

AEWA EUROPEAN GOOSE MANAGEMENT PLATFORM



WORKSHOP FOR THE REVISION OF THE INTERNATIONAL
SINGLE SPECIES MANAGEMENT PLAN
FOR THE SVALBARD POPULATION OF THE
PINK-FOOTED GOOSE



8-9 October, Levanger, Norway

**DEFINING FAVOURABLE REFERENCE VALUES FOR THE SVALBARD
POPULATION OF THE PINK-FOOTED GOOSE**

**Discussion paper on considerations relevant to determining the Favourable Reference
Population size**

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Cover note:

The revision process for the *International Species Management Plan for the Svalbard Population of the Pink-footed Goose* will align this plan with the *Format and Guidelines for AEWA International Single and Multi-species Management Plans* (adopted in 2022 by the eighth Meeting of the Parties to AEWA). The format and guidelines envision, *inter alia*, the definition of Favourable Reference Values (FRVs) for each population covered by an International Species Management Plan, as well as for the management units thereof (if applicable). The definition of FRVs is a crucial step, as it provides the reference for assessing whether a population is in a Favourable Conservation Status, and thus whether AEWA's requirements are being met. FRVs must be included either in the revised Management Plan itself or, if this is not possible, in the subsequent Adaptive Flyway Management Programme(s).

This document outlines relevant considerations for determining the Favourable Reference Population (FRP) for the Svalbard breeding population of the Pink-footed Goose and makes a tentative proposal for defining the FRP. It is intended to provide a basis for discussing this topic at the revision workshop. However, it will only be possible to finalize the FRP once definitions have also been developed for Favourable Reference Habitat (FRH) and Favourable Reference Range (FRR).

Introduction

The goal of the current International Single Species Management Plan (ISSMP) for the Pink-footed Goose is to “to maintain the favourable conservation status of the Svalbard Pink-footed Goose population at flyway level while taking into account economic and recreational interests” (Madsen & Williams 2012)¹. According to the new Format and Guidelines for AEWA International Single and Multi-species Management Plans, the goal of the revised ISSMP will similarly be “to maintain the population in a favourable conservation status while taking into account ecological, economic and recreational interests”².

At the time of the adoption of the ISSMP by the Meeting of the Parties (MOP) to AEWA in 2012, there was no guidance or established procedures for defining Favourable Conservation Status (FCS) under AEWA. AEWA still lacks MOP-adopted guidance on this topic. However, in 2017 the AEWA Technical Committee endorsed a short provisional guidance document on the interpretation of FCS, and a more comprehensive guidance is currently being developed for submission to the 9th session of the AEWA MOP in 2025 (MOP9). Moreover, in the period since the Pink-footed Goose ISSMP’s adoption, the processes to develop ISSMPs and AFMPs for Barnacle Goose and Greylag Goose (implemented in 2018) under the EGMP produced detailed, species-specific discussion papers to inform the definition of FCS of the target populations. Favourable Reference Values were used as measurable indicators that describe hypotheses about the size of the population, its distribution and the availability and quality of habitat that describe the FCS (Doc. [AEWA/EGMIWG/Inf.5.12](#)).

This document outlines relevant considerations for determining the Favourable Reference Population size (FRP) for the Svalbard breeding population of the Pink-footed Goose, and makes a tentative proposal for defining the FRP, as a basis for discussion at the Pink-footed Goose ISSMP revision workshop. Definitions of Favourable Reference Habitat (FRH) and Range (FRR) will be incorporated into one integrated definition of FRV’s later in the revision process or in the subsequent development of the AFMP, at which stage the FRP may require further refinement. The first reason for initially splitting the processes is that, whereas it was possible to produce a provisional FRP proposal within a relatively short period, the definition of FRR and FRH will require interaction with and data provision by the Range States that could not be concluded within the timeline preceding the revision workshop. In addition, a tentative definition of the FRP will enable participants at the forthcoming revision workshop to engage in preliminary discussions regarding population target-setting.

In the absence of MOP-adopted AEWA guidance on defining FRVs, the assessment below follows the considerations that were taken into account in setting FRVs for the Barnacle Goose (Doc. [AEWA/EGMIWG/Inf.6.11](#)).

Populations

The Pink-footed Goose is divided in two biogeographic populations:

The Svalbard breeding population, traditionally staging and wintering in Norway, Denmark, The Netherlands and Belgium. In recent years, few pairs have been found breeding in Finnmark in Northern Norway; however, there has been no systematic survey to document the number of breeding pairs. Within the last two decades, Pink-footed Geese have also colonised Novaya Zemlya in North Russia

¹ Throughout this document the population is termed as the Svalbard population for brevity even if the breeding range has expanded and it currently also breeds on Novaya Zemlya.

² [Doc. AEWA/PfG/ISSMP/Inf.1.2](#).

(Madsen et al. 2023). The Novaya Zemlya segment is increasing and currently counts around 4,000 individuals, and it can roughly be calculated that around 400-500 pairs breed successfully. Individuals from the traditional Svalbard flyway have emigrated to the new route and breeding grounds. The Novaya Zemlya geese have established autumn staging areas in south Sweden and wintering grounds in southeast Denmark; however, they also mix with Svalbard geese on the wintering grounds in western Denmark, The Netherlands and Belgium. In spring the Novaya Zemlya geese migrate via staging areas in south Sweden and northwest Finland to Novaya Zemlya. Some of the geese migrating via Sweden and Finland also migrate to breed in Svalbard. Because of the flow of individuals between the two groups, it has been decided for now to regard the population as one biogeographic population, regarding the Novaya Zemlya as a range expansion, facilitated by global warming (Madsen et al. 2023).

The Iceland/East Greenland breeding population, wintering in the British Isles. This population has steadily increased from c. 20,000-30,000 in the 1950s (Mitchell et al. 1999) to c. 500,000 individuals in around 2020 (Wetlands International 2024).

Exchange

The two populations of Pink-footed Geese are demographically distinct. Annually, some hundreds of individuals exchange, but the vast majority either return to their original population or appear to succumb in the new environment (Madsen et al. 2014). The populations are also genetically distinct (Ruokonen, Aarvak & Madsen 2005; Pujolar et al. 2017), but a low degree of gene flow exists, suggesting a low degree of interchange in both directions, but one order of magnitude higher from Svalbard to Iceland than in the opposite direction. It is estimated that for every generation, on average one individual effectively migrated from the eastern to the western population (Pujolar et al. 2017).

Definition of Favourable Reference Population

Since the Pink-footed Geese primarily breed in Svalbard and Novaya Zemlya and with negligible demographic exchange with the Iceland/East Greenland population, the FRP will be defined at the biogeographic flyway scale.

The EU guidance and previous processes under AEWA have recognized two different approaches to establish FRVs: either an approach based on historic reference levels (comparing the current situation to a more favourable historical situation, i.e. a 'reference-based' approach), or an approach based on modelled information for the population, i.e. a 'population-based' approach. In most cases, e.g., Barnacle Goose and Greylag Goose, historic reference levels are poorly documented and a population-based approach has been used. However, in the case of the Pink-footed Goose, historic records of the population size and trajectories go back to the 1930s (Madsen 1982) and, in a longer time perspective, demographic inference can be made based on whole genome and RAD sequencing data generated for the Pink-footed Goose (Pujolar et al. 2017; Pujolar et al. 2018); with this information, the demographic history going back to the last ice age can be established. Given the long time series and independent sources at hand, it has been decided to rely on the reference-based approach to define the FRP.

The genomic demographic history analyses suggest that the Pink-footed Goose population reached a low point during the last glaciation. The population might have occurred in refugia in parts of Iceland, whereas Svalbard was completely covered by ice, except for some nunataks (Pujolar et al. 2017). Following the retreat of the ice from around 25,000 BCE onwards, the population started to increase, and this is probably also the time when Svalbard was colonized and the population split took place (Fig. 1).

The population continued to increase during the Holocene (from 7,000 years ago until 2,000 years ago), which was probably caused by a combination of new favourable habitats becoming readily available as the ice sheet retreated, such as the formation of intertidal habitats like the Wadden Sea, and anthropogenic positive effects such as deforestation and cultivation providing more habitat in the wintering areas. The analysis suggests a sharp decline in population sizes around 1,500 years ago causing a decimation of the population size which remained consistently low all throughout the Middle Ages until recent times. This abrupt decline cannot be explained by glaciation (the Little Ice Age occurred later between the sixteenth and nineteenth centuries) or other environmental factors but is most likely explained by increased human persecution on the breeding and moulting grounds, including Iceland (Storå 1968; Pujolar et al. 2017). With the invention and common use of firearms for hunting, waterfowl shooting for market sale and own consumption became widespread in Europe from the eighteenth century onwards, and this probably also contributed to the control of the population of the Pink-footed Goose.

The genetic demographic history analysis cannot make inferences for recent times. The fastsimcole2 simulation method suggests an effective population size of 8,000 individuals for the Iceland population and 2,500 individuals for the Svalbard population in the first half of the twentieth century (Fig. 1). Applying a conservative rule of thumb that effective population size is usually about one-fourth of the total census size in birds (Grant & Grant 1992), the results match the observed numbers quite well, viz. c. 20,000-30,000 individuals for the Icelandic and c. 10,000 for the Svalbard census populations in the 1950s (Pujolar et al. 2017).

For the Svalbard population of the Pink-footed Goose, census data go back to the 1930s, when the wintering population was estimated at 5,000-8,000 individuals (Madsen 1982). Numbers increased to 8,000-12,000 in the 1940s and 1950s, and this increase continued in the 1960s and 1970s. By 1980, the population size had reached 27,000 individuals. The growth continued until the 2010s. Since then, the population size is estimated to have fluctuated between 72,000 and 90,000 in spring (based on an integrated population model; Johnson et al. 2020; Jensen et al. 2023) (Fig. 2). The causes behind the continued increase since the 1940s are mainly attributed to better protection from hunting, such as ban of spring shooting in Denmark since 1965, a national hunting ban in The Netherlands since 1976 and in Belgium since 1981 (but local bans were instigated from 1958 onwards). The impact of hunting was corroborated by an analysis of ring recoveries showing an increase in adult survival from 1955-1974 to 1975-1983 (Ebbinge et al. 1984). Climate change giving milder winters and land use changes (growth of winter cereals and maize) may also have contributed to better winter survival (Kéry, Madsen & Lebreton 2006).

The demographic analyses suggest that the two populations of the Pink-footed Goose were suppressed by human persecution until the first half of the twentieth century. One has to be cautious of using the analyses to infer about absolute past population sizes. If one assumes that the peak reached around year 0 (N_e c. 35,000; Fig. 1) represents a total population size of $4 \times N_e$, equivalent to c. 140,000 individuals, this is close to the aggregated census level of the two populations by 1980, i.e., 27,000 + c. 100,000 individuals. The habitat availability and quality in year 0 and 1980 cannot be compared and the argument shall only be seen as a rough evaluation that the number of Pink-footed Geese were within the same order as it was at their peak around year 0. By year 2000, the populations were twice as high as in year 0, and by 2020 nearly five times as high.

It is noteworthy that there are no signs of density-dependent regulation of the current population size (based on integrated population simulations; F. Johnson per. comm.). Hence the current stabilization in

population size is primarily an effect of the current adaptive harvest management program controlling the population size, not a sign of carrying capacity being reached.

In summary, within the last 200-300 years, which is the long-term reference period for defining FRP according to the EU guidance, the Svalbard population of the Pink-footed Goose has been very low until the mid-1950s. Since then, the population has undergone an eightfold increase, primarily caused by improved protection and facilitated by climate change and changes in agricultural land use benefitting survival. Currently, the population has been stabilised as a result of an adaptive harvest management program under the EGMP with the objective to maintain a stable population in order to minimize agricultural conflicts and reduce degradation to Arctic tundra due to goose grazing.

Taking into account the available EU Guidance, the definition of 'Favourable Conservation Status' in the Convention on Migratory Species (CMS), and the previous processes for defining FRVs under AEWA, the following considerations should be made concerning the Favourable Reference Population (evaluation is written in italics):

1. The Favourable Reference Population should be a viable component of its ecosystem in the long-term³.

This appears to be fulfilled. On the breeding grounds in Svalbard, geese play an important role in the ecosystem, foraging on vegetation and modifying vegetation biomass, composition, ecosystem state and functioning, and the geese are important prey of Arctic Foxes. The Pink-footed Goose is regarded as a keystone species in the terrestrial environment of Svalbard (see www.coat.no). The pink-footed geese exert an increasing grazing pressure on the tundra, and, within the last two decades, this has increased with the increasing goose abundances, to an extent that it has raised concerns for the tundra ecosystem function (Madsen & Williams 2012; Ravolainen et al. in prep. cited in Madsen et al. 2024). However, to define how many is enough to consider a population to be a viable component of its ecosystem is difficult because of a general lack of scientific understanding of Arctic food web interactions and feedbacks and the fact that the Arctic environment is undergoing rapid change due to global warming; hence habitat availability for geese and their role in the ecosystem are in a transition phase. In the wintering and staging areas, geese mostly feed in agricultural habitats, but also in extensively farmed grasslands. Ecosystem services provided by the species include grazing effects on vegetation, transfer of nutrients from terrestrial to aquatic systems, as well as transport of seeds etc.

2. Abundance should approach historic levels as far as it is feasible and consistent with wise wildlife management⁴.

On the breeding grounds abundances have exceeded historic levels; existing colonies have increased in abundances and new colonies have been established, both within and outside the traditional range. Outside the breeding season, abundances have increased, and the geese have dispersed to new staging and wintering areas throughout the existing range and beyond.

³ The CMS definition of FCS includes the following element: "population dynamics data indicate that the migratory species is maintaining itself on a long-term basis as a viable component of its ecosystems".

⁴ The CMS definition of FCS includes that: "the distribution and abundance of the migratory species approach historic coverage and levels to the extent that potentially suitable ecosystems exist and to the extent consistent with wise wildlife management".

3. The Favourable Reference Population should be at least the size when the EU Directive came into force. In previous determinations of FRPs under AEWA it was similarly agreed that, in principle, the FRP should be at least the size when the Agreement came into force.
The population exceeds the size when the Directive came into place and when AEWA came into place (Table 1).
4. Both DG Environment (2017) and the AEWA Technical Committee (2017) recognise that FRVs do not automatically correspond to the ‘potential values’ such as carrying capacity, but these should be used to understand restoration opportunities and constraints.
The population has not reached carrying capacity; the population is on purpose maintained at a stable level; above the population target agreed in the ISSMP.
5. When applying the reference-based approach and the population has not undergone visible shifts or reductions in the past and the current population size is large enough to ensure the long-term viability of the population, DG Environment (2017: p.117) advise that the Favourable Reference Population size should be equal to the current population size except for populations that are secure and have triggered human-wildlife conflict. In that case the FRP should be lower than the Current Value.
The population of the Pink-footed Goose is subject to an ISSMP with the purpose to reduce human-wildlife conflicts and ecosystem impacts; in this case it is therefore an option to define the FRP below the current population level.

Conclusion

It will only be possible to finalize the FRP for the Svalbard population of the Pink-footed Goose once the other FRVs have been defined for this population. However, according to the reference-based approach to define FRP for the Svalbard population of the Pink-footed Goose, it is tentatively proposed that, because the AEWA value is above the EU value, the FRP is to set at 49,000 individuals, i.e., the closest available value after the date that AEWA entered into force on 1 November 1999.

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Table 1. Population reference values for the Svalbard population of the Pink-footed Goose.

Historic known value (1930s)	8,000
EU Birds Directive value (1980)	27,000
AEWA Agreement value (2000)	49,000
ISSMP Target (2013)	60,000 ($\pm 10,000$)
Current value (spring 2024)	78,000

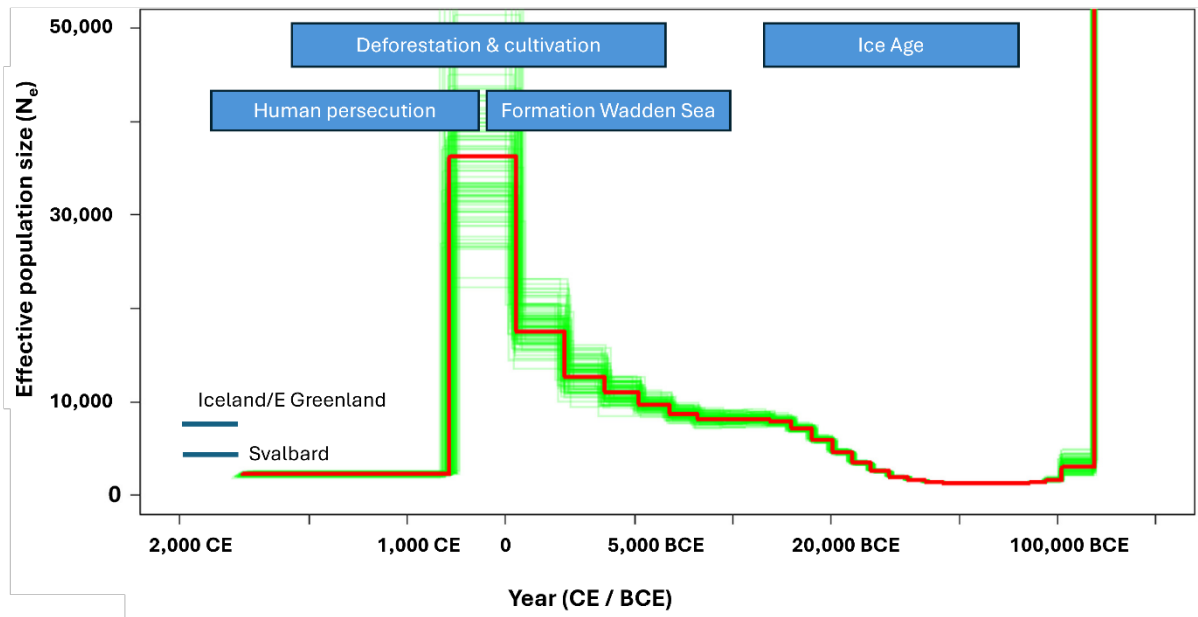


Figure 1. Reconstruction of the demographic history of the population of Pink-footed Goose based on genomic analyses. PSMC estimates of the demographic changes in effective population size, N_e over time: The red curve is the PSMC estimate for the original data and the green curves indicate PSMC estimates for 100 bootstrapped sequences. Blue lines for the most recent time show inferences from a fastsimcole2 simulation, giving N_e for the Iceland/East Greenland and the Svalbard populations, respectively. Major periods of environmental and anthropogenic effects are indicated (redrawn from Pujolar et al. 2017).

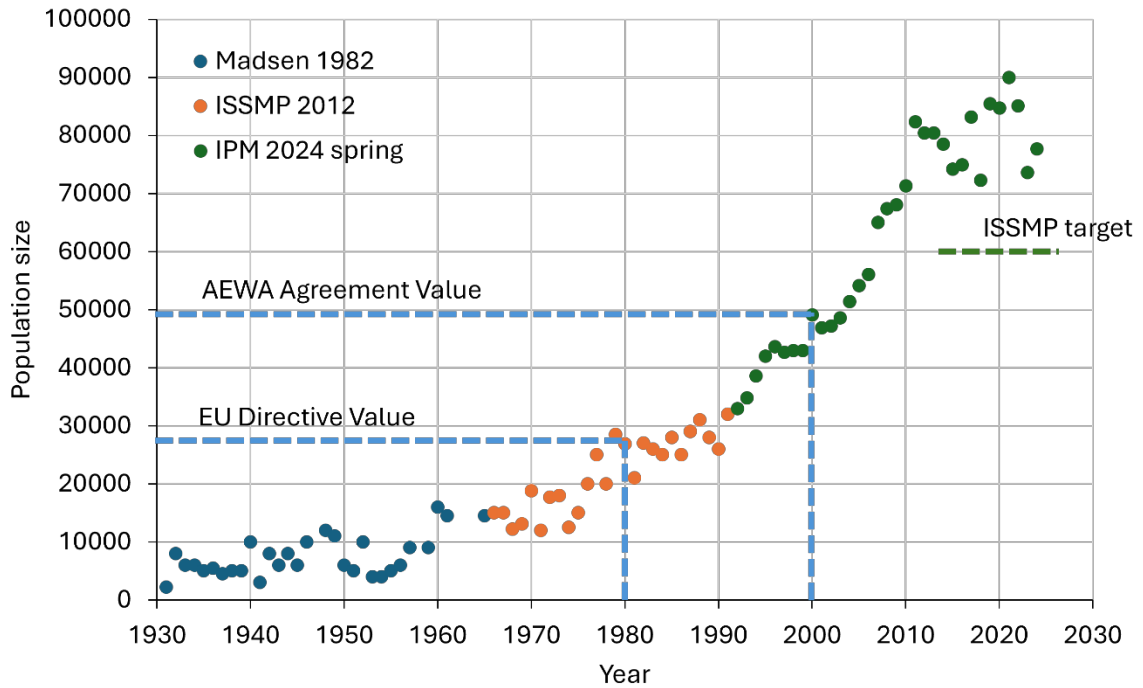


Figure 2. Trajectory of the Svalbard population of the Pink-footed Goose, 1931-2024, based on censuses (Madsen 1982; ISSMP 2012, referring to Madsen and Williams 2012) and outputs from the integrated population model used to estimate the spring population size under the EGMP (IPM 2024 spring; only median values shown). The population size at the time when the EU Birds Directive and AEWA entered into force are shown. The population target agreed in the ISSMP for the Pink-footed Goose is also indicated.