

Threatened to least concern and after: the Barnacle Goose *Branta leucopsis* in Latvia

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Abstract

In Latvia, the Barnacle Goose *Branta leucopsis* was, except for a period in the first half of the 19th century, reported to be rare or relatively rare from the late 18th century to about 2010. The marked change in conservation status from threatened in 1985 to least concern in 2000 was due to better knowledge about the situation at the Russian breeding grounds and had nothing to do with the occurrence in Latvia. Since the first flock ever of at least 100 individuals was observed in April 2007, the number of spring-staging birds has shown a steady increase. In 2021, numbers reached 5000 birds in the Svēte flood-plain staging area and more than 10 000 in the country as a whole. Numbers were lower in autumn. There are no recoveries or re-sightings of marked individuals indicating the origin of the staging birds. The increase in numbers in Latvia coincided with a marked decline in importance of the islands in the Baltic Sea for breeding and spring-staging Barnacle Geese.

Key words: Barnacle Goose *Branta leucopsis*, Latvia, staging.

Introduction

Three populations of Barnacle Goose *Branta leucopsis* were known until 1970 (Owen 1980). One bred in eastern Greenland and wintered in western Scotland and Ireland, another bred on western parts of the Spitsbergen archipelago and wintered on the Solway Firth in northern Britain and the third bred in Novaya Zemlya and Vaygach Island and wintered in The Netherlands. Only birds from the last-mentioned population could be expected to turn up in Latvia.

Since 1970, a Baltic population was established and built up to at least 100 000 birds (Kampe-Persson 2010). In 1971, a successfully breeding pair was discovered on Laus Holmar, an island off the eastern coast of Gotland (Beinert 1982). From 1978 onwards, local populations were established in other Swedish provinces and by 2001, the species had been recorded breeding in all Swedish provinces except Lapland (Bengtsson 2007). Ten years after the first Swedish breeding record, the first breeding pair was found in Estonia (Leito 1993). The Estonian population increased to 189 pairs in 1999, and a close correlation was found between the number of Barnacle Geese staging in spring and the number of pairs breeding the same year (Leito, Truu 2008). In other countries, the species started to breed as follows: Finland 1978 (Koskimies 1983), Norway 1979 (Bengtson et al. 1994), The Netherlands 1982 (Feige et al. 2008), Belgium 1980s (Feige et al. 2008), Germany 1988 (de Vries 1990), Denmark 1989 (Meininger, van Swelm 1994), Russian part

of the Gulf of Finland 1995 (Kouzov et al. 2018) and France 2001 (Dubois 2007). This population is now breeding from the northernmost parts of the Bothnian Bay to northern France, mainly along the coast but also inland, especially in Sweden, Finland, The Netherlands, Belgium and Germany (Walker, Clewley 2020).

While the Baltic population increased and expanded its breeding range, the Russian population expanded westwards, reaching Shoina (67°50'N, 44°10'E) at the White Sea in the early 1980s (Filchagov, Leonovich 1992). Notwithstanding that the Baltic population is naturalised (Kampe-Persson 2010), these two populations are usually treated as one. The combined population increased from 10 000 birds in the early 1950s to 1.3 million in 2021 (Table 1).

In the Latvian Red Data Book, the Barnacle Goose was listed as threatened in 1985 (Andrušaitis 1985; Lipsbergs 1985), but not mentioned at all in the following version (Andrušaitis 2000). This change in conservation status from the highest to the lowest category gives occasion to several questions about the occurrence of the species in Latvia, such as: What happened during the last two decades of the 20th century? What has happened during the first two decades of the 21st century? What will happen during the years to come?

The aim of this study was to describe the occurrence of the Barnacle Goose in Latvia, both historical and recent, and by putting the Latvian data into an international context address the questions given above.

Table 1. Estimates and counts of the Russian/Baltic Barnacle Goose *Branta leucopsis* population. *, only imputed numbers for Germany as no census data were available

Year	Estimate/count	No. of individuals	Reference
Early 1950s	estimate	10 000	Boyd 1961
1960	estimate	20 000	Boyd 1961
1975	estimate	40 000	Ebbinge et al. 1975
1997	estimate	267 000	Ganter et al. 1999
2008	estimate	770 000	Fox et al. 2010
2015	estimate	1 200 000	Jensen et al. 2018
2019	count*	1 399 000	Heldbjerg et al. 2021
2020	count*	1 432 000	Heldbjerg et al. 2021
2021	estimate	1 300 000	Ganter 2021

Materials and methods

During searches for staging Lesser White-fronted Geese *Anser erythropus* in Latvia in the springs 2007 to 2021 (Kampe-Persson 2020b), all staging Barnacle Geese were noted. Field-work started in March but was most intense from April 10 to May 10. Most of the field-work was done during one-day trips (Table 2). 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 and 2021, the field-work was geographically restricted by the COVID-19 pandemic. Field-work in the autumns 2007 to 2021 was of an occasional character.

Each staging Barnacle Goose flock was, if possible, designated to a staging area. A 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 Svēte flood-

plain staging area 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 the 931 hectares nature park Svētes paliene (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 2014). Due to no admittance during the period March 1 to June 1, feeding and day roosting geese in the protected area could only be counted when the geese were close to the dyke.

For actively feeding Barnacle Geese the field type was noted. To avoid disturbing the birds the field type was determined from a distance, which limited how detailed the field type could be identified. It was, for instance, rarely possible to identify the crop in a newly-sown field. Likewise, it was sometimes difficult to distinguish between natural and cultivated grasslands. Only data from the years

Table 2. Number of field trips, visited staging areas, checked grey geese *Anser* sp. and staging Barnacle Geese *Branta leucopsis* found, total number in the left column and number of feeding in the right column, during searches for staging Lesser White-fronted Geese *Anser erythropus* in Latvia in the springs 2007 to 2021. All field-work done by the author. *, total number of different staging areas visited during the springs 2007 to 2021

Year	No. of field trips	No. of visited staging areas	No. of checked grey geese <i>Anser</i> sp.	No. of found Barnacle Geese	
				Total	Feeding
2007	2	4	4 000	100	100
2008	17	2	57 200	4	4
2009	13	3	7 275	0	0
2010	10	1	6 658	0	0
2011	17	2	34 900	0	0
2012	20	1	139 100	336	336
2013	15	35	60 000	350	242
2014	32	5	35 500	510	10
2015	38	5	155 000	8 000	7 908
2016	42	7	72 257	837	14
2017	52	28	211 000	1 250	1 229
2018	41	16	80 904	1 162	53
2019	49	23	288 000	2 187	2 006
2020	64	13	248 000	11 000	4 916
2021	52	23	240 771	12 353	5 191
Total:	464	109*	1 640 565	38 089	22 009

2015 to 2021 were used, as the sample sizes were very small in the years 2007 to 2014 (Table 2). Overall sample size for actively feeding birds in the years 2015 to 2021 (expressed in goose-days) was a simple summing-up, excluding double-counts within but not between days, of all observed feeding Barnacle Geese those springs.

Latvian and international publications from the late 18th century onwards, and the web site www.dabasdati.lv as well, were thoroughly searched for information about the Barnacle Goose in Latvia. The Latvian Ringing Centre was contacted for recoveries of foreign-ringed Barnacle Geese in Latvia, while Kjell Larsson and Henk van der Jeugd were contacted for observations in Latvia of Barnacle Geese fitted with leg-bands or satellite transmitters. For further information about transmitter birds, Chiel Boom and Sander Moonen were consulted.

Turn-over rate of individuals at the different staging areas was assumed to be low. That assumption was not possible to corroborate by proper calculations, however, due to lack of individually marked birds, but it was supported by indirect evidences. The spring-staging in the different staging areas showed a unimodal pattern (having only one peak). The length of stay for easily identified individuals, hybrids between Barnacle Goose and Red-breasted Goose *Branta ruficollis* and Red-breasted Geese that associated with Barnacle Geese were similar to the period when the majority of the Barnacle Geese in that staging area were present. Even the unusual long lapse between the peak count of 4965 birds in the Svēte flood-plain area on April 11, 2021 and the time when the last 1000 birds left the area on migration on May 15 to 18, a period of 34 to 37 days, agrees with the normal length of stay for Barnacle Geese spring-staging in Gotland and the Estonian islands up to the first half of the 1990s, more than five weeks (Eichhorn et al. 2009).

Results

All but one of the historical sources reported the Barnacle Goose in Latvia as rare (Kawall, Merkel 1846; Russow 1880; von Löwis 1893; Tauriņš, Vilks 1949; von Transehe 1965; Kumari 1971; Mednis 1983; Avotiņš 2005; Strazds, Ūze 2006), relatively rare (Vīksne 1986; Baumanis, Klimpiņš 1997) or did not mention the species at all (Fischer 1778, 1791; Beseke 1792; Meyer 1815; Hummel 1855; Goebel 1873; Cramp, Simmons 1977; Račinskis, Ūerus 2007). The species was mainly found along the coast (Russow 1880; von Transehe 1965; Baumanis, Klimpiņš 1997) or in coastal lakes (Baumanis, Klimpiņš 1997) and more often in the western part of the country (Mednis 1983). The number of birds passing Latvia had not been determined however (Andrušaitis 1985). Lichtenstein (1829), on the other hand, stated that the species by no means was rare in Courland. The species, named Nonne by the hunters, was found in Courland the whole summer, but the author did not know

if it was breeding there.

The Svēte flood-plain developed during the last decade into the main spring-staging area for Barnacle Geese in Latvia. It was at this site, the first Latvian spring-staging flock ever of at least 100 birds was observed on April 26, 2007. The annual peak counts showed a more or less constant increase onwards from 2010, reaching nearly 5000 birds in 2021 (Fig. 1). The first flock often arrived in the middle of March, the main influx took place during the second and third week of April, numbers peaked in late April and early May, and all birds were usually gone by May 10. In 2021, the main influx occurred already in the first week of April, the number peaked the following week and there were 1000 birds still present on May 15.

The largest reported staging flock outside the Svēte flood-plain area was 4200 birds at Kuiviži on April 30, 2018 (Andris Klepers on www.dabasdati.lv). This is, however, the only reported flock numbering more than 100 birds in that staging area. Besides the Svēte flood-plain and Kuiviži, peak counts in spring exceeding 100 birds have been recorded in 11 staging areas, most of them situated close to either the Baltic Proper or Gulf of Riga (Fig. 2). In most staging areas, the highest number of Barnacle Geese was noted in 2021.

In autumn, peak numbers of more than 100 Barnacle Geese have been reported from nine staging areas, two at Gulf of Riga, four at the Baltic Proper and three inland (Fig. 2). The largest flock, numbering about 800 birds, was seen outside Ventspils on November 17 to 18, 2018 (Edgars Smislovs on www.dabasdati.lv). The first flocks arrived during the second half of September, but the main staging period was October and November, in the latter month mainly in staging areas close to the Baltic Proper. The November flocks sometimes remained into December or even January.

Grasslands, natural as well as cultivated, dominated with 58% the field choice of the Barnacle Geese in Latvia in spring (Fig. 3). About 8.5% of the geese were found in stubble fields, mainly of maize, 1.5% in winter cereals,

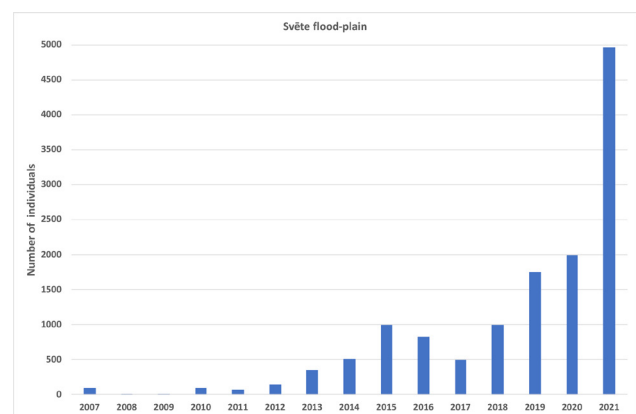


Fig. 1. Annual peak counts of staging Barnacle Geese *Branta leucopsis* in staging area Svēte flood-plain in the springs 2007 to 2021.

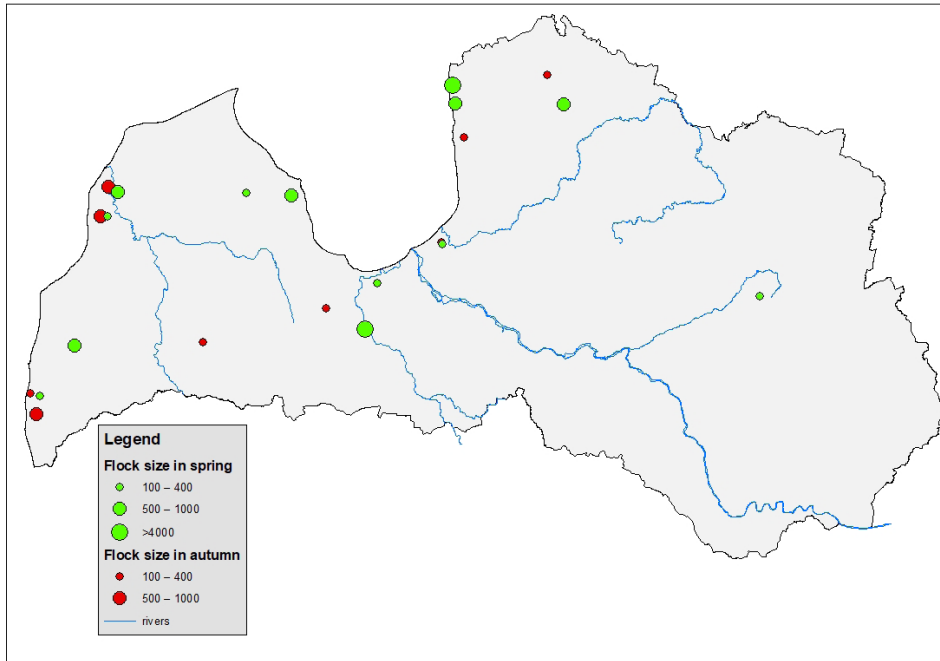


Fig. 2. Map of Latvia showing staging areas where peak counts of at least 100 Barnacle Geese *Branta leucopsis* have been recorded in spring and autumn, respectively, in 2007 to 2021.

17.0% in harrowed or newly-sown fields and the remaining 15.0% in sprouting spring cereals. Only a few individuals were once found feeding in no-tilled winter rape. From March to May there was a gradual switch (data not shown) from grasslands, stubbles and winter cereals to harrowed and newly-sown fields and finally, just before the geese left Latvia, to spring cereals.

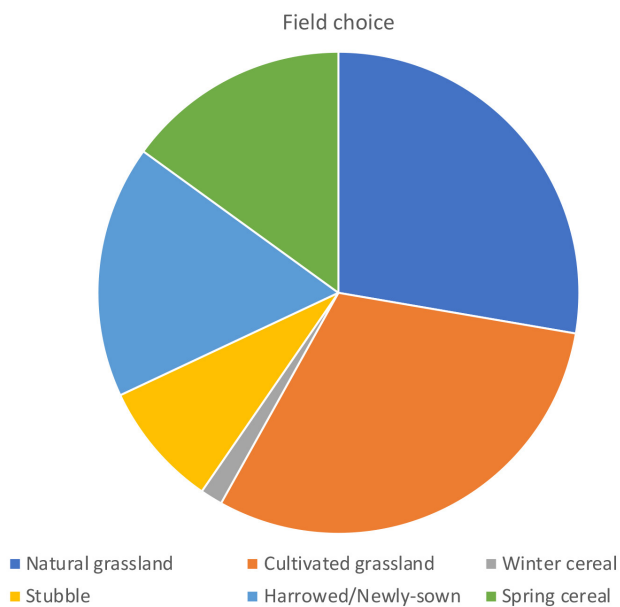


Fig. 3. Field choice of spring-staging Barnacle Geese *Branta leucopsis* in Latvia in 2015 to 2021. Sample size = 21 317 goose-days.

There are no recoveries of Barnacle Geese marked with conventional metal rings in Latvia (Edmunds Račinskis *in litt.*) and only one re-sighting of a leg-banded bird (Lisenka de Vries *in litt.*); a male, ringed at Utrecht, The Netherlands, on January 24, 2018, was seen north-east of Ādaži from October 5 to 7, 2018. None of ten birds equipped with transmitters in Russia flew over Latvia during their autumn migrations (Chiel Boom *in litt.*). Of 51 birds fitted with transmitters by Nelleke Buitendijk in The Netherlands, one flew over the Latvian Baltic Sea coast on May 23, 2019, while four birds flew over/along the Latvian Baltic Sea coast on April 4, May 13 and May 16, respectively, 2020 (Chiel Boom *in litt.*). Other migrations by these five birds, and all migrations by the other birds as well, followed routes north-west of Latvia. In a third study of transmitter-tagged birds, one bird migrated over northernmost Latvia and staged from the evening of October 24 to the evening of October 28, 2018, another bird crossed Courland from Liepāja to Kolka Cape while a number of birds flew along the Latvian Baltic Sea coast (Sander Moonen *in litt.*). As in the other two studies, the vast majority of all migrations followed routes north-west of Latvia. Of 80 individuals fitted with transmitters at Nordkehdingen, Lower Elbe, north-westernmost Germany and followed during their pre-nuptial migrations, one passed close to Kolka Cape while the others followed routes north-west of Latvia (Kruckenberg 2021).

Since 2001, the Barnacle Goose has regularly passed Kolka Cape in north-western Latvia on migration, in both spring (March to May) and autumn (mid-September to mid-November). The species was most numerous in May,

when the daily total of many small flocks could amount to several thousand birds (Matrozis 2020). The highest day count was 7479 birds on May 4, 2020 (Andris Klepers on www.dabasdati.lv). Spring counts of 600 birds or more have also been reported from the Baltic Sea coast between Pape and Kolka Cape. The autumn migration at Kolka Cape peaked at the end of September, with daily totals reaching 600 to 1000 birds (Matrozis 2020).

Discussion

In the early 19th century, Barnacle Geese regularly staged in large numbers along the coast of southernmost Sweden (Nilsson 1817; Nilsson 1835) but stopped doing so in the 1850s (Fabricius 1962). During the following 150 years, the species was rare or relatively rare in that area (Kampe-Persson 2013). This period of abundance in southernmost Sweden coincided with Lichtenstein's statement (1829), that the species by no means was rare in Courland. The Barnacle Goose was not mentioned in the following two accounts from Courland (Hummel 1855; Goebel 1873). One feature of the Barnacle Goose is unexpected changes in its migration pattern. The species can abruptly start using a new staging area only to as suddenly stop using it (Owen 1980). That seems to have happened in both southernmost Sweden and in Courland in the first half of the 19th century. In the Estonian islands and West Estonia, on the other hand, the species has been staging in large numbers ever since the beginning of the 19th century (Kumari 1971).

The summering Barnacle Geese in Courland in early 19th century (Lichtenstein 1829), were probably birds that remained due to injuries or bad condition. These birds can be viewed also in another context however. The readiness with which the Barnacle Goose built up a large breeding population in the Baltic Sea, as soon as it had started breeding, has given rise to speculations, that the Baltic Sea region maybe once was a natural part of the species' breeding range (Svensson et al. 1999). The species' extreme vulnerability to hunting might in such case have contributed to its extinction, whereafter hunting and persecution effectively prevented establishment until the species became protected. Lichtenstein (1829) mentioned, in fact, that he did not know, if the species was breeding in Courland, even though that sounds unlikely.

As no increase in the number of Barnacle Geese in Latvia was noted during the last decades of the 20th century, the marked change in conservation status between 1985 and 2000 must have had another explanation. Evidently, the status in the Latvian Red Data Book of 1985 was a mere reflection of the official view on the Russian population. Stepanyan and Gladkov (1969) had stated that the situation was very threatening, as the population had declined extremely much and needed full protection. In 2000, on the other hand, it was known, that the average annual increase in the Russian population had been approximately seven

percent between 1960 and 1997 (Ganter et al. 1999) and by that, there was no reason to list it in any Red Data Book.

Recent occurrence in Latvia

In autumn, Russian Barnacle Geese migrate through the White Sea, lakes Onega and Ladoga, the Gulf of Finland, West Estonia and the Estonian islands, Gotland and Öland, and southernmost Sweden, and in spring, in the opposite direction (Owen 1980; Ganter et al. 1999; Heldbjerg et al. 2021). Irbe Strait, the sound between Estonian Saaremaa and Latvia, makes up the south-eastern flank of this migration corridor. Thus, Barnacle Geese migrating along the Latvian Baltic Sea coast, over north-westernmost Courland or along the eastern coast of Gulf of Riga follow a slightly more southern route than the vast majority. All transmitter birds found migrating along the Latvian Baltic Sea coast or over north-westernmost Courland only did it once, the main migration corridor being used during all other migrations (*Chiel Boom in litt.*). Consequently, it seems as they turned up at the Latvian Baltic Sea coast unintentionally. The fact that they moved northwards to the main migration corridor when reaching the Latvian Baltic Sea coast in spring, supports that view. Wind drift might be the reason for birds ending up south of the main migration corridor (cf. Green 2001), and that is very likely also the reason behind flocks ending up making short stop-overs in staging areas close to the Latvian Baltic Sea coast or the eastern coast of Gulf of Riga.

Except for the above-mentioned staging flocks, and providing that the assumption of a low turn-over rate is correct, the vast majority of all staging Barnacle Geese in Latvia arrived intending a longer stop-over. That applies to those encountered in the Svēte flood-plain staging area, very likely also for those found at lakes Engure, Babīte, Burtnieks and Lubāns, and probably also to some other flocks. A third group of staging Barnacle Geese in Latvia was made up of individuals that migrated and staged together with Anser geese. The size of the Latvian spring-staging population was recently estimated to be in the range 4000 to 10 000 birds (Kampe-Persson 2020a). In 2021, the number amounted to more than 10 000 birds (this study), corresponding to almost one percent of the total flyway population.

Origin of staging Barnacle Geese

It is not possible to trace the origin of Barnacle Geese staging in Latvia directly, as there are no recoveries or re-sightings of marked individuals in Latvia linked to a breeding ground (this study). Thus, indirect evidences have to be used. The number of staging Barnacle Geese started to increase around 2010 (this study), i.e. after that the species had established breeding colonies in the Baltic Sea region. The fact that the increase in Latvia might be directly or indirectly related to the existence of this new breeding population urges for a closer look at the establishment and

development of the Baltic population.

Since the late 1960s, or maybe from the mid-1950s, a free-flying semi-captive Barnacle Goose population has bred at the out-door museum Skansen in Stockholm (Palm 1975; Brusewitz, Ekman 1995). In spring, they evidently followed Russian Barnacle Geese from The Netherlands to the staging areas in Gotland before taking off in the direction of Stockholm (Palm 1980). The first reported case of dispersal among breeding areas in the Russian/Baltic flyway took place in about 1976 to 1978 and was of five unmarked birds, assumedly originating from Novaya Zemlya, or maybe Gotland, that paired to Skansen birds started to breed at Skansen (Palm 1980). Colony establishments in both Sweden (Brusewitz, Ekman 1995) and Finland (Hildén, Laine 1991) were initiated by birds from Skansen. Thus, a free-flying semi-domestic Barnacle Goose population existed in the Baltic Sea region already before the first breeding record in Gotland, a fact often overlooked.

The origin of the Barnacle Geese that founded the breeding population in Gotland is not known. The first time the breeding birds were checked for rings was in 1979, eight years after the first breeding record, when no ringed birds were found (Larsson et al. 1988). The first breeding pair was extremely tame, while the geese staging in the very same area were extremely shy and impossible to approach (Brusewitz 1984). This marked difference in shyness between the breeding and staging birds strongly indicates captive or semi-captive origin of the first breeding pair. Often, it is assumed that the founders originated from the Russian population (Feige et al. 2008). However, for Russian birds to start breeding in Gotland, they had to overcome several obstacles. That would have entailed a dispersal by more than 2000 km, a change from Arctic to temperate climate, a change from nest sites on cliff ledges to ground nesting and a change to other food species during brood-rearing. Further, to offer their young good rearing conditions the birds needed to adapt to a much earlier peak in food availability (van der Jeugd et al. 2009). Free-flying semi-captive Barnacle Geese, on the other hand, had already adapted to the earlier peak in food availability and had already managed the other changes. The fact that semi-captive birds could start nesting while large numbers of Barnacle Geese were staging in Gotland might have been of crucial importance. In Gotland, Barnacle Geese started to arrive in late March and early April and remained until 18 to 25 May, when most of them left (Beinert 1982). Fleischer (2001) envisaged another origin of the founding pair. In Gotland during the years 1942 to 1967, farmers were allowed to shoot staging Barnacle Geese as a preventive of damage on planted and sown fields (Thelander 1982). Other Barnacle Geese were shot to obtain birds for captive breeding and specimens for stuffing (Fleischer 2001). These activities resulted in a number of winged birds, which had to summer along the east coast of Gotland and which

could have bred there (Fleischer 2001). However, for such a scenario to work too many requirements had to be fulfilled at the same time to make it feasible. Kjell Larsson (*in litt.*) arrived at the same conclusion. As the main spring-staging areas in Gotland have been used by Barnacle Geese since 1911 (Wibeck 1946) and coastal areas grazed by domestic animals suitable for brood-rearing have been available since pre-historic time (Förare 1982), it is probably no coincidence that the species did not start to breed until a free-flying semi-domestic population existed. Taking all facts into account, Kampe-Persson (2010) concluded: "Without releases and escapes from captivity, there had, in all probability, been no breeding colonies of the Barnacle Goose in temperate areas today."

After having increased from one pair in 1971 to just over 5000 in 2001 to 2005, the number of breeding pairs on Gotland declined to about 200 in 2020 (Kjell Larsson on www.jagareforbundet.se). The development was similar in Estonia, an increase from one pair in 1981 to 189 in 1999 followed by a decrease to 80 in 2006, (Leito, Truu 2008). These declines were mainly caused by avian predators; in Estonia by White-tailed Eagle *Haliaeetus albicilla* and in Sweden by large gulls like Herring Gull *Larus argentatus* and Greater Black-backed Gull *Larus marinus* as well as White-tailed Eagle (Feige et al. 2008). The White-tailed Eagles influenced not only the breeding geese. Up to the first half of the 1990s, more or less the entire Russian population staged for more than five weeks in spring in Gotland and the Estonian islands (Eichhorn et al. 2009). During the following decade, an increasing proportion of the flyway population delayed their departure from the wintering grounds by one month and reduced their stay in the Baltic Sea to less than seven days. Predation danger was very likely behind this change, because there are much fewer White-tailed Eagles in The Netherlands than in the Baltic Sea (Jonker et al. 2010).

At about the same time as this shift in spring-staging strategy took place, the Barnacle Goose started to make stop-overs in the Svête flood-plain staging area (this study). This can be viewed as an alternative strategy, and it might be a profitable one, even though there are White-tailed Eagles also at this site. Latvia is situated about 1000 km closer to the breeding grounds than The Netherlands and access to suitable staging areas along the migration route can significantly improve the breeding result (Nilsson, Persson 1996).

The Barnacle Goose is listed in Annex I of the Birds Directive (European Council Directive on the Conservation of Wild Birds, 79/409/EEC, April 2, 1979) not allowing hunting of the species. Therefore, any lethal control in the EU must be exercised under a derogation fulfilling the requirements of Article 9 of the Directive. Differences in disturbance level, especially those caused by hunting, can have large impact on the local and regional distribution of staging and wintering geese (e.g. Mooij 1991). Currently,

most derogation takes place in The Netherlands (48 926 birds in 2020) and Denmark (on average 16 193 birds per year during the period 2017 to 2020), while only an average of 2700 Barnacle Geese were killed in Estonia during the years 2015 to 2019 (Heldbjerg et al. 2021). It cannot be fully ruled out, however, that the killing in Estonia has had some positive effect on the number of Barnacle Geese staging in Latvia. The situation might change markedly, if the Barnacle Goose one day is moved from Annex I to Annex II, which allows hunting of the species.

Lack of Latvian breeding records

In the beginning of the 21st century, the Baltic Barnacle Goose population had a wide distribution in the Baltic Sea region, with a large number of colonies (Bengtsson 2007). Most of these colonies were on off-shore islands, close to suitable brood-rearing sites (Feige et al. 2008). Latvia is devoid of such islands, which gives an explanation for the lack of breeding records. However, the species also breeds on lake islands, including tree-covered ones, and on islets in golf courses (Persson 1997). There have been colonies close to Latvia, from which birds could have dispersed, as birds hatched on Gotland are known to be able to disperse more than 2000 km (van der Jeugd, Litvin 2006). Colonies in Gotland were situated about 150 km (Feige et al. 2008) and on Saaremaa about 80 km from Latvia (Leito, Truu 2008). However, birds born in colonies along the migration corridor of the Russian population have only established new colonies at staging and wintering sites in this corridor (Feige et al. 2008). Semi-captive birds, on the other hand, which can disperse more than 1000 km, establish colonies also outside this migration corridor (Bengtsson 2007), as in the case of birds born in Scotland (Berry 1951), which were found breeding in the Swedish mountains (Burman 1957).

One important factor in Latvia may be a total lack of free-flying Barnacle Geese of captive origin (this study), birds that could have initiated breeding at regular spring-staging sites. Prior to the establishment of new breeding colonies, often small numbers of geese remain at spring-staging areas throughout the entire summer and finally start to breed (Kruckenberg, Hasse 2004; Feige et al. 2008). Summer observations of Barnacle Geese are rare in Latvia and almost all observations refer to single birds (www.dabasdati.lv). There is, for instance, no summer observation reported from the Svēte flood-plain area. In addition, it is questionable if this staging area provides any safe nesting sites for the species, sites free from both ground predators (Red Fox *Vulpes vulpes*) and aerial predators (White-tailed Eagle).

The coming years

Barnacle Geese staging in Latvia have till now made up a very low proportion of the total number of individuals in the Russian/Baltic population. Numbers staging in Latvia have been estimated at 4000 to 10 000 birds in spring and

fewer than that in autumn (Kampe-Persson 2020a), though exceeding 10 000 birds in spring 2021, while the Russian/Baltic population currently numbers about 1.3 million birds (Ganter 2021). However, a number of circumstances make it likely that the importance of Latvia for staging Barnacle Geese, especially in autumn, may grow markedly in the years to come; Latvia is situated along the southern edge of the migration corridor of the Russian population, a fully modernised agricultural landscape offers a large variety of harvest remains as food for autumn-staging geese, the Russian/Baltic population is forecasted to increase to about 13 million birds in 2038 (Jensen et al. 2018) and the species is known for abrupt changes in its migration pattern (Owen 1980).

In South-west Scania, an area comprising about six percent of that of Latvia, the number of autumn-staging Barnacle Geese increased, after having been scarce during the 20th century up to 1999, from 34 000 birds in 2000 to 281 000 in 2021 (Kampe-Persson 2013, and unpublished results). The species also started to winter in Sweden in the early 2000s, reaching 97 000 birds in 2019, of which 85% were found in South-west Scania (Nilsson, Kampe-Persson 2020). The peak number of Barnacle Geese in South-west Scania in the autumn of 2021 corresponded to about 22% of the total Russian/Baltic population. Although South-west Scania is situated along the migration corridor of the Russian Barnacle Geese, while Latvia is situated immediately south-east of that corridor, a similar rapid increase in the number of autumn-staging and wintering birds can most likely take place also in Latvia.

The Barnacle Goose has a short bill and grazes efficiently on short swards (Owen 1980). In spring, the species mainly forages on monocotyledonous plants in grasslands and cereals in the traditional staging areas in Gotland and Estonia (van der Graaf et al. 2006), as well as in Latvia (this study). In autumn, on the other hand, the species has broadened its food choice by feeding on harvest remnants (Nilsson, Kampe-Persson 2013; Nilsson, Kampe-Persson 2020). Since the species learned to exploit sugar beet fields in the 1990s, sugar beet remains have been the main food of autumn-staging and wintering Barnacle Geese in South-west Scania (Nilsson, Kampe-Persson 2013). Cereal stubbles are also an important food source, especially in the first part of the autumn. Locally, flocks of up to 60 000 birds have been attracted to maize stubbles (Hakon Kampe-Persson, unpublished). As Latvia offers a similar richness of harvest remnants, it can probably feed large numbers of autumn-staging Barnacle Geese. In 2021 for instance, 776 400 ha cereals, 25 600 ha maize and 16 300 ha potatoes were sown in Latvia (Central Statistical Bureau of Latvia, www.data.stat.gov.lv/pxweb/en/OSP_PUB/START_NOZ_LA_LAG/LAG020). About 13 000 ha was annually sown with sugar beet up to 2006 but in 2007, Latvia's two sugar refineries were closed after a decision in the EU (Piskunova, Aļsiņa 2010). Sugar beet was not grown during the years

2008 to 2017, but notwithstanding that farmers started to grow it again in 2018, sugar beet has not been included in the official agricultural statistics since 2007.

That large numbers of Anser geese stage in Latvia in autumn (Kampe-Persson 2020a) do not prevent also large numbers of Barnacle Geese from doing the same. In South-west Scania, Barnacle Geese often feed in other fields and closer to roads and buildings than Anser geese (Hakon Kampe-Persson, unpublished results).

Management implications

Wherever Barnacle Geese stage in large numbers, farmers complain about crop damage (Beinert 1982; Leito 1991; van Roomen, Madsen 1992). This agricultural conflict has recently been summarized by Jensen et al. (2018, pp. 50–51): “Modern agricultural landscapes effectively offer unlimited food supply to the Barnacle Goose and the species has demonstrated a high degree of flexibility to exploit new resources in new areas. Therefore, it is predictable that agriculture damage will further increase with the growth of overall populations.”

A scenario with a marked increase in the number of staging Barnacle Geese in Latvia sounds likely, taking into account that the Russian/Baltic population is forecasted to number about 13 million birds in 2038 (Jensen et al. 2018). As such a shift in staging pattern can come about very quickly, Latvian authorities ought to include such a scenario in their planning, in case it should result in agricultural damage.

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