds in this study only were found staging west of Riga, along the traditional migration route, while most Scandinavian birds were found staging either in staging area Svēte flood-plain or east of Riga.

The Lesser White-fronted Goose is hard to spot and count during field surveys, also by experienced observers, when occurring in flocks of other goose species, especially the Greater White-fronted Goose (for references, see Kampe-Persson 2008). However, also when occurring in single-species flocks, the species can be hard to spot, owing to a well-developed ability of concealment (Gábor Kovács personal communication; Gerard Ouweneel personal communication). To overcome these obstacles, different sampling methods have been used to obtain a measure of the total number of individuals in a region (Sterbetz 1982; Tolvanen et al. 2000a; Cuthbert et al. 2018; Rozenfeld et al. 2019). The field-work in Latvia was not done in a way that allows any such calculation. However, an indication of the total number of Lesser White-fronted Geese annually staging in Latvia in spring can be calculated by using the figure of one staging Lesser White-fronted Goose per 18 100 grey geese (this study). The total number of staging grey geese in Latvia in spring has been estimated to number at least 815 000 birds (Kampe-Persson 2020). In such a case for the springs 2007 to 2020, an average of 45 Lesser White-fronted Geese staged in Latvia, of which 15 were single birds. The correct interpretation of these averages is very likely, that about 15 birds from the Scandinavian population annually staged in Latvia, and that higher spring totals were reached in years when North Fennoscandian birds made stop-overs. Considering that a high proportion of all transmitter-tagged Swedish birds were staging in Latvia (Niklas Liljebäck, *in litt*), the average number of annually spring-staging Scandinavian birds may have been higher than 15 from 2011 onwards.

As only one of the transmitter-tagged birds staging in Latvia was checked in the field, the number of conspecifics

accompanying the others is unknown, except for the adult seen at Lake Laidze the day after Mr Blue left the site. An indication about other conspecifics accompanying Mr Blue can be found by checking observations made just before and just after Mr Blue turned up in Latvia (www.piskulka.net). When Mr Blue was seen in Poland on the 17th, it was in a flock of 35 Lesser White-fronted Geese. In the Estonian island of Hiiumaa, a flock of 109 Lesser White-fronted Geese was seen on the 22nd, at a place from where Mr Blue had been reported on the 21st. The number of 109 agrees with the flock of 111 birds seen in Hortobágy National Park on the 9th, as one bird remained in Hungary after the flock had left and one remained at Lake Laidze. Similar checks remain to be conducted for the Scandinavian transmitter-tagged birds that have staged in Latvia.

Hybridisation

Hybridisation has for two decades been one of the main discussion subjects regarding the conservation of the Lesser White-fronted Goose in Fennoscandia. In context with concerns about the genetic purity of the captive stocks used in the release programs, the occurrence of wild hybrids between Lesser and Greater White-fronted Goose was disputed (Ottvall 2008). Banks et al. (2008) stated that the Lesser White-fronted Goose is not known to hybridise in the wild, while Nijman et al. (2010) described two hybrids collected in 1936 and 1966. This discussion started by a comment by Peter Scott in *British Birds* 49 (1956): 229–230. Regarding hybrids between released male Lesser White-fronted Geese and naturalised or wild Barnacle Geese, there is a project trying to track down the whereabouts of these hybrids (Niklas Liljebäck, *in litt*). During the last two decades, the Scandinavian population has been accused of being genetically impure and to contain hybrids (Ruokonen et al. 2000; Jones et al. 2008; Aarvak et al. 2016). These accusations have one thing in common however, none of them was based on wild-caught birds. Instead, they were based on birds in captivity or referred to completely different populations. Therefore, the validity of the conclusions in the first publications have been put into question (Kholodova 2001; Nijman et al. 2010). A recent study, the first based on wild-caught birds, did not find the slightest evidence of hybridisation in the Scandinavian population (Diez-del-Molino et al. 2020).

Essential for identification of hybrids between Lesser and Greater White-fronted Geese, and the parent species as well, is a good knowledge of the individual variation in the two species. Both species vary greatly in body size. Of two Greater White-fronted Geese at Lake Lubāns in May 2019, one was only half the size of the other (Kampe-Persson, unpublished results). In addition, quite a number of Greater White-fronted Geese have a narrow yellowish or whitish eye-ring and some of them also dark head and upper neck (Tolvanen et al. 1999). Among Russian Lesser White-fronted Geese, some individuals have quite large

bills (Christer Larsson, personal communication). Both hybrids reported in this study had a bright yellow orbital ring and a white front going up on the head. For both birds, the identification was confirmed by their calls, which were almost identical to that of a Lesser White-fronted Goose and markedly different from that of a Greater White-fronted Goose. Birds with such morphological characters are typical for the hybrid offspring of a male Lesser White-fronted Goose and a female Greater White-fronted Goose (Nagy 1950).

A strong pattern of natal female philopatry and male dispersal is the norm in geese and swans (Clarke et al. 1997). When dispersing Lesser White-fronted Goose males amid declining populations had problems in finding a mate, some males apparently paired up with Greater White-fronted Geese females. Hybridisation during such conditions is in accordance with the “Best-Option-Hypothesis”. Instead of giving up breeding altogether, the bird mates with an individual of another species (Hubbs 1955). So, it was probably more than a coincidence, that the first mixed pair was observed during the time of the large crashes of the Fennoscandian populations. At Slimbridge (UK) in the winter 1956, a rather small adult male Lesser White-fronted Goose was mated to a female Greater White-fronted Goose with two young (Scott, Boyd 1956). That hybridisation can occur in a similar way among range-expanding species was shown for swan species in the Baltic Sea region (Kampe-Persson, Boiko 2011).

Of 117 1st-calendar-year Lesser White-fronted Goose males released in Sweden in 1981 to 1999, six paired up with Barnacle Geese and produced hybrids (Kampe-Persson, Lerner 2007; Andersson 2019). The hybridising Barnacle Geese belonged to the naturalised population in the Baltic Sea region (Kampe-Persson 2010b). Other released Lesser White-fronted Goose males followed wild Barnacle Geese to the Russian breeding grounds. It is not known how many they were but probably more than six. There are at least four observations of spring-staging birds among Barnacle Geese in Estonia (Lilleleht, Leiback 1991; Leito 1994; Pehlak, Lilleleht 1998; Tolvanen et al. 2004), and three males were reported dead in Russia at the age of three, eight and eleven years, respectively (Andersson 2019). There are no indications of any hybridisation of these birds in Russia. In fact, it seems that wild Barnacle Geese rarely hybridise with *Anser* geese. Hybrids between Barnacle Goose and Greater White-fronted Goose are, for instance, rarely found in Germany (Randler 2000), Sweden (Kampe-Persson, Lerner 2007) or Latvia (this study). The origin of the few hybrids found may have been the Malozemelskaya and Bolshezemelskaya tundra, Russia, where both mixed broods and hybrids have been recorded (Oleg Mineev, personal communication).

The Lesser White-fronted Goose males that became imprinted on Barnacle Geese and the hybrids produced between these two species associated with the latter species

and became a part of the naturalised Barnacle Goose population. By that, they were never a threat against the Lesser White-fronted Goose. These hybrids were never a part of the Scandinavian Lesser White-fronted Goose population as Aarvak et al. (2016) falsely stated.

Hunting

The open hunting season for geese in Latvia is September 15 to November 30. Allowed species are Taiga Bean Goose, Tundra Bean Goose, Greater White-fronted Goose, Greylag Goose *Anser anser* (since 2008) and Canada Goose *Branta canadensis* (since 2008) (Viksne 2014). Up to the mid-1980s, also the Lesser White-fronted Goose was an allowed species, and there was also an open season in spring, from the arrival of the geese until 10 May. So, still in the early 1980s, the Lesser White-fronted Goose could be hunted during the entire autumn and spring migration periods (Lampio 1983). In the spring of 2020, 140 farmers received licenses to kill a total of 1000 staging geese to mitigate crop damage (www.daba.gov.lv). The main problem for the Lesser White-fronted Goose is its similarity in appearance to the Greater White-fronted Goose, making it very difficult for hunters to separate the two species (Øien et al. 1999), and particularly as the two species often occur in mixed flocks. Therefore, the Lesser White-fronted Goose faces the risk of being shot by mistake or by inexperienced hunters as long as there is an open season on its relative or when licences are issued to shoot its relative for mitigation of crop damage.

Even though the Lesser White-fronted Goose was a passage migrant in large numbers in the past, there is no indication of it being a common staging bird in the 20th century. Of about 400 geese hunted and bagged in Cena Bog, Livbērze and Lake Babīte, along the species' main migration route, in the years 1926 to 1928, there were three Lesser White-fronted Geese (Hans Stack in von Transehe 1965). If this proportion of Lesser White-fronted Geese in the goose hunting bag (0.75%) was representative for the entire country in the first half of the 20th century, the hunting pressure on this species must have been insignificant in Latvia. The corresponding proportions among bagged and identified grey geese in Denmark in the years 1961, 1965 and 1966 were 0.33, 0.08 and 0.59%, respectively (Fog 1977). These figures are surprisingly similar to the Latvian, despite the fact that the Lesser White-fronted Goose was a numerous passage migrant in Latvia (this study), but counted as a stray vagrant in Denmark (Fog 1977). In Hortobágy, eastern Hungary, in the first half of the 20th century, 6 to 8% of the total hunting bag (12 000 to 14 000 geese) was made up of Lesser White-fronted Geese (Szomjas 1920; Szomjas 1926; Tarján 1931; Graefel 1934; Sterbetz 1982).

Nowadays, when Scandinavian birds migrate west of the Baltic Sea in autumn and North Fennoscandian birds usually pass Latvia without staging, very few Lesser White-

fronted Geese are ever exposed to hunting during the open season for geese in Latvia. Thus, it is not surprising that no Lesser White-fronted Goose has been reported hunted in Latvia since 1998 (this study). However, birds shot by mistake may not have been correctly identified by the hunters (cf. von Transehe 1965). In the last few autumns, about one tenth of the hunted geese were properly checked within a hunting bag study (Kampe-Persson, Boiko 2019).

During the last few decades, especially after joining the European Union in 2004, the Latvian agriculture was modernised and it is now largely quite similar to that in western and central Europe. Contemporaneously, especially during the last few years, Latvian farmers started to complain about crop damage caused by geese (Keišs 2019). The main problem was, very surprisingly, the growing of field bean *Vicia faba*. It has been shown, that bean geese in captivity reject all kinds of beans as food (Leo van den Bergh, personal communication). So, it came as a surprise, when geese started to feed on field beans, just after that the beans had germinated. The reason was that germination makes the beans soft and palatable, at the same time as it is easy for the geese to follow the rows and find the beans. To mitigate this damage, farmers wanted to hunt geese in spring (Keišs 2019). After discussions with the authorities, 350 farmers wanted licenses to shoot 20 geese each and finally, 60 farmers got licenses for 10 geese each and 80 farmers got licenses for five geese each (www.daba.gov.lv). Allowed species were Taiga Bean Goose, Tundra Bean Goose, Greater White-fronted Goose and Canada Goose. To mitigate damage in also cereal fields, licences were valid March 15 to May 31 (Jēkabs Dzenis, *in litt*). The licensed hunters' total bag was 25 bean geese and 45 Greater White-fronted Geese but no Lesser White-fronted Goose (Jēkabs Dzenis, *in litt*).

The number of hunted birds is not the only factor to take into account however, as the species can be affected also indirectly. Disturbance caused by hunting at staging sites during spring migration can have large negative impacts on the breeding performance (Nilsson, Persson 1996). The indirect effects might even be much larger than the direct ones (Persson 1999).

Conservation implications

The opinion that official records of a taxon give a good representation of the true occurrence is often hampering the conservation of threatened bird taxa, as the case was with the Slender-billed Curlews *Numenius tenuirostris* wintering in Doñana National Park (Blanco, González 1992). The fact is, that official records mainly describe actions of the bird-watchers and only to a small extent that of the birds (Persson 1997). The Lesser White-fronted Goose in Latvia is a good example of that. The accumulated number of birds of this species passing Latvia in the first half of the 20th century was in excess of three million (this study). Of these, only 12 individuals (< 0.0004%) were accepted

in the official records (www.putni.lv). The corresponding percentage during the second half of the 20th century and the first years of the 21st century was higher but still only a fraction of a percent. When systematic surveys started in Latvia, these revealed that the Lesser White-fronted Goose was not only a passage migrant but also a regular staging bird (this study). In which numbers the species stages are not known, as the searches have been on a low scale and geographically skewed. The fact that the species is annually staging in at least one IBA in Latvia motivates, however, the inclusion of Latvia among the Principal Range States at next up-date of the International Single Species Action Plan for the Lesser White-fronted Goose.

For fulfilment of Latvia's international obligations regarding this threatened species, more detailed data are needed. Studies to establish if also other staging areas than Svēte flood-plain regularly are used by this species must be given a high priority. Another study of importance is to reveal if Svēte flood-plain is used by any Lesser White-fronted Geese that are both roosting and feeding in the nature reserve and for that reason never observed. To safe-guard that necessary studies are carried out within reasonable time, Latvia should start financially supporting the most urgent field-work.

Furthermore, the results of this study prompt the following modifications of future issuing of licenses for the shooting of geese for mitigation of crop damage:

(1) No licences ought to be issued in the feeding grounds of the staging area Svēte flood-plain for the period April 8 to May 13, as this is the time when the area annually houses staging Lesser White-fronted Geese.

(2) No licences ought to be issued in Courland (Kurzeme) for the period April 14 to 20, as this is the week when larger numbers of North Fennoscandian birds might be staging there.

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