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International Single Species Management Plan for the Barnacle Goose

(Russia/Germany & Netherlands Population East Greenland/Scotland & Ireland Population Svalbard/South-west Scotland Population)

Branta leucopsis

Ministry of Environment and Food of Denmark
Environmental Protection Agency

Ministry of Agriculture, Nature and Food Quality

provinsje fryslân
provincie fryslân

AARHUS UNIVERSITY

rubicon

Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)

International Single Species Management Plan for the Barnacle Goose

(Russia/Germany & Netherlands Population
East Greenland/Scotland & Ireland Population
Svalbard/South-west Scotland Population)

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Aarhus University/AEWA European Goose Management Platform Data Centre and Rubicon Foundation

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Legal Disclaimer: This International Single Species Management Plan has been developed to facilitate the cooperation amongst Parties to minimise or mitigate the damage to crops and humans risk caused by the Barnacle Goose populations in accordance with Paragraphs 4.3.3 and 4.3.4 of Annex 3 of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

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List of Acronyms and Abbreviations

AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
AEWA EGMP DC	AEWA European Goose Management Platform Data Centre
AFMP	Adaptive Flyway Management Programme
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CJEU	Court of Justice of the European Union
CMS	Convention on the Conservation of Migratory Species of Wild Animals
EC DG ENV	European Commission Directorate-General for Environment
EGM IWG	European Goose Management International Working Group
EGMP	AEWA European Goose Management Platform
FCS	Favourable Conservation Status
FO	Fundamental Objective
FRV	Favourable Reference Value
ISSMP	International Single Species Management Plan
IWC	International Waterbird Census
MU	Management Unit
SDM	Structured Decision Making
SPA	Special Protection Areas (EU Birds Directive)

Key Terms

Adaptive Management	Adaptive management is an approach to natural resource management that emphasizes learning through management where knowledge is incomplete, and when, despite inherent uncertainty, managers and policymakers must act. Unlike a traditional trial and error approach, adaptive management has explicit structure, including a careful elucidation of goals, identification of alternative management objectives and hypotheses of causation, and procedures for the collection of data followed by evaluation and reiteration. The process is iterative, and serves to reduce uncertainty, build knowledge and improve management over time in a goal-oriented and structured process (Craig R. Allen and Ahjond S. Garmestani 2015).
Accommodation or refuge area	Specifically designated goose foraging and resting areas to accommodate geese. These can be either natural habitats left without disturbance or agricultural areas where farmers receive incentives to tolerate the presence of geese in large numbers, in order to alleviate human-wildlife conflicts and to allow the maintenance of the population at desired levels. Sometimes also called "go" areas.
Favourable Conservation Status of a population	As defined in Article I.1(c) of the Convention on Migratory Species, which provides that conservation status will be taken as "favourable" when: *(1) Population dynamics data indicate that the migratory species is maintaining itself on a long-term basis as a viable component of its ecosystems;* *(2) The range of the migratory species is neither currently being reduced, nor is likely to be reduced, on a long-term basis;* *(3) There is, and will be in the foreseeable future sufficient habitat to maintain the population of the migratory species on a long-term basis; and* *(4) 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*. This definition is applied taking into account operative para. 9 of CMS Resolution 12.21.
Favourable Reference Values	The minimum necessary values of population size, habitat and range to ensure the long-term viability of the population.
Fundamental objectives	Objectives that express what matters to stakeholders, representing a direction of change.
Group / Segment	The terms group or segment are used when referred to a part of a population that shares the flyway (i.e. may become a management unit of an ISSMP).
Key sites	Supporting internationally important numbers of the species (i.e. over 1% of the flyway population at any time during the year). These can be sites designated under the Ramsar Convention or in response to AEWA, the Bern Convention and the EU Birds Directive obligations, but also include Important Bird Areas identified for the species that are not yet designated.

Management Unit	Management Units (MUs) are functionally differentiated population segments**,** i.e. having somewhat different seasonal distribution (although may overlap during certain stages of the annual cycle), exhibiting distinct demographic processes and showing somewhat reduced exchange with other segments of the flyway population. The concept is defined in more detail in Annex 5 to this document.
Means objectives	Represent means to achieve one or more fundamental objectives.
Multi-criteria decision analysis	Framework for deliberations to evaluate the consequences of alternative strategies. It combines scientific information with social objectives to reach a preferred decision alternative.
Population	When the term population is used with a name of a country, the term refers to the national population of a species. The AEWA title of the population, e.g. *Svalbard/South-west Scotland* population, is used when the text refers to the entire flyway population.
Satisfactory level	A population level that satisfies the requirements of Article II(1) of AEWA, Article 2 of the Bern Convention, and Article 2 of the Birds Directive.
Sensitive areas	Areas determined by the national authorities as being sensitive to the presence of geese because of other interests such as, air safety, sensitive crops or special areas designated for the protection of other flora and fauna sensitive to the presence of geese.
Sensitive crops	Crops that have higher than usual value per unit and would suffer loss of market value if grazed and trampled by geese during their normal occurrence in the area and consequently high economic losses can be expected if grown in areas regularly used by geese. This category does not include widespread and relatively lower economic value crops, even if a large proportion of goose damage occurs in such habitats.
Serious/ Significant damage	In those instances in which birds can only be legally killed by way of derogation from the ordinary provisions of the Birds Directive (or, in the case of AEWA and the Bern Convention, exemption/exception), it is for each Range State to decide whether it wishes to grant derogations for damage-prevention purposes and, if it does so, to demonstrate that there is a risk of 'serious damage' to crops/forests/fisheries/livestock/water. The ISSMP envisages the use of more detailed analysis of data on damage to agriculture as set out in Box 1 (see below on p.16) and the following action to improve consistency in states' decision-making regarding derogations and the consistency of their justifications: "Create a toolbox for decisions in relation to determining significant damage (including metrics, benchmarking, verification, monitoring, various management techniques to prevent damage, compensation)" (Action B3 in the ISSMP). The use of derogations can be applied in terms of preventing serious damage to crops, i.e. relating to an economic interest. However, it should also be noted that the Birds Directive does not specify whether damage should be assessed in financial or production terms. Nor does it define what constitutes 'serious damage', and this concept needs to be understood in relative terms.

Introduction

This draft International Single Species Management Plan (ISSMP) for the three populations (Russia/Germany & Netherlands, East Greenland/Scotland & Ireland, Svalbard/South-west Scotland) of the Barnacle Goose (*Branta leucopsis*) was developed in response to the AEWA Action Plan, which provides for developing ISSMPs for populations which cause significant damage, in particular, to crops and fisheries. In addition, it responds to AEWA Resolution 6.4, which requested the establishment of a multispecies goose management platform and process to address the sustainable use of goose populations and to provide for the resolution of human-goose conflicts, targeting as a matter of priority Barnacle and Greylag (*Anser anser*) Geese.

1 Basic Data

This International Single Species Management Plan (ISSMP) covers all three populations of Barnacle Goose (*Branta leucopsis)*: The East Greenland/Scotland & Ireland population, the Svalbard/South-West Scotland population and the Russia/Germany & Netherlands population[1]. Additional naturalised Barnacle Geese occur in the UK and other Range States but are not included within the scope of this ISSMP. The Russia/Germany & Netherlands population consists of three groups: the Arctic-breeding Russian group and the temperate-breeding Baltic and North Sea groups, respectively. Due to specific management challenges caused by the temperate-breeding groups in summer, the three groups are treated as three separate Management Units (MUs), the arctic breeders and the two groups of temperate breeders (for definitions see Annex 5), e.g. the Arctic breeding birds are not responsible for summer damages to agriculture in the temperate zone while temperate-breeding birds are not contributing to the grazing pressure in the Arctic.

In the case of the temperate-breeding Baltic and North Sea MUs of the Russia/Germany & Netherlands population, it is not possible to separate birds of wild and naturalized[2] origin anymore (Kampe-Persson 2010). Naturalized birds breeding in the other flyways where they are separable from wild birds are not subject to this plan.

Principal Range States: Belgium, Denmark (including the Faroe Islands), Estonia, Finland, Germany, Greenland, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Russia, Sweden and the UK (Figure 1, Table 1).

The Barnacle Goose is considered globally Least Concern (LC) by the IUCN Red List, but it is subject of various international conservation instruments (see Table 2).

[1] This document uses the population titles as they are in the legal text, i.e. Table 1 of Annex 3 to the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).
[2] The term 'naturalized' is used here following Holmes & Stroud (1995) and the term in the context of this management plan includes birds originated from re-establishment, self-establishment, introduction and feral origin.

Table 1. *Status of Barnacle Goose in the principal Range States.*
*It is unknown to which population these birds belong

	East Greenland/Scotland & Ireland population	**Svalbard/South-west Scotland/ population**	**Russia/Germany & Netherlands population**	
			Arctic breeding MU	Baltic/North Sea MUs
Belgium			Wintering	All year around
Denmark			On passage Wintering	All year around
Faroe Islands	Breeding*	Breeding*		
Estonia			On passage	Breeding
Finland			On passage	Breeding
Germany			Wintering	All year around
Greenland	Breeding			
Iceland	On passage Breeding			
Ireland	Wintering			
Latvia			On passage	
Lithuania			On passage	
The Netherlands			Wintering	All year around
Norway		On passage		Breeding
Norway/Svalbard		Breeding		
Sweden			On passage	All year around
Russia			Breeding	
UK	Wintering	Wintering		

Table 2. *Summary of international conservation and legal status of the Barnacle Goose*[3].

	East Greenland/Scotland & Ireland population	**Svalbard/South-west Scotland population**	**Russia/Germany & Netherlands population**
IUCN Red List status	Least Concern (LC)		
AEWA Table 1 status	B1	A3a	C1
CMS	Appendix II		
CITES	This species is not currently listed in the CITES Appendices		
Bern Convention	Appendix II		
EU Birds Directive	Annex I		

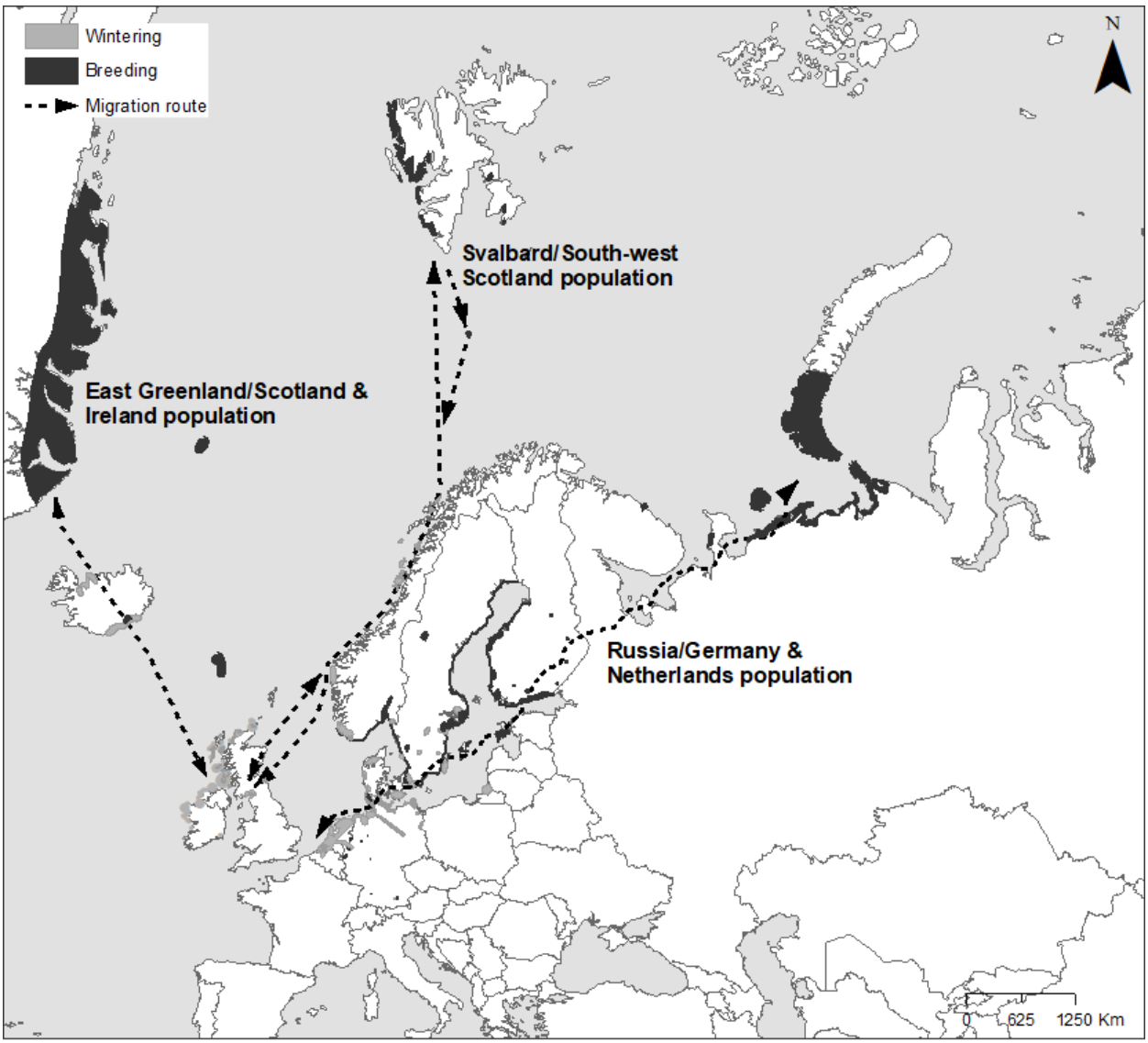


Figure 1. *Annual distribution and migration routes for the three populations of Barnacle Geese; East Greenland/Scotland & Ireland, Svalbard/South-west Scotland and Russia/Germany & Netherlands populations including breeding (dark grey) and wintering and staging (light grey) areas.*

[3] Annex 4 describes the implications of the international legal status of the species on its management.

2 Framework for Action

2.1 Introduction[4]

This ISSMP was commissioned in accordance with paragraph 4.3.4. of the AEWA Action Plan, which provides that AEWA's Contracting Parties "*…shall cooperate with a view to developing single species management plans for populations which cause significant damage, in particular to crops and to fisheries*[5]", and in response to operational paragraph 9 of AEWA Resolution 6.4, which requested the UNEP/AEWA Secretariat to establish a multispecies goose management platform and process to address sustainable use of goose populations and to provide for the resolution of human-goose conflicts targeting as a matter of priority Barnacle (*Branta leucopsis*) and Greylag (*Anser anser*) Geese.

As the Barnacle Goose is also protected under other international instruments (specifically, the EU Birds Directive and the Bern Convention on the Conservation of European Wildlife and Natural Habitats), this ISSMP shall also respect their provisions (see Annex 4 for details).

Development of an ISSMP for the Barnacle Goose was deemed necessary because the species is causing increasing damage to agriculture, poses increasing risk to air safety in several Range States, and there are increasing concerns regarding its potential impact on other flora and fauna, especially on Arctic ecosystems (see Annex 2 for more details) as the consequence of the conservation status of the species having changed dramatically over the last half a century.

At the time of the adoption of the EU Birds Directive and the Bern Convention in 1979, 90% of the species was restricted to less than ten sites in winter (Tucker and Heath 1994), and this justified the species' listing on Annex I of the Directive and Appendix II of the Convention. Today, the Barnacle Goose is the most numerous goose species in the countries that were members of the European Union at the time the Birds Directive came into force (i.e. Ireland, the United Kingdom, Denmark, Germany, the Netherlands, Belgium, Luxembourg, France and Italy - EU-9), surpassing the numbers of all other goose species that are listed in Annex II of the Birds Directive and expanding its breeding range into the temperate zone (Figure 2). The total population size of the Barnacle Goose has increased from c. 112,000 in the 1980s (Madsen 1991) to 1,319,000 in the 2010s (Fox & Leafloor 2018) and BirdLife International (2004) has concluded that the species no longer qualifies as 'Localised' in winter and evaluated it as 'Secure' as a result of the expansion of its wintering range accompanying its population growth, which assessment was also maintained by BirdLife International (2015).

[4] During the development of this plan, it has been recognised that the structured decision-making process is more suitable for the management plan than the traditional planning framework used for action plans. Therefore, the structure of the management plans slightly differs from the structure set out for the action plans in the AEWA action planning guidelines.
[5] The AEWA Action Plan does not define specifically what constitutes 'significant damage'. However, Contracting Parties' request that the Agreement's Secretariat coordinate the development of an international management plan for Barnacle Goose suggests that they consider the damage as being sufficiently significant to be addressed through coordinated action. *See description in Key Terms (page 8-9).*

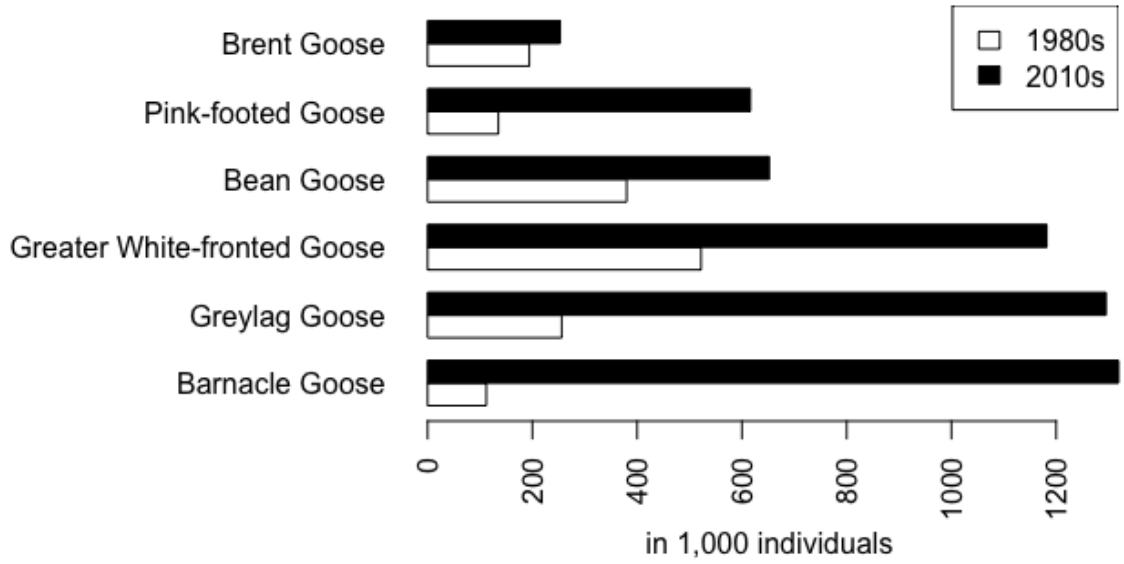


Figure 2. *Population sizes of Barnacle Goose (listed on Annex I of the Birds Directive) and other goose species (all listed in Annex II of the Birds Directive) in the 1980s (i.e. around the time the directive came into force) based on Madsen (1991) and in the 2010s (i.e. representing the current situation) based on Fox & Leafloor (2018).*

The three populations have increased at different rates between the 1980s and 2010s (Figure 3). The Svalbard/South-west Scotland population has increased the least, by 2.7 times, but already exceeds the target of 25,000 individuals set in an earlier flyway action plan for the population (Black 1998) by 1.5 times. The East Greenland/Scotland & Ireland population is 4.8 times larger than it was in the 1980s. The size of the Russia/Germany & Netherlands population has increased by 30 times and it has expanded its breeding range to the Baltic and North Sea area where it continues to expand to inland areas. These increases are demographically driven by reduced mortality as the result of reduced taking in Russia and hunting bans introduced at various times across the range, but applied more widely and in a less flexible manner after the Birds Directive came into force (population relevant chapters in Madsen et al. 1999) and it is reinforced by the ability of the species to utilise intensively managed agricultural areas (see Annex 1 for details).

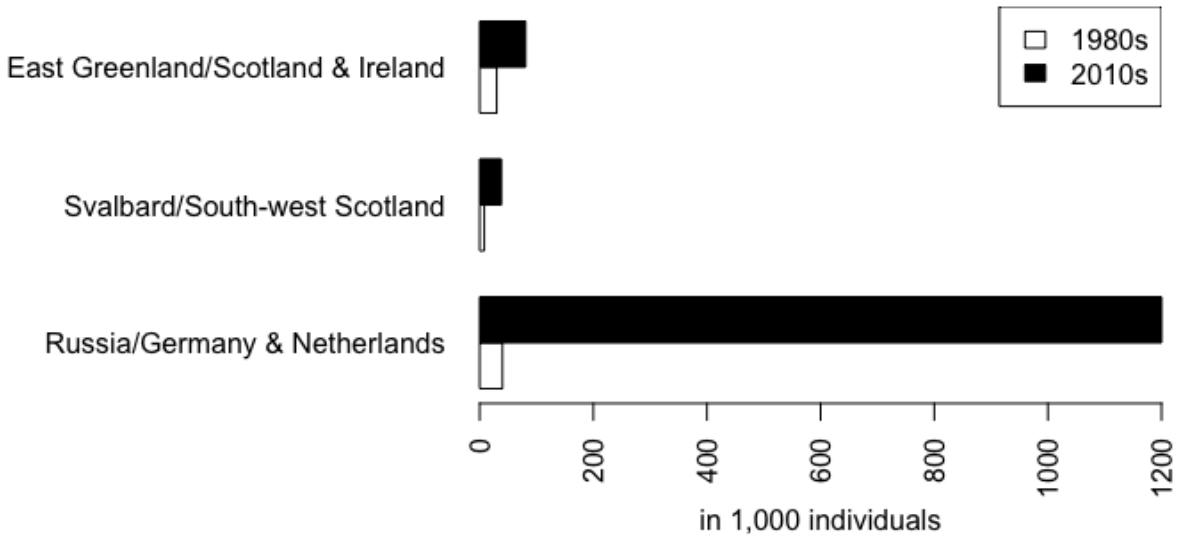


Figure 3*. Population sizes of Barnacle Goose populations in the 1980s (i.e. around the time the Bird Directive came into force) based on Madsen (1991) and in the 2010s (i.e. representing the current situation) based on Fox & Leafloor (2018).*

This population increase, combined with the increasing year-round presence of the species, has led to increasing human-wildlife conflicts, particularly in relation to agricultural damage and air safety (see Annex 2 for details). Range States to the species have been applying a wide range of measures, from providing more attractive foraging areas either by conservation organisations in their own reserves or by providing incentives to farmers in selected areas. Although these measures temporarily reduce the conflict with agricultural interests, they also support further growth of the population and thus contribute to expanding distribution of the species and consequently making damage to agriculture even more widespread (Stroud et al. 2017). This has led to killing individuals under derogation in response to conflicts with various societal and conservation interests in an increasing number of Range States, without having any shared vision concerning the future state of the populations.

As Figures 6-8 in Annex 1 show, all Barnacle Goose populations are increasing at a high rate without any sign of density dependence and, based on the close relationship between abundance and the amount of compensation payments paid in the Netherlands and Sweden (Figure 9), it can be predicted that these conflicts and the cost of managing them will increase with the predicted future growth of the populations (Annex 3) in the foreseeable future. These projections indicate that the size of the Russia/Germany & Netherlands population will double by 2023 (i.e. increase from an estimated 1.2 million to an estimated 2.4) and may reach 8.7 million birds in 25 years (Figure 14) if no control measures are taken and no density dependent population regulation comes into effect. Density dependent regulation at the flyway scale, however, is rather unlikely in the foreseeable future, because the species responds to reaching local carrying capacity by expanding its range (Black et al. 2014, van der Jeugd & Kwak 2017). The size of the two other populations wintering in the UK are smaller and they show slower growth, but these may also double within 25 years if no control measures are taken or other factors will start limiting their growth.

Therefore, this ISSMP and the related population-specific Adaptive Flyway Management Programmes (AFMPs) aim to establish an agreement amongst Range States on the strategic goal and objectives of the conservation and management of the species and more specifically each of its populations. This intention is fully compatible with the provisions of both Article II (1) of AEWA[6] and Article 2 of the Birds Directive[7] and Bern Convention[8]. The compatibility of the plan with these international instruments is further elaborated in the rest of this chapter and in Annex 4.

This ISSMP only addresses the strategic issues in general terms to provide a mandate for developing population-specific AFMPs for the three populations of Barnacle Goose, recognising that the populations have a different status on Table 1 of AEWA and that there are differences in their distribution and the human-wildlife conflicts involved. These AFMPs will be adopted and then revised periodically by the European Goose Management International Working Group (EGM IWG). Therefore, implementation details or issues that may require revision in the future, such as Favourable Reference Values (FRVs), indicators, any co-ordinated adjustment of the populations to a particular level at an appropriate spatial scale (if this is necessary at all, following an assessment of the presence of legitimate grounds for derogation and the availability of suitable alternatives) and tasks related to the actions agreed in the management plan will be elaborated in the AFMPs (Figure 4 and Box 1 page 16).

[6] "Parties shall take co-ordinated measures to maintain migratory waterbird species in a favourable conservation status …".

[7] "Member States shall take the requisite measures to maintain the population of the species referred to in Article 1 at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level."

[8] "The Contracting Parties shall take requisite measures to maintain the population of wild flora and fauna at, or adapt it to, a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements and the needs of sub-species, varieties or forms at risk locally."

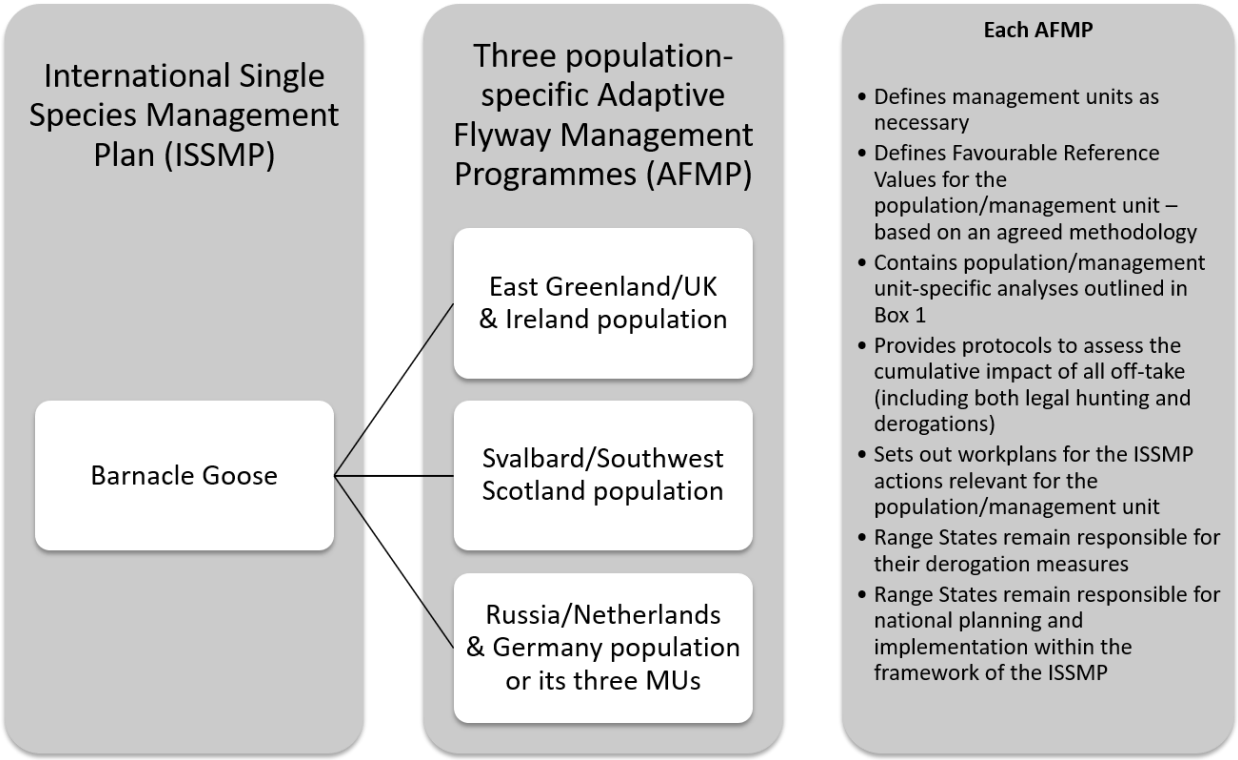


Figure 4. *Relationship between this management plan and the population-specific Adaptive Flyway Management Programmes (AFMPs).*

Box 1. Information needed in each AFMP concerning damage and site protection

Care must be taken to ensure that the management actions recommended by AFMPs are not inconsistent with the legal obligations prescribed by relevant international instruments. The AFMPs have the potential to, *inter alia*, assist Range States in assessing the need for derogations from the provisions of Article 5 of the Birds Directive (and, to the extent that they are relevant, the protections prescribed by the Bern Convention and AEWA) and in coordinating the implementation of their derogation schemes. Each AFMP should therefore contain information that is relevant for assessing the need for derogations at Range State level. This should include:

i. Characterization of the spatial and temporal extent and trends of damage to agriculture and of risks to air safety as well as to other flora and fauna that can be attributed to the population/MU in question, including predicted future changes in these;
ii. Description of the methods applied in the past assessments for each country and recommendations for the development of future guidelines for assessments;
iii. Description of the methods applied or tested to prevent damages and to reduce risks, their effectiveness and sufficiency to tackle the problem;
iv. Understanding of the link between population level and damages or risk.

Each AFMP shall also contain information on habitat conservation measures, including designation of Special Protection Areas (SPAs) under Article 4 of the Birds Directive:

i. List of SPAs and other protected areas designated for the Barnacle Goose;
ii. Management of the species and the damage inside and outside SPAs;
iii. Tackling damage prevention inside and outside SPAs (accommodation areas, derogations, etc.).

This plan follows the principles of Structured Decision Making (SDM, Gregory et al. 2012), which recognizes that management plans should strike a balance between multiple fundamental objectives. This approach is compatible with the spirit of Article 2 of the Birds Directive and Article 2 of the Bern Convention, both of which recognise various conservation and societal requirements and that it might be necessary to adapt

population levels to such requirements. However, the Barnacle Goose is not listed in Annex II of the Birds Directive. Therefore, any deliberate killing of birds belonging to the species within EU Member States must be consistent with the requirements of Article 9 of the Birds Directive. It is also listed in Annex I of the Directive, with the result that management measures within EU Member States must comply with these states' obligations concerning SPAs. Range States which are Parties to the Bern Convention and AEWA must further ensure compliance with their commitments under these instruments (see Annex 4). The identified fundamental objectives can be achieved through various means and process objectives. One means objective may contribute to several fundamental objectives. For example, protection of the SPAs on Islay not only provides protection to a significant proportion of the East Greenland/Scotland & Ireland population of Barnacle Goose, but also provides ecosystem services linked to recreation for people who enjoy watching geese.

2.2 Goal

Maintain each of the three populations in favourable conservation status while taking into account ecological, economic and recreational interests.

Considering that the Barnacle Goose is not a huntable species under the Birds Directive and is listed in Annex I of the Directive, and further considering the fact that the Arctic-breeding population segments are long-distance migrants, this plan aims to provide a framework to coordinate the management measures of Range States in a manner that is consistent with their legal obligations and avoids the cumulative impact of management measures from being detrimental to the species and its populations or jeopardising conservation efforts elsewhere along their flyways.

To support the decision-making process and to secure the long-term viability of the populations favourable reference values for population size, habitat and range will be established in the population-specific AFMPs by the EGM IWG, respecting the requirements of international instruments listed in Table 2.

2.3 Fundamental Objectives

This plan recognises seven fundamental objectives[9] based on the stakeholders' perspectives expressed at the management planning workshop (June 2017, Copenhagen). Fundamental objectives do not need to be shared by all stakeholders, they express what is important for certain groups of stakeholders. Following the standards of SDM they are presented with a direction of change although it is recognised that these directions may conflict with one another. The plan and its associated programmes aim to resolve trade-offs between them.

I. ***Maintain the populations at a satisfactory level[10]***

Satisfactory level of the population is to be determined by the Range States above the favourable reference values, taking into account the requirements of fundamental objectives II-VI while avoiding that conservation efforts elsewhere along the flyway are jeopardised (see Annex 4).

II. ***Minimise agricultural damage and conflicts***

Those derogations from the provisions of Article 5 of the Birds Directive or from the relevant protections in AEWA and the Bern Convention which are aimed towards preventing damage to agriculture can only be granted after having established the likelihood of serious damage to crops based on objective data and only in the absence of satisfactory alternatives to prevent it. However, agricultural damage is a composite element of the broader human-goose agriculture conflict. Thus, by also addressing the conflict, rather than focusing on the damage alone, the plan takes a more holistic

[9] The order of objectives does not imply any prioritisation.

[10] Satisfactory means in this context a population level that satisfies the requirements of Article II (1) of AEWA, Article 2 of the Bern Convention, and Article 2 of the Birds Directive.

approach to dealing with all elements of the issue at stake, which include (1) actual or predictable future damage, (2) perception of damage and (3) tolerance to damage.

III. Minimise the risk to air safety

It is recognised that these risks are either localised (as air safety) or may not be well-understood. Nevertheless, they are legitimate concerns of some stakeholders and therefore represent a valid fundamental objective.

IV. Minimise the risk to other flora and fauna[11]

It is recognised that this risk is rather localised and local actions may suffice at current population levels. However, it is also understood that the potential of damaging of Arctic tundra vegetation may increase with the further increase of the population, especially in case of the populations with more restricted breeding range on East Greenland and Svalbard.

V. Maximise ecosystem goods and services

Here, the plan recognises ecosystem services not related to hunting, such as the cultural and aesthetic value of geese. Ecosystem services related to hunting are reflected in Fundamental Objective VII.

VI. Minimise costs of goose management

Preventing significant damages to agriculture and risk to public health and air safety through land management, scaring or exclusion, compensating farmers for the damages that have already occurred or for measures to be taken to prevent such damages, paying them incentives for managing their land according to the needs of the species, carrying out killing of animals or destroying their eggs under derogation by paid agents of the competent authorities, managing, administering and inspecting goose management actions are all examples of the costs associated with goose management. As Figure 9 shows, the cost of Barnacle Goose management is closely linked to the population size in countries where such data is available.

VII. Provide hunting opportunities that are consistent with maintaining the populations at a satisfactory level[12]

The Barnacle Goose is not listed in Annex II of the Birds Directive and it is listed in Appendix II of the Bern Convention. In addition, the Svalbard/South-west Scotland population is listed in Category 3a of Column A of AEWA Table 1. Consequently, killing of individuals is only possible under derogations/exceptions/exemptions in the countries that are legally bound by these instruments. However, the species can be legally hunted in the Russian Federation and there are also open hunting seasons for the species in Iceland (which has entered a reservation in respect of the Bern Convention's Appendix II listing of Barnacle Geese) and Greenland. Therefore, this objective applies only in those countries where the Barnacle Goose can be legally hunted.

Appropriate indicators for assessing the progress towards achieving the fundamental objectives will be developed by the EGM IWG during the development of the AFMPs taking into account also the information needs outlined in Box 1 (see p.16) and this information will be updated periodically.

[11] Including also habitats and ecosystem functions.

[12] It is recognized that for the territory of the EU Member States this, as a legitimate fundamental objective, can only relate to species that are listed in Annex II of the Birds Directive and which, therefore, can be hunted for recreational purposes in accordance with the provisions of national and international legislation.

2.4 Means objectives

Means objectives represent ways to achieve the fundamental objectives. This management plan has four means objectives complemented by a set of process objectives (expressing ways to run the process to realistically achieve the objectives).

The four means objectives were identified after a wider range of management options were considered. The selected means objectives represent a complementary intervention logic: (1) protect the population at internationally important key sites and fulfil site protection obligations under Article 4(1) of the Birds Directive and similar provisions of the Bern Convention and AEWA, (2) prevent or (3) manage localised damages to agriculture, other flora and fauna and risks to air safety and (4) if necessary, reduce or prevent the further increase of agricultural damages and the associated increase of management costs through regulating the population.

Other management options, such as agricultural extensification and strengthening predator populations to control the species, are considered, but not suggested for immediate application. The potential impact of agricultural extensification on goose populations and society is complex and yet insufficiently understood and should thus be the subject of research.

Strengthening predator populations to control the species in the temperate zone could be considered in the longer term but would not offer a viable option to resolve the problem in the short-term. Side-effects on other species in unfavourable conservation status (such as Common Eider *Somateria mollissima*) should also be carefully considered. Moreover, the Arctic-breeding populations are already subject of natural predator-prey dynamics.

Therefore, increasing the understanding of how agricultural extensification and strengthening predator populations could help in goose management is included into the plan under actions A.5 and A.6 as medium and high priority respectively.

The following means objectives were identified:

1. ***A network of safe key sites is maintained and managed throughout the range of the species***

   This objective aims to ensure that Range States meet their site protection obligations under Article III(2)(d) of the AEWA Agreement text and paragraph 3 of the AEWA Action Plan, Article 4 of the Bern Convention and Article 4(1) of the EU Birds Directive (in the EU Member States). This site network already encompasses a very high proportion of the staging and wintering numbers of the species. Thus, this network will act as a rather sizeable safety net that ensures the viability of the species above FRVs and ensures that it continues to provide valued ecosystem services. This objective also includes the obligations of EU Member States to maintain the SPAs designated for the species in good ecological conditions for the species they have been designated for and to avoid significant disturbance of the species at such sites.

2. ***Geese are kept away from sensitive areas[13]***

   This objective aims to avoid damages to agriculture and other flora and fauna, and risks to air safety, by using various means, such as deterring, diverting e.g. through habitat management, or avoiding, locally in areas determined by the national authorities as being sensitive to the presence of geese.

[13] Areas determined by the national authorities as being sensitive to the presence of geese because of other interests such as air safety, special areas designated for the protection of other flora and fauna sensitive to the presence of geese.

3. Conflicts and risks in sensitive areas are managed

This objective recognises that it is impossible to keep geese away from all sensitive areas, but some risks and conflicts can also be managed through other measures such as payments, adaptation of operations and communication measures.

4. If necessary, grant derogations to address the prevention of damage by management at the appropriate scale

This objective recognises that several of the fundamental objectives are linked to the population size and that it might therefore be necessary to regulate the population in order to prevent widespread impacts on sensitive areas, including damage to agriculture. Decisions concerning whether population regulation is necessary or not must comply with the requirements of both AEWA and other applicable legal instruments. Importantly, the Barnacle Goose is the subject of strict species protection provisions under both the Birds Directive and the Bern Convention, and the Svalbard/South-west Scotland population enjoys similar protections under AEWA (a more detailed description of the species' legal status under each instrument is provided in Annex 4).

As the Barnacle Goose is not listed in Annex II of the Birds Directive, EU Member States must find solutions, within the framework set by Article 9, to prevent further increases in serious agricultural damage and risks to air safety, and associated increases in management costs, arising from their increasing Barnacle Goose populations. It presents a unique challenge for the application of Article 9 that, by now, the Barnacle Goose has become more abundant in its Range States than any other goose species listed in Annex II of the Birds Directive. It has also enormously expanded its native breeding range from the Arctic into the Baltic and the North Sea and has become a widespread species in the range of the Russia/Germany & Netherlands population, with other naturalised populations in the UK and elsewhere that are not included within this ISSMP.

For Contracting Parties to the Bern Convention, any use of lethal control measures must comply with Article 9 of the Convention; and for the use of such measures in respect of the Svalbard/South-west Scotland population, Parties to AEWA must comply with paragraph 2.1.3 of the Agreement's Action Plan. Given the overlap between the relevant provisions of the Birds Directive, Bern Convention and AEWA, it can, for the most part, be assumed that derogations which comply with the Birds Directive will also satisfy the requirements for exceptions/exemptions under the other two instruments (for further detail, see Annex 4).

As is explained below, this ISSMP, and the AFMPs it envisages, will assist Range States to make better informed decisions regarding derogations. However, applying derogations within the framework of the Birds Directive (and, where relevant, other legal instruments) will remain the responsibility of the individual Range States. EU Member States that decide to grant derogations aimed at the prevention of serious damage to crops or reduction of other risks recognized by Article 9 of the Birds Directive by means of population regulation must ensure the following (see further Annex 4):

(1) These levels guarantee that each populations' status satisfies Article 2 of the Directive - in particular, by being maintained at levels which correspond to ecological requirements (ensuring maintenance of the population concerned at a satisfactory level is a precondition to the use of derogations);

(2) There is strong and robust evidence that the part(s) of population(s) being targeted present a widespread threat to the protection of flora and fauna, air safety and/or a widespread risk of serious damage to agriculture, and that this threat or risk of serious damage is linked to the size of the population being targeted by derogation, such that population management

is able to address the problem in question. These population management methods may differ among Parties;

(3) All alternative measures that would be compatible with Article 5 of the Birds Directive have been seriously examined, and it is demonstrated (through strong and robust arguments, based on the scientific and technical evaluation of objectively verifiable factors) that these on their own do not provide a satisfactory solution to the problem in question; and

(4) The reduction is proportionate to the damage prevention needed.

Although the application of derogations remains the responsibility of individual Range States, this ISSMP and the subsequent AFMPs will assist Range States and the European Commission's decision-making processes concerning derogations by:

- Assessing the cumulative impact of derogations on the fundamental objectives recognised in the management plan through updating the information outlined in Box 1 (see p.16);
- Monitoring the status of both the population and the damage to crops; and
- Modelling and providing an on-going mechanism to coordinate derogation measures amongst Range States to increase their efficiency and to avoid unintended effects at flyway-scale.

2.5 Process objectives

This management plan has five process objectives that relate to the shared management of the populations.

A. Knowledge is available to support shared goose management

The adaptive management of shared populations requires coordinated monitoring and assessment to support shared periodical decision-making. Coordinated comparative studies are needed to support future refinement of the management strategies. Importantly, Parties to AEWA have undertaken various legal commitments concerning the collection and communication of data (details in Annex 4) and this objective specifies how these commitments could be fulfilled in the framework of this plan.

B. Experience and expertise are shared

This objective aims to improve the effectiveness of management by sharing experience and expertise on key topics.

C. Acceptance of goose management is increased

The public opinion concerning goose management can be highly polarised and often represents an obstacle to rational and cost-effective management measures. Creating a better acceptance can thus contribute to the de-escalation of the conflict.

D. Relevant national legislation is harmonised

If it is determined that the adjustment of certain Barnacle Goose populations (or parts thereof) to a particular population level is necessary for preventing serious damage to crops, the implementation of a dynamic management framework may require frequent (periodical) updating of Range States' derogation regulations in the light of monitoring data. For those Range States in which hunting occurs legally, the periodical adjustment of hunting regulations may also be necessary.

E. Sufficient resources secured on long-term basis

Adaptive management of the populations is not possible without long-term funding to maintain the capacity for monitoring, assessment and implementation.

Table 3 sets out the actions for each means and process objective together with their priorities, time scale and responsible organisations.

Table 3. *Framework for action.*

FOs	Means / Process objectives	Actions	Priority[14]	Time scale[15]	Organisations responsible
I V VII	1. A network of safe key sites is maintained and managed throughout the range of the species	1.1 Provide adequate protection and management to key sites of international importance under Article 4(1) of the Birds Directive in the EU and other relevant instruments in other Range States throughout the range of the populations and maintain them in good ecological status	Essential	Short / Rolling	National authorities
		1.2 Promote goose-based eco-tourism at selected key sites	Medium	Medium	National authorities, NGOs
II III IV	2. Geese are kept away from sensitive areas	2.1 Take key sites for geese into account in land use planning and growing of sensitive crops[16]	High	Immediate / Rolling	National authorities
		2.2. Provide accommodation areas to reduce risks and conflicts at sensitive areas through e.g. subsidies[17]	Medium	Medium/ Rolling	National authorities
		2.3 Apply scaring and/or land management techniques to reduce the attractiveness of sensitive areas to geese, monitoring the	High	Short / Rolling	National authorities, Airport authorities

[14] *Essential*: the sustainability of the management cannot be guaranteed without the action, *High*: actions that guarantee achieving the means objective, *Medium*: actions that contribute to achieving the means objective, *Low*: explorative actions that are unlikely to contribute to achieving the means objective within the life-time of the management plan.
[15] *Immediate*: launched within the next year, *Short*: launched within the next 3 years, *Medium*: launched within the next 5 years, *Long*: launched within the next >5 years, *Ongoing*: currently being implemented and should continue, *Rolling*: to be implemented perpetually.
[16] Avoidance.
[17] Diversion.

FOs	Means / Process objectives	Actions	Priority[14]	Time scale[15]	Organisations responsible
		implications of such local displacement for conflicts at wider scale[18]			
II III IV	3. Conflicts and risks in sensitive areas are managed	3.1. Reduce risk posed by goose migration to air safety through operational measures such as radar surveillance[19]	High	Short / Rolling	National authorities, Airport authorities
		3.2 Establish an internationally coordinated programme to assess agricultural damage including monitoring and assessment protocols	High	Short	National authorities
		3.3 Liaise with farmers affected by goose damages to reduce agricultural conflicts	High	Short / Rolling	National authorities
I II V VI VII	4. If necessary, grant derogations to address the prevention of damage by management at the appropriate scale	4.1 If necessary and if there is no other satisfactory solution, apply lethal population control under derogations according to the provisions of the Birds Directive, the Bern Convention and AEWA, for preventing serious damage to crops	Essential	Short	National authorities
		4.2 Assess periodically, and report to the AEWA EGM IWG, the cumulative impact of derogations (as well as hunting in Range States in which derogation is not required) on the development of the population, the likelihood of serious damage to agriculture and risk to air safety and to other flora and fauna (including the	Essential	Short	AEWA EGM IWG, National authorities, EC DG ENV

[18] Deterrence.
[19] Adaptation.

FOs	Means / Process objectives	Actions	Priority[14]	Time scale[15]	Organisations responsible
		Arctic ecosystems), and the non-lethal measures taken to prevent damage/risk, as well as the effectiveness of these. If necessary, coordinate the derogation measures between Range States to avoid risk to the population and to enhance effectiveness of the measures.			
		4.3 Improve effectiveness of derogation measures through experimenting with different timing and methods and better understanding the relative efficacy of lethal versus non-lethal scaring techniques	High	Medium	Research institutes, National authorities, National hunting federation
		4.4 Promote best practices of goose population adjustment including timing to minimise damage and significant disturbance to other species	Medium	Medium / Rolling	National authorities, National hunting federations
		4.5 Maintain low crippling rates	High	Medium / Rolling	National authorities, National hunting federations
		4.6 Improve derogation shooting techniques to further reduce crippling	Medium	Long / Rolling	Research institutes, National hunting federations

FOs	Means / Process objectives	Actions	Priority[14]	Time scale[15]	Organisations responsible
All	A. Knowledge is available to support goose management through a shared knowledge-base	A.1 Produce and update periodically, spatially explicit population size estimates based on agreed international monitoring	Essential	Short / Rolling	AEWA EGMP DC
		A.2 Maintain an annually updated bag statistics database including geese taken by any means (whether under derogations or, in those Range States in which it is permissible, hunting)	Essential	Ongoing / Rolling	AEWA EGMP DC
		A.3 Maintain a spatially explicit database on goose damage to agriculture, other fauna and flora and fauna and risk to air safety	Essential	Medium / Rolling	National authorities with periodic reporting to the AEWA EGMP DC
		A.4 Collect demographic (mortality, reproduction, differential migration and connectivity) data from an agreed representative sampling framework across the range	High	Short / Rolling	AEWA EGMP DC
		A.5 Analyse the impact of various agricultural policy scenarios and measures (Nitrate Directive, agri-environmental measures, various production incentives including biofuels) on goose populations and on goose damage	High	Medium	National authorities, Research institutes
		A.6 Assess the role of predators (e.g. White-tailed Eagle, Red Fox, Polar Bear, Arctic Fox) in regulating goose populations	Medium	Long	Research institutes

FOs	Means / Process objectives	Actions	Priority[14]	Time scale[15]	Organisations responsible
		A.7 Monitor and assess the impact of the populations on other flora and fauna and ecosystems in the Arctic	High	Short	Research institutes
All	B. Experience and expertise are shared	B.1 Produce best practice guide on establishing refuge areas (size, management, subsidies)	Medium	Short	AEWA Secretariat with EC DG ENV and EU Member States
		B.2 Provide guidance on conflict resolution and how to make this consistent with the European legal framework, including the Common Agricultural Policy	High	Short	AEWA Secretariat with EC DG ENV and EU Member States
		B.3 Create a toolbox for decisions in relation to determining significant damage (including metrics, benchmarking, verification, monitoring, various management techniques to prevent damage, compensation)	High	Short	AEWA Secretariat with EC DG ENV and EU Member States
		B.4 Provide guidance on implementation of population management protocols at national level	Medium	Medium	AEWA Secretariat with EC DG ENV
		B.5 Share experience concerning methods to prevent damage to agriculture and risks to air safety as well as to other flora and fauna	Medium	Medium	AEWA Secretariat with EC DG ENV and EU Member States
All	C. Acceptance of goose management is increased	C.1 Develop and implement a communication strategy and plan	Medium	Short / Rolling	AEWA Secretariat, National authorities

FOs	Means / Process objectives	Actions	Priority[14]	Time scale[15]	Organisations responsible
All	D. Relevant national legislation is harmonised (if it is determined that population adjustment is necessary)	D.1 Develop a specific guidance on the application of Art. 9 of the Birds Directive in the context of the Barnacle Goose Management Plan	Essential	Immediate[20]	EC DG ENV, National authorities
		D.2 For Range States in which hunting is legal, review national legislation in the light of the framework legal guidance document developed under the EGMP	Essential	Immediate[21]	EC DG ENV, National authorities
All	E. Sufficient resources secured on long-term basis	E.1 Range States strive to provide voluntary contributions to the budget of the EGMP on a regular basis	Essential	Ongoing / Rolling	National authorities
		E.2 National and regional governments secure the necessary funds for the implementation of the actions at national and sub-national levels	Essential	Rolling	National authorities

[20] This is an essential precondition to develop and implement the adaptive management programmes.
[21] This is an essential precondition to develop and implement the adaptive management programmes.

Annex 1 Biological Assessment

1 Distribution throughout the annual cycle

The East Greenland/Scotland & Ireland population of Barnacle Geese breeds along the coast in East Greenland. Since the late 1990s increasing numbers have been found breeding in Iceland, with recent numbers of up to 2000 pairs in 2017 (K. Skarhedinsson pers. comm.). Large concentrations of non-breeding Barnacle Geese gather to moult flight feathers in Jameson Land in the southern-most areas of the East Greenland breeding range (Madsen et al. 1984). During spring-migration the population uses staging areas in the northern valleys of Iceland (Percival and Percival 1997), while in autumn they are found mainly in south-east Iceland (Ogilvie et al. 1999). The winter destinations include western Ireland and north and west Scotland, with the island of Islay as the principal winter resort (Ogilvie et al. 1999) and remaining birds scattered in relatively small numbers across many small (traditional) island sites.

The Svalbard/South-west Scotland population of Barnacle Goose breeds and moults in Svalbard, mainly on the west coast of Spitsbergen (Owen and Black 1999; Tombre et al. 2012). During autumn they migrate from Svalbard via Bear Island and along the west coast of Norway, to the wintering areas in southwest Scotland and northwest England. Here they congregate around one large estuary complex, the Solway Firth on the Dumfries and Galloway, Scotland and Cumbrian, England sides (Owen and Gullestad 1984; Cope et al. 2003). During spring the population gathers in its entirety on Rockcliffe Marsh, Cumbria, before moving to the breeding grounds via the west coast of Norway, mostly staging on small coastal islands in the Helgeland and Vesterålen regions although some birds, more recently, have tended to bypass these areas to travel straight to the breeding grounds from the main wintering area on the Solway Firth, UK (Gullestad et al. 1984; Owen and Gullestad 1984; Black et al. 1991; Prop et al. 1998; Griffin 2008; Tombre et al. 2008; Shimmings et al. 2011). There is recorded occasional exchange between the East Greenland/Scotland & Ireland population and the Svalbard/South-west Scotland population.

Most recently Barnacle Geese have started to breed on the Faroe Islands with 48 pairs on Sandoy in 2016 (Hammer et al. 2017). It is not yet known from where these birds originate.

Until the early 1970s, the Russia/Germany & Netherlands population bred exclusively in the Russian Barents Sea region, confined to the islands of Novaya Zemlya and Vaygach (Ganter et al. 1999). Since 1980 it has established breeding colonies in new areas (some of which may have been occupied in the past, before human depopulation). These include mainland Yugorski Peninsula, Kolguyev, Sengeysky, Dolgy, Matveev and Goletz islands, Varandeysksya lapta and whole coastal area along the Pomoprsky channel, Timan coast of Malozemelskaya tundra, and the Kanin Peninsula (Filchagov and Leonovich 1992; Syroechkovsky 1995; van der Jeugd et al. 2003). Sporadic nesting is known from the Kola Peninsula (Dalnie Zelentsy) and Western Taymir (Lemberova River). Large moulting aggregations for the Russia/Germany & Netherlands population are confined to the coasts of Novaya Zemlya and Vaygach, Yugorski Peninsula, Kolguyev, Sengeysky, Dolgy, Matveev and Goletz islands, Varandeysksya lapta and coastal strip of the Pomoprsky channel and the Kanin Peninsula (Ganter et al. 1999; Rozenfeld and Sheremetiev 2014; Volkov and Timoshenko 2015).

The main first staging areas used after departing the breeding areas in autumn are in Khaypudyrskaya, Bolvanskaya, Kolokolkova and Pakhantheskaya bays, Sengeysky Island, the southern island of the Novaya Zemlya archipelago and the Kanin Peninsula (Syroechkovsky 1995; Morozov and Syroechkovsky 2004, Rozenfeld 2017). Further south staging areas in the White Sea and the Baltic Sea (especially the Swedish islands Gotland and Öland, western Estonia and eastern Finland) are used before finally reaching the wintering areas (Eichhorn et al. 2006, 2009).

The traditional core wintering areas for the Arctic-breeding Russian MU as well as the temperate-breeding Baltic/North Sea MUs are located in the Netherlands and Germany. As the population has grown, the wintering area has been extended to Denmark, southern Sweden and Belgium (Ebbinge 2009; Nilsson 2014; Pihl et al. 2015). Hence, the MUs mix in winter, use some of the same staging areas and, to some extent, exchange

individuals between breeding areas, e.g. birds hatched on Gotland have been observed breeding in Russia (van der Jeugd and Litvin 2006; Feige et al. 2008). In spring, geese congregate in Sweden (Öland, Gotland), Estonia (Ganter et al. 1999) and, more recently, Lithuania (Svazas and Raudonikis 2009). Since the 1990s, an increasing proportion of the population stays longer in the wintering areas during spring.

The temperate-breeding Baltic/North Sea MUs was established in the early 1970s, when the first breeding pairs were found around Gotland and Öland, Sweden (Larsson et al. 1988). This first Baltic colony most probably was founded by birds originating from the Arctic-breeding Russian MU (Larsson et al. 1988). Subsequently they have spread in the Baltic region (Sweden, Finland, Denmark, Estonia) and the North Sea region (Norway, Denmark, Germany, the Netherlands and Belgium, including inland lake areas) (Larsson et al. 1988; Olsen 1992; Meinger and van Swelm 1994; Leito 1996; Koop 1998; Larsson and van der Jeugd 1998; Mortensen and Hansen 1999; Ouweneel 2001; Samuelsen et al. 2004; Kruckenberg and Hasse 2004; Anselin and Vermeersch 2005; Sudmann 2007; Voslamber et al. 2007; Feige et al. 2008; Gundersen 2016).

The temperate-breeding Baltic/North Sea MUs has a considerably shorter migration route, and some have even become resident. This change may have genetic consequences, but Jonker et al. (2013) showed that genetic exchange occurs between all the investigated breeding populations in Greenland, Spitsbergen, Russia, Sweden and the Netherlands, and that especially the newly established non-migratory sub-population in the Netherlands is characterized by high emigration into other populations. Van der Jeugd (2013) showed a high degree of emigration from the Dutch breeding population into the Russian population.

The main moulting areas are found at Gotland, Öland and the west Estonian Archipelago (Ganter et al. 1999), as well as within the breeding sites in the North Sea region, e.g. in the Dutch Delta area and along the West coast of Schleswig-Holstein, Germany.

Birds from all three Arctic breeding populations arrive at the breeding areas in May/June, and leave again in September/October, a period corresponding to the Arctic summer (Ganter et al. 1999; Ogilvie et al. 1999; Owen and Black 1999; Shariatinajafabadi et al. 2014). The temperate-breeding birds (Baltic/ North Sea MUs) breed in the original spring-staging areas and can initiate breeding at the end of April (Black et al. 2014). However, they still cannot fully exploit the peak in food availability at these low latitudes (van der Jeugd et al. 2009). The time taken for migration to and from the breeding grounds varies from a day to more than a month (Koffijberg and Günther 2005; Eichhorn et al 2009). In the 1990s and early 2000s an increasing proportion of birds delayed their departure from the wintering grounds (recorded in both the Russia/Germany & Netherlands and the Svalbard/South-west Scotland populations), but still manage to arrive at the breeding grounds in time to breed successfully. Some individuals now have a shorter distance between the wintering and breeding areas and an increasing proportion of the arctic-breeding birds from the Russia/Germany & Netherlands population skip traditionally used spring stopover sites in the Baltic (Eichhorn et al. 2006, 2009).

2 Habitat requirements

In the Arctic, Barnacle Geese typically nest on small islands free of Arctic Foxes *Vulpes lagopus* and in Russia very often under the protection of raptors, mainly Rough-legged Buzzard *Buteo lagopus* and Peregrine Falcon *Falco peregrinus* on cliff ledges or rocky outcrops (Tombre et al. 1998b; Ganter et al. 1999; Ogilvie et al. 1999; Owen and Black 1999). However, with the population expansion, the geese increasingly exploit new nesting habitats. For the Arctic breeding birds this includes dunes, saltmarshes, floodplains and typical tundra habitats (Syroechkovsky 1995; Gurtovaya 1997; Gurtovaya and Litvin 2001; Karagicheva et al. 2011; Rozenfeld and Sheremetiev 2014). Barnacle Geese breeding in the temperate regions prefer islands with short vegetation (Ganter et al. 1999; Feige et al. 2008). The preferred feeding habitats during breeding are salt marshes and tundra habitats (wet fens and drier tundra) (Prop et al. 1984; Alsos et al. 1998; Fox et al. 2007; Soininen et al. 2010; Rozenfeld et al. 2011; Rozenfeld and Sheremetiev 2014). During wing moult, the temperate-breeding brood-rearing geese often move to the mainland, to find sufficient feeding habitat (primarily managed pastures or meadows) for the goslings (Feige et al. 2008). The Arctic non-breeding

Barnacle Geese gather in rivers, lakes or along sheltered coast lines, foraging on wet or dry tundra vegetation in close proximity to the open water (Madsen and Mortensen 1987).

In autumn the main concentrations of Barnacle Geese feed on extensive salt marshes in the Russian tundra zone. Further south they feed on a mixture of semi-natural grassland, salt marshes as well as fertilized grasslands/pastures (Black et al. 1991; Prop and Black 1998). In the temperate regions geese forage on coastal salt marshes and increasingly on managed grassland. In some regions, they have largely abandoned their traditional feeding areas and prefer managed grasslands and winter cereals (Feige et al. 2008; J. Madsen pers. comm.), whereas at other sites Barnacle Geese still feed solely on salt marsh vegetation (e.g. Saltholm, Denmark) or short-cropped maritime grasslands (e.g. offshore islands, UK).

In late autumn and winter large numbers of the Russia/Germany & Netherlands birds leave the coastal sites and move inland to agricultural sites to feed on fertilized grasslands/pastures, winter cereals as well as agricultural leftovers after harvest, e.g. spilt grain, remains of sugar beet, carrots, potatoes (Owen and Kerbes 1971; Koffijberg and Günther 2005; J. Madsen pers. comm.) as well as on maize (Clausen et al. 2018). The Greenland and Svalbard birds remain coastal throughout the winter.

During spring migration, the geese track “the green wave” of grass growth and utilise sites when they peak in nutrient content (van der Graaf et al. 2006; Shariatinajafabadi et al. 2014). In Norway, an increasing number of Barnacle Geese have moved away from the maritime outer island spring staging habitats to feed on managed grasslands on larger islands nearer the mainland (Gullestad et al. 1984; Black et al. 1991).

At night during the non-breeding period Barnacle Geese roost on shallow-water and sheltered estuaries and lakes, as well as on fields, e.g. on Islay and other offshore islands (Owen 1980; Ydenberg et al. 1983).

3 Survival and productivity

Barnacle Geese are capable of breeding from the age of two years, but typically do not start before the age of three or four years. The peak in reproduction success however, is not reached before the age 10-11 years (measured as the number of females bringing at least one gosling to the wintering area) (Black and Owen 1995). Recorded annual mean clutch sizes in the three populations vary from 2.67-5.57 (Greenland population: 3.57-4.16 (Cabot 1988); Svalbard population: 3.30-4.06 (Dalhaug et al. 1996; Tombre et al. 1998a); Russian population Baltic areas: 2.67-5.57 (Larsson and Forslund 1994); Russian population Arctic areas: 2.77 – 3.91, and with a hatching success of 71 – 95% (van der Jeugd et al. 2003; Rozenfeld et al. 2011; Kondratyev et al. 2012; Rozenfeld and Sheremetiev 2014). Survival of young during the first six months is, however, heavily reduced due to predation, harsh weather and environmental conditions on the breeding grounds, a long and energy demanding migration to the wintering grounds and, potentially, density dependent effects due to food competition (Ganter et al. 1999; Ogilvie et al. 1999; Owen and Black 1999; Black et al. 2014; Prop et al. 2015).

The proportion of juveniles in the autumn population (age ratio) can range from 1% to 60%, which have been recorded in the temperate-breeding Baltic/North Sea MUs (Griffin 2014; van der Jeugd et al. 2014). The age ratios for the Russia/Germany & Netherlands population observed during first half of winter among flocks in the northern part of the Netherlands and adjacent parts of Germany have declined from on average 15% in the 1970s and early 1980s to an average of 10% recently (Figure 5a). Especially peak years with more than 20% first-year birds in the population have not occurred since 1999, whereas annual variation has become much less in the past decade. It is not clear to what extent the rise of temperate-breeding populations has influenced the trend in productivity, as these cannot be separated in winter when the age ratio counts are carried out. At this time the sample includes both Russian breeders and temperate-breeders from at least the Baltic (but probably less from the breeding populations in the Netherlands). Dramatic changes in productivity have been reported, especially in the colonies in the Baltic, where e.g. the juvenile ratio in the summer population on Gotland declined from 60 % in 1984 to 4 % in 2003 (van der Jeugd et al. 2014).

The age ratio for the East Greenland/Scotland & Ireland population has been recorded on Islay, Scotland since the early 1960s. During this period (1959/60-2016/17) the average proportion of juveniles was 11% (range 2.6-30.6%) (Figure 5b; WWT 2017a).

The age ratio for the Svalbard/South-west Scotland population has been recorded during approximately the same period and shows a slightly higher average proportion of juveniles of 15.2% (range 2.1-48.9%) (Figure 5c; WWT 2017b). In both populations, the proportion of juveniles has showed a substantial decline since the 1960s.

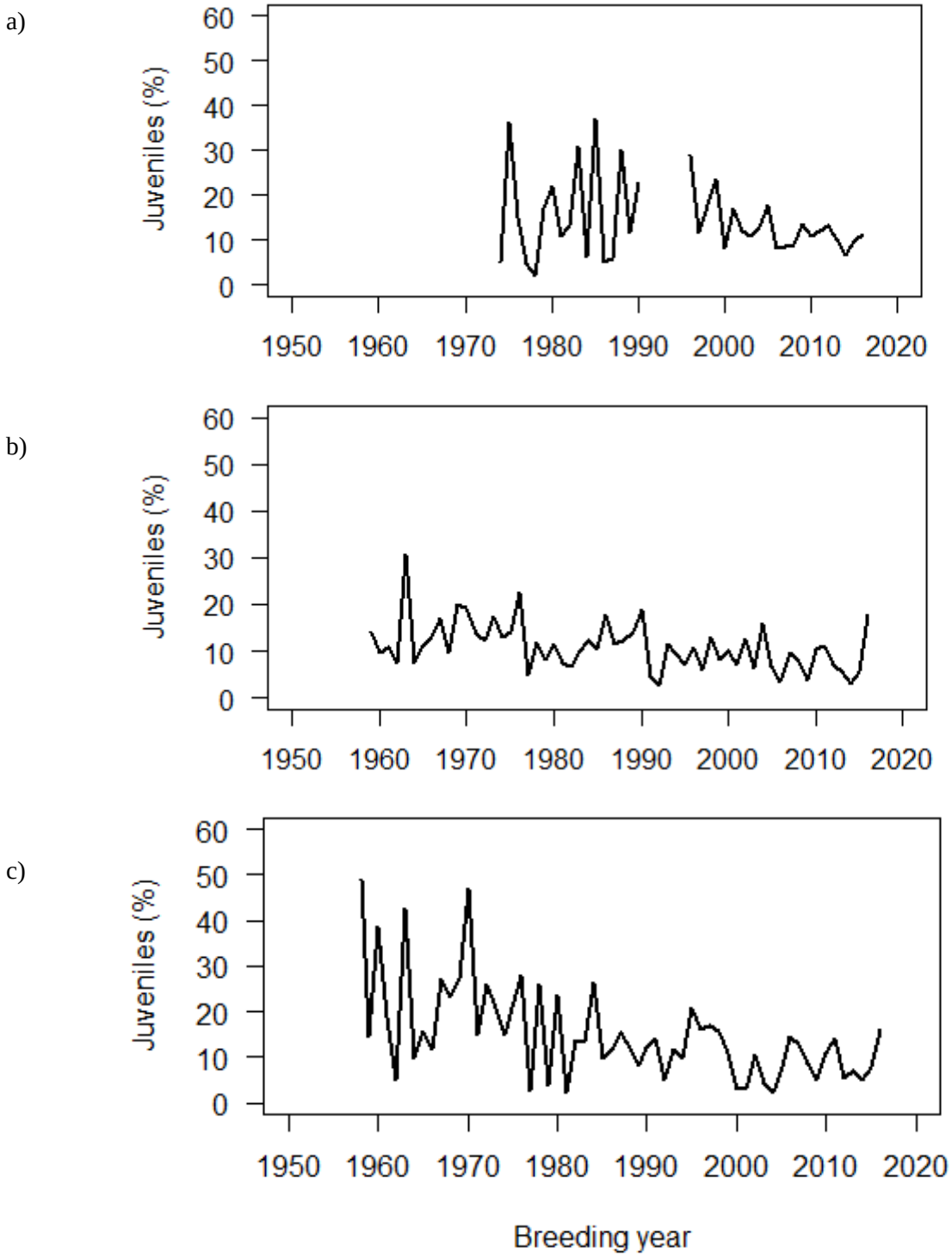


Figure 5. *Percentage of juveniles in the a) Russia/Germany & Netherlands population of the Barnacle Goose (Sovon Vogelonderzoek Nederland); b) East Greenland/Scotland & Ireland population (WWT 2017a); and c) Svalbard/South-west Scotland population (WWT 2017b).*

The high mortality during the first six months of life is also reflected in a lower survival rate for juveniles compared to adult birds. From the mid-1980s to the mid-2000s the first-year survival rate in the East Greenland/Scotland & Ireland population was 0.82, whereas the mean annual survival rate of older birds was 0.84 (Trinder 2014a). The annual mortality includes natural mortality as well as harvest. The East Greenland/Scotland & Ireland population of Barnacle Geese is hunted in Greenland and in Iceland, and is subject to derogation shooting in the UK, mainly on Islay and more recently on Uist, Tiree and Luing.

As part of a Population Viability Analysis (PVA) for the Islay sub-population of the East Greenland/Scotland & Ireland population (which regularly supports over 50% of the population), Trinder (2014a) estimated that the harvest rate on Islay had to exceed 3.8% (while maintaining a harvest rate of 1.5% on Iceland), before the Islay sub-population would stop increasing. In 2012/13 the bag size for Barnacle Geese on Islay increased following review of the bag prior to completion of the Trinder (2014a) PVA. Once that work was available, it was used to set the harvest rate around 3.8% with an aim of reducing the population as set out in the Islay Strategy from 2015/16 onwards (Annex 2). The most recent population estimates for the Islay sub-population suggest that the population has stabilized (with some fluctuations), which supports the predictions by Trinder (2014a); however, it is uncertain whether emigration from Islay to other wintering sites also contributed to the observed stabilisation.

The Svalbard/South-west Scotland population is protected from hunting throughout its flyway. In recent years however, there have been small amounts of derogation shooting on the Scottish side of the Solway Firth. Nevertheless, this population shows adult annual survival that is typically at or above 90% and juvenile survival rates between 0.85 and 0.87 for female and male birds, respectively (Black et al. 2014; Trinder 2014b).

For the Russia/Germany & Netherlands population, analyses of annual mortality rates revealed that mean mortality rates halved from 25% in 1958-1969 to 12% in 1978-1984 after major changes in hunting legislation (Ebbinge 1991). Currently, no representative population survival rates are available, and they are too complex to estimate because of the mixture of the Arctic and the temperate breeding MUs. The species is widely hunted in Russia and derogations have been granted to shoot birds in Estonia, Sweden, Denmark, Germany and the Netherlands. Currently, there is no comprehensive overview of the number of Barnacle Geese shot per annum, nor of the effects of derogation shooting, at the population level. However, the total population continues to grow and the colonies in Russia continue to expand despite the current level of derogation and other shooting (Annex 2).

Since 2005 the resident population of Barnacle Goose breeding in the Netherlands has been subject to derogation shooting as a measure to scare geese from sensitive crops and to reduce the population size. As a result, the annual survival rate has decreased from 0.98 (adults and juveniles) in 2004-2005 (before derogation shooting) to 0.85-0.91 for adults and 0.67-0.76 for juveniles between 2009 and 2012 (when derogation shooting was carried out). However, in 2013-2014, survival has increased again, most likely because the level of derogation shooting was insufficient to keep up with the reproduction capacity of the population. Furthermore, shooting especially during August and May might also be less effective because of the disproportionate take of immature post-breeding and of individuals from other populations wintering in the same area (van der Jeugd and Kwak 2017).

4 Population size and trends

4.1 Russia/Germany & Netherlands population

This is the largest and the fastest growing of the three populations. In the early 1950s this population was a pure Russian Arctic breeding population of around not more than 20,000 individuals (Boyd 1961; Syroechkovsky 1995) and the population size appeared to be, at least partly, limited by hunting (Busche 1991). The most recent population estimated based on counts data from 2007/08 arrived at an estimated 770,000 individuals (Fox et al. 2010). Since then the population has continued to increase and extrapolations of the annual growth rate point to a population size of about 1 million in 2011/12 (Hornman et al. 2013) and about 1.2 million in 2014/15 (K. Koffijberg/Sovon Vogelonderzoek Nederland). The time series used was compiled by Fox and Leafloor (2018) and represents a recalculation of count data since 2009; for subsequent data, a recalculation has not yet been made but awaits some national data to become available (Figure 6).

The majority of the population still breeds in Russia, but the Baltic/North Sea MUs are expanding quickly, with recent growth rates as high as 26% per year (Baltic MU; 24% North Sea MU), compared to 7.8% in the Russian MU (Fox et al. 2010; Black et al. 2014; Fox and Madsen 2017). In 2012, the resident breeding population in the Netherlands was estimated to count 52,200 individuals (Schekkerman 2012). Reasons for the initial population increase have been attributed to reduced mortality rates following improved protection from hunting (Ebbinge 1991). The continued increase has probably been caused by a combination of factors, such as improved winter foraging conditions, reduced persecution on the Russian breeding and moulting grounds, and the expansion of the breeding range to the temperate zone. However, the relative weight of factors contributing to population growth cannot be unravelled.

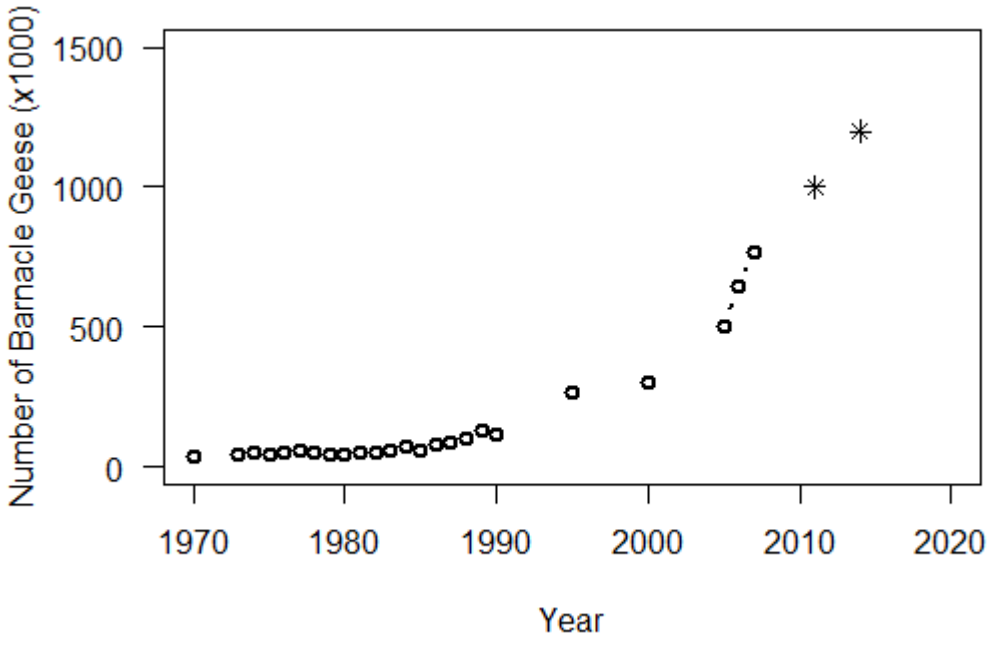


Figure 6. *Population size and trends for the Russia/Germany & Netherlands population of the Barnacle Goose. Dots: Recalculated counts; Stars: Extrapolation (Data: Ganter et al. 1999; Ebbinge BS 2009; Fox et al. 2010; Hornman et al. 2013; K. Koffijberg/Sovon Vogelonderzoek Nederland).*

4.2 East Greenland/Scotland & Ireland population

The size of the total East Greenland/Scotland & Ireland population has been estimated since 1959, when 8,300 birds were counted. Since then, the population has grown at an annual rate of 3.6%, and the latest estimates are from 2013[22,23], when 80,670 birds were counted, with 63,170 (78%) wintering in Scotland and 17,500 (22%) in Ireland (Mitchell and Hall 2013) (Figure 7; Table 4). Several factors have contributed to the long-term increase; the Barnacle Goose was protected from shooting in Ireland in 1976 and completely protected in Scotland in 1982 (Wildlife and Country Act 1981; although licensed shooting (i.e. derogation) continued on Islay until 1991 and again from 2000 until the present). Changes in agricultural management have also provided good quality winter feeding (e.g. the Agricultural Development Programme from 1980s) (McKenzie 2014; McKenzie and Shaw 2017). The decline in Barnacle Goose numbers from the mid-1970s to the early 1980s was probably due to an increase in crop protection and sport shooting combined with some poor breeding seasons (McKenzie and Shaw 2017). The Islay sub-population has stabilised since the second half of the 2000s as the result of population control under derogations.

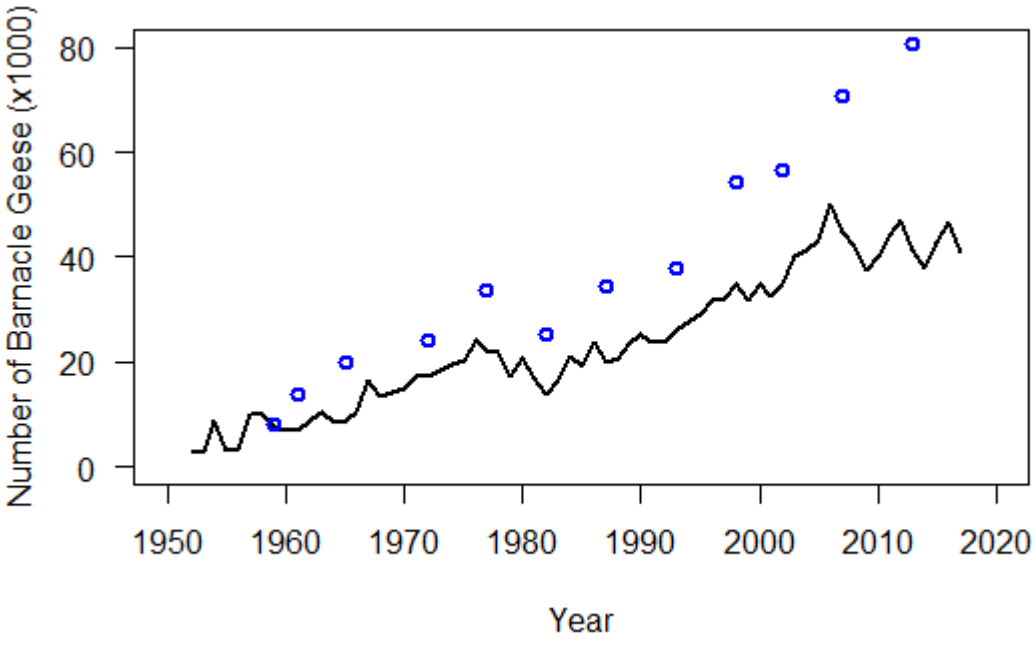


Figure 7. *Population size and trends for the East Greenland/Scotland & Ireland population of the Barnacle Goose (dots), and of the Islay sub-population which is counted each year (line) (Source: WWT).*

4.3 Svalbard/South-west Scotland population

The Svalbard/South-west Scotland population has been counted on the wintering grounds on the Solway Firth each year since 1958. This population was protected from shooting in Britain in 1954 and in Svalbard in 1955, which together with the establishment of the National Nature Reserve at Caerlaverock in 1957 led to a recovery in numbers (Owen and Black 1999). Since then the population has grown at an annual rate of 6.6%, increasing from 1,350 birds in 1958 to 41,700 in 2016/2017 (Griffin 2014; WWT 2017b) (Figure 8; Table 4). The recovery of the population has been attributed to reduced mortality rates following protection and creation of reserves

[22] Due to the remoteness of some wintering areas, a full survey of the East Greenland/Scotland & Ireland population is conducted approximately every five years, with the latest results being from 2013.
[23] The most recent results from the March 2018 international census (WWT in press) give a total population size of 72,162 Greenland Barnacle Geese across the international range in March 2018. Ireland held 16,237, the UK (Scotland) total was 55,925 and of that, 34,750 were counted on Islay.

(Owen and Black 1999). Now the primary working hypothesis for the continuous increase is the establishment of additional breeding colonies in Svalbard that are not limited by density related processes (Black 1998).

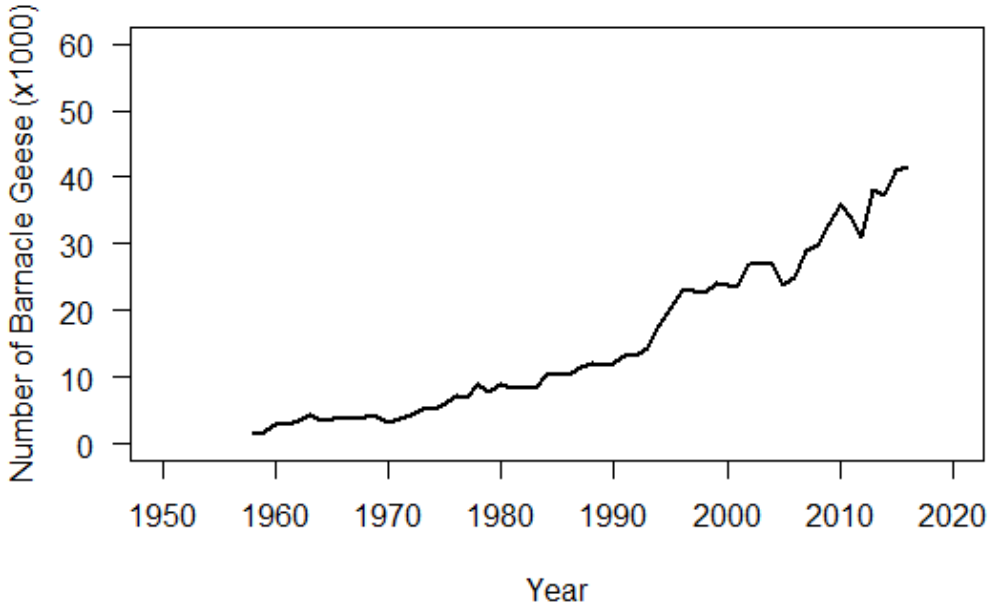


Figure 8. *Population size and trend for the Svalbard/South-west Scotland population of the Barnacle Goose (Source: WWT).*

Table 4. *Most recent Barnacle Goose population sizes and trend by Range State.*

[1]Hanna Joensen and Jens-Kjeld Jensen; [2]Kristinn Skarhedinsson; [3]Mitchell and Hall 2013, 2018; [4]Shimmings & Øien 2015; [5]Griffin 2017; [6] Eionet (https://bd.eionet.europa.eu/article12), Haas and Nilsson 2017; [7]Aarhus University; [8]Stefanie Opitz; [9]Sovon Vogelonderzoek Nederland; [10]Frank Huysentruyt; [11]Mooij et al. 2011, Sonia Rozenfeld; [12,]Finnish Breeding Bird Atlas and Eionet; [13]Leito 2017; [14]Eionet;[15] Saulius Svazas.

*Naturalized birds in the UK and Ireland are not subject to this plan.

Range State	Breeding numbers (pairs)	Quality of data	Year(s) of the estimate	Breeding population trend in the last 10 years (or 3 generations)	Quality of data	Max. size of migrating or non-breeding populations in the last 10 years (or 3 generations)	Quality of data	Year (s) of the estimate
Faroe Islands[1]	48	High	2016	Increasing	Good			
East Greenland/Scotland & Ireland population								
Greenland	NA							
Iceland[2]	1500-2000	High	2017	Increasing	Good			
Ireland[3]	*					17,500	Good	2013
UK[3] (Total)	*					63,170	Good	2013
UK[3] (Islay)	*					40,989	Good	2017/18
Svalbard/South-west Scotland population								
Norway Svalbard[4]	12,000-15,500	Good	2015					
UK[5]	*					41,700	Good	2016/17
Russia/Germany & Netherlands population								
Norway Mainland[5]	600-700	Good	2015					
Sweden[6]	4,900	Moderate (best estimate based on partial data with some extrapo-lation and/or modelling)	2008-2012	Long-term trend is increasing; Local decrease in Gotland and Öland	Good (complete survey)	Sept: 58,991 Oct: 186,423 Nov: 125,284 Jan: 22,934	Good	2016/17
Denmark[7]	4,521	Good	2015	Increasing	Good	Jan: 150,171 March: 197,362	Good	2015
Germany[8]								
Schleswig-Holstein	250	Good	2010	Unknown	Good	190,000	Good	2015
North Rhine-Westphalia	70-100	Good	2014	Slightly increasing	Good	16,800	Good	2015

Range State	Breeding numbers (pairs)	Quality of data	Year(s) of the estimate	Breeding population trend in the last 10 years (or 3 generations)	Quality of data	Max. size of migrating or non-breeding populations in the last 10 years (or 3 generations)	Quality of data	Year (s) of the estimate
Hamburg					Monitoring programme - Counts	11,748		2016
Mecklenburg - Vorpommern					Max. Monthly Counts	11,194		2014/15
Nieder-sachsen	45	Good	2014	Increasing	Max. Weekly Counts in 11 important geese areas	265,609	Good	2015/16
Netherlands[9]	16,000 – 22,000	Good	2013-2015	Increase, 13.2% per year 2006-2015	Good	845,000	Good	2012
Belgium[10]	200	High	2010-2015	Increase	High	13,000	High	1991-2016
Russia (sub data)[11] ***Kolguev*** ***Vaygach*** ***Kanin*** ***Kolokolkova bay***	 180,000 2,078 9,800 3,000					346,000 birds were counted during autumn in Nenetsky Autonomous Okrug		2015/17
Finland[12]	3,800-5,000	Moderate	2013	Increase, 39% per year since 1985.	Good	>300,000 individuals (daily maximum)	Good	2016
Estonia[13]	70-120	Good	1999-2017	Decrease (2001-2012) (Long-term trend is increasing)	Good	70,000-140,000	Good	2017
Latvia[14]	0					0 (January)		2017
Lithuania[15]	0					3,200	Good	1997-2017

Annex 2 Problem Analysis

1 Services and disservices

1.1 General overview

The analysis of services and disservices provided by Barnacle Goose is primarily based on responses by Barnacle Goose Range States (11[24] out of 15 Range States) to a questionnaire sent out by the EGMP Data Centre in March 2017, with additional information provided by specific countries and stakeholders as well as by literature review. Many of the general ecosystem services or disservices provided by geese have been summarised by Buij et al. (2017), but the specific influence accruing from Barnacle Geese are briefly set out here.

1.2 Results from the questionnaire

Damage to agricultural crops

For most Range States, information provided is a qualitative assessment made by the authorities and may be backed by the number of complaints over damage received. For some countries evaluations are backed by semi-quantitative field assessments of damage made by expert assessors, but only few quantitative experimental studies are available to document the actual yield losses and their variation (see Fox et al. 2017). For some countries, the amount of compensation paid to farmers to allow geese to forage on agricultural land has been used as an indicator of the extent of damage. Hence, from the data available it is possible to evaluate the direction of trend in national damages, but not the overall damage in economic terms.

Already in the 1990s, agricultural conflict had increased in the ranges of all three populations with the growth of population sizes (Owen and Black 1999, Ogilvie et al. 1999). Ganter et al. (1999) reported that for the Russian/Baltic population no major agricultural conflict occurred on staging and wintering grounds, although with the growth of the population some conflict had arisen locally. However, the authors also noted that the populations still used more or less natural coastal habitat for a large part of the year or concentrated on nature reserves and therefore suggested it was unlikely that the damage caused by Barnacle Geese would reach the dimensions of that caused by other goose species.

Based on responses to the questionnaire, damage to agricultural crops caused by Barnacle Geese has been recorded in all the present wintering and staging Range States, with an increasing trend over the last 10 years (2007-2017) for all but one Range State (with decreasing/stable trend in Belgium). In most countries, grassland (permanent, fertilized as well as new-sown) is the most affected crop, followed by winter and spring cereals, beans, maize, vegetables and ripening cereal.

In eight[25] out of 11 Range States, economic subsidy schemes or compensation payments have been instigated to alleviate the conflict and compensate farmers for losses. In six[26] of these, there is systematic recording of agricultural damage caused by geese. For example, in the Netherlands, assessors measure the length of the damaged (grazed) grass swards using a so called “grass height meter” and compares it with measurements taken at an undamaged reference point, preferably within the same parcel of land. The dry weight biomass per centimetre of grass is based on previous research and is set at 150 kilograms per hectare of dry matter for the spring cut and 120 kilograms per hectare for summer cuts. The price per kilogram dry matter is determined annually for the spring and summer cuts. In arable crops and vegetable cultivation traded in kilograms or by piece, the assessor determines the damage based on visual perception or on measurements and counts at contrasting damaged and undamaged plots. The potential yield per hectare and prices are based on published data of average yields from previous years, or - if these are not available - based on actual market prices.

[24] Belgium, Denmark, Finland, Germany, Iceland, Latvia, Lithuania, Netherlands, Norway, Sweden, UK.
[25] Belgium, Finland, Germany, Latvia, Netherlands, Norway, Sweden and UK.
[26] Belgium, Finland, Germany, Latvia, Netherlands and Sweden.

In the Netherlands and Sweden (Russia/Germany & Netherlands Barnacle Goose population) time-series of compensation payments and wintering/staging Barnacle Goose numbers are available. The present assessment is based on tentative data, which is currently analysed in more detail. Nevertheless, both show strong correlations with the goose numbers, even if economic compensation does not exactly reflect the change in goose damage in natural terms, as damage to crops caused by geese varies depending on weather conditions, soil types, age of pastures and timing of goose grazing (see Fox et al. 2017). Furthermore, it is not possible to take changes in compensation rates over the years into account in these calculations. Despite these shortcomings, expressing the damage in monetary terms is an appropriate solution because damage is defined as income loss or extra costs to an economic interest. The two national datasets indicate that national authorities spend an increasing amount of money to alleviate agriculture conflict with Barnacle Geese (Figure 9).

In the main wintering areas in Lower Saxony, Germany uses EU agri-environment subsidy schemes to create undisturbed foraging areas for the geese, c. 24.000 ha of grasslands and tillages are managed under these schemes. For such an adapted management Lower Saxony spends in cooperation with the EU c. 7.0 million EUR per year (for all goose species)[27]. In 2015 Finland, (the state) paid 160,000 EUR to compensated winter cereal damage, however, there is no information on real annual damage. In Belgium damage has been systematically reported since 2009, and the annual estimated compensation paid since then is c. 5,000 EUR[28].

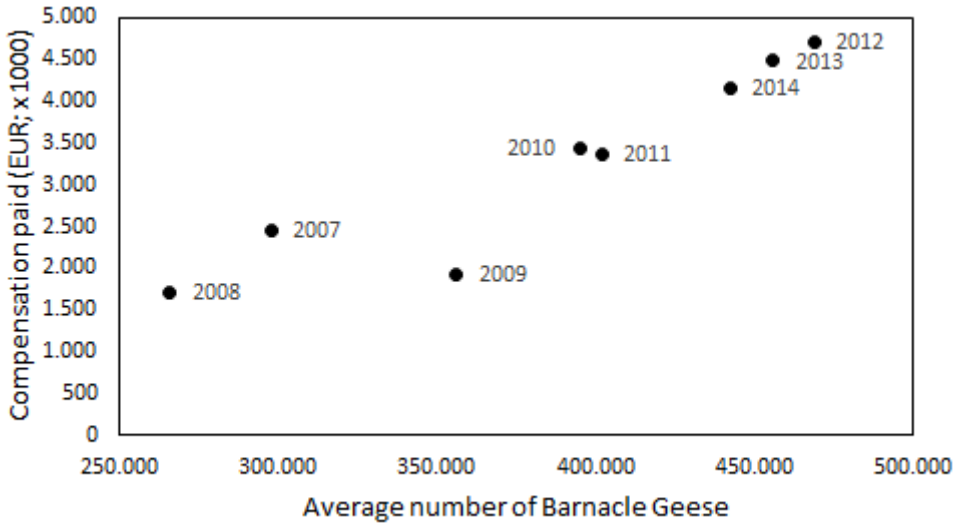
In the UK (in 2016), compensation payments (all crop types) totalled 1,893,000 EUR for the East Greenland/Scotland & Ireland Barnacle Goose population and 414,000 EUR for the Svalbard/South-west Scotland Barnacle Goose population. In Norway, a subsidy system is in place for the spring staging Svalbard Barnacle Geese, costing 98,000 EUR for fertilised grassland (pasture), 78,000 EUR for permanent grassland and 20,000 EUR for new-sown grassland (data as from 2016).

Other management actions used to alleviate the problem of Barnacle Goose damage to agriculture encompass local scaring, derogation shooting, provision of alternative feeding areas and, for summering geese, culling of adults and young, egg collection, egg oiling/pricking and shaking of eggs. National goose management strategies have been implemented in only two countries (Norway and Scotland). However, the Netherlands also implement a variety of goose management strategies at the level of the provinces.

[27] In the years 2008-2010 Lower Saxony carried out an extensive study on crop damage of wintering geese in the main wintering areas along the Wadden Sea coast. These areas are mainly used by Barnacle Geese and White-fronted Geese. With regard to crop types all types of grasslands (new sown, fertilized, permanent) were mainly affected. It turned out that on average farmers lost 30 % of the biomass of the first cut. The second cut of grass was almost unaffected. Since farmers claimed that crop damage has increased over the last 10 years, the study is currently repeated on the same fields as used 10 years previously. Besides grass plants wintering geese also caused damages to other crops, like winter cereals and rape (Lower Saxony).

[28] Damage is reported at species level, but Barnacle Geese often cause damage together with other species. This amount represents the average damage of all cases where Barnacle Goose was involved, hence including cases where Barnacle Geese caused damage together with other species.

a)



b)

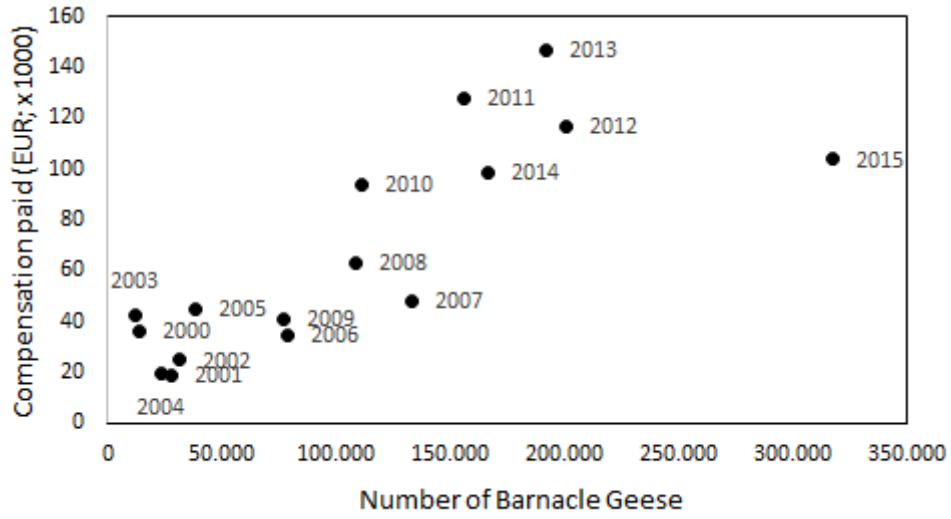


***Figure 9**. Relationship between number of Barnacle Geese and compensation paid (EUR) in a) the Netherlands 2007/08-2014/15[29] and b) Sweden 2000-2015[30]. It should be noted that the October numbers in Sweden represent the seasonal peak, hence these birds are only there for one or two months. By January, the numbers in Sweden drop to a tenth of those numbers. In the meantime, birds spend the period between November and March in the Netherlands including the more damage prone spring period. Furthermore, the amount of compensation payments is not corrected for inflation over time for either countries.*

[29] For the Netherlands, the national total of Barnacle Geese has been used, averaging the monthly national total per winter season (September-May), source: Sovon Vogelonderzoek Nederland. Damage figures from the Netherlands are from Faunafonds.

[30] For Sweden, the national total number of Barnacle Geese present in October has been used as an estimate of the abundance of geese. Sources: L. Nilsson, unpubl. data; Swedish Wildlife Damage Centre (J. Månsson unpubl. data).

Air safety (bird strike)

Four[31] out of 11 Range States reported bird strikes with Barnacle Geese as a management issue. Mainly passing/migrating birds appear to cause concern. For instance, a bird strike with a Barnacle Goose was recorded for the first time at Copenhagen Airport A/S (CPH) in 2002. The frequency of bird strikes with Barnacle Geese (as well as with Greylag Geese) has increased during the last 10 years (Figure 10a). The increase in frequency of Barnacle Goose bird strikes is mainly linked to an increase in numbers of Barnacle Geese. This is among other reflected in an increase in records of geese passing over or settling at CPH since 2004 (Bradbeer et al. 2017) and a corresponding increase in Barnacle Geese migrating over Falsterbo in south Sweden in the 2000s (Falsterbo Bird Observatory; http://www.falsterbofagelstation.se/index_e.html). Whereas the number of operations (take offs and landings) in CPH have been quite stable (2007-2017; range 236,172 (2009) - 265,784 (2016); mean: 252,326) (C. Rosenquist pers.comm).

To improve and provide a targeted and long-term wildlife management, CPH is in the final stage of implementing a 3D radar system for monitoring birds on the airfield and in its surroundings. The main purpose with the radar is to collect comprehensive data on bird movements (numbers, body size, flight direction, flight height, flight speed) and thereby strengthen analysis of bird hazards, especially migrating geese e.g. Barnacle Geese. Since the radar will not be used for sense-and-alert[32], it is not expected to see a direct effect on bird strike numbers. However, it is expected that stronger wildlife hazard analyses and targeted management will lead to a reduction of the risk posed by these wildlife hazards e.g. Barnacle Geese[33] (C. Rosenquist pers. comm).

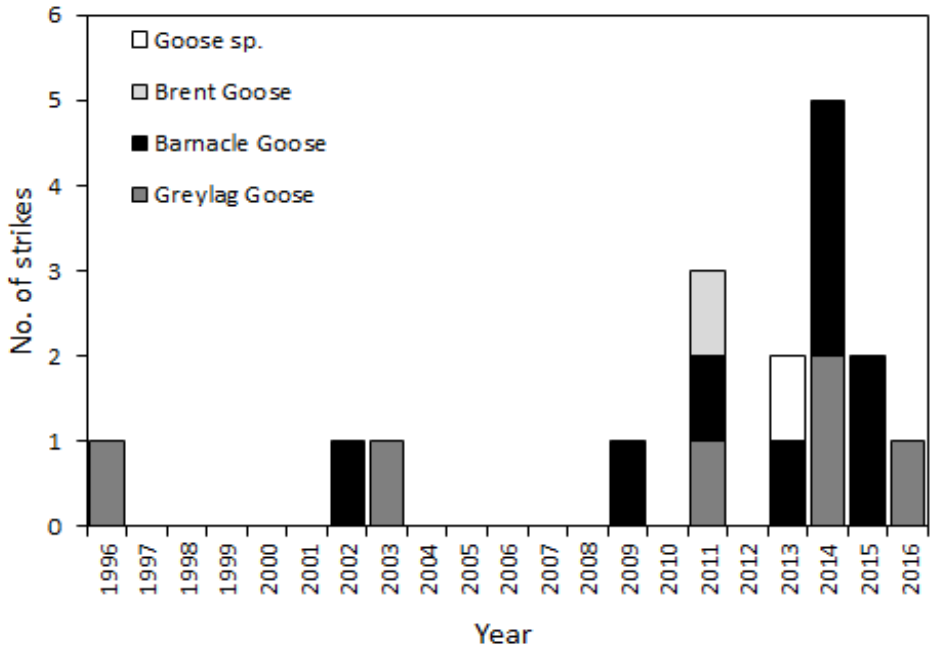
In the Netherlands, at Schiphol Airport, bird strikes with geese have been recorded since 2005 and the frequency of bird strikes with geese in general has increased during the last 10 years (Figure 10b) despite a comprehensive management scheme being in place.

[31] Sweden, Denmark, Belgium, UK.

[32] A sense-and-alert system is a decision-making system that provide the pilot/plane with the ability to re-route its current path to a safer flight course.

[33] Even though large numbers of Barnacle Geese are observed at the airfield during migration season, it is not reflected in the bird strike statistic involving Barnacle Geese, and hence the purpose with the radar is to maintain the low risk via the aforementioned approach (C. Rosenquist pers.comm.).

a)



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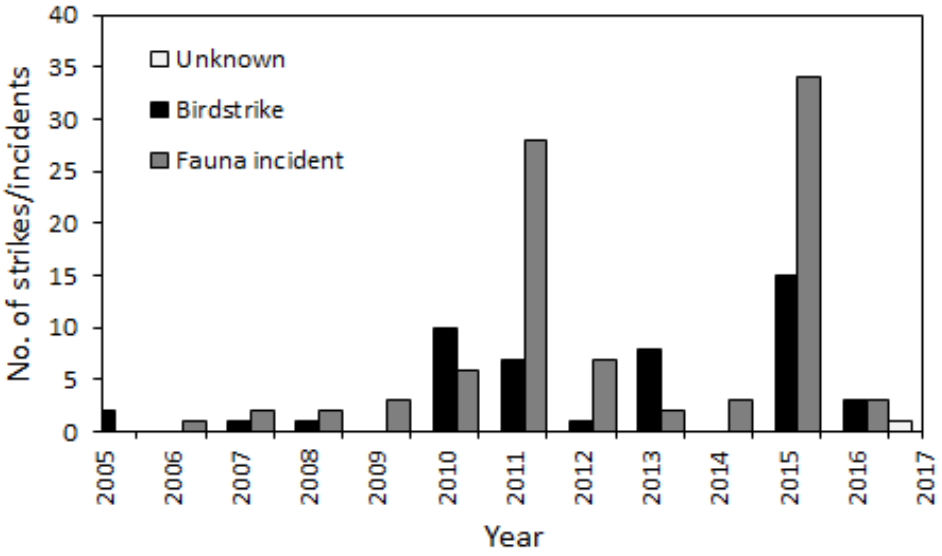

***Figure 10**. Annual number of bird strikes caused by geese in a) Copenhagen Airport 1996-2016 and b) Schiphol Airport 2005-2017 (sources: Copenhagen Airport & Bird Control Schiphol). At Schiphol Airport, bird strike is an actual collision of a goose with an airplane; fauna incident involves a found goose (often still intact) at the Schiphol site.*

<u>*Ecosystem impacts*</u>

The information reported here is based on responses to the questionnaire and hence represent a first qualitative evaluation of issues of concern and their trends. Since information from two (Greenland and Russia) out of three Arctic Range States is lacking, possible impacts on Arctic ecosystems cannot be evaluated at present.

Eight[34] out of 11 Range States, excluding those with no information, have reported some kind of ecosystem impacts caused by Barnacle Geese, most of them with increasingly adverse effect. Only in Germany has a stable and positive effect been observed on breeding of some meadow bird species as a result of goose grazing

[34] Belgium, Denmark, Germany, Finland, Norway, Netherlands, Sweden, UK.

of grassland. All ecosystem impacts caused by Barnacle Geese recorded by the Range States were only at a few sites at a local level except grazing of swards, which was reported on a regional level by one Range State (Table 5).

Table 5. *Summary of ecosystem impacts caused by Barnacle Geese.* The summary is based on the questionnaire, which was sent out to the Range States. Unless otherwise stated the increasing trend is negative. *A stable and positive effect is observed in certain areas in Germany.

Management issue	Trend over last 10 years	Number of countries
Eutrophication of lakes (defaecation)	Increasing	3 - Local (few sites)
	No effect	7
	No information	1
Grazing of lake vegetation (effects on reed vegetation)	Increasing	2 - Local (few sites)
	No effect	6
	No information	3
Grazing of lake vegetation (effects on breeding birds)	Increasing	1 - Local (few sites)
	No effect	7
	No information	3
Grazing of swards (effects on breeding meadow birds)	Increasing*	4 - Local (few sites)
	No effect	4
	No information	3
Grazing of swards (effects on terrestrial ecosystem)	Increasing	2 - Local (few sites) and Regional
	No effect	3
	No information	6
Grazing of swards (effects on vegetation composition)	Increasing	4 - Local (few sites) on the winter/staging areas (UK, NL) and summering areas (NL, BE, FI) for the Baltic/S North Sea group of Barnacle Geese
	No effect	2
	No information	5
Grazing of natural terrestrial habitats	Increasing	3 - Local (few sites)
	No effect	3
	No information	5

Health/welfare issues

Only two[35] out of 11 Barnacle Goose Range States have reported disease transmission as a management issue, whereas half of the countries reported having no information. However, the replies probably reflect a lack of knowledge, as relative few studies have been conducted on this subject. What is known, however, is that wild goose species may act as a principal reservoir for viral diseases that can impact birds (e.g. avian influenza) as well as carriers of pathogenic protozoans *Toxoplasma gondii* and bacteria (e.g. *Camphylobacter*). These diseases have the potential to cause human health effects (Alexander 2000; Gorham and Lee 2016), although there is little evidence of transfer to livestock and humans (Weber & Heuvelink 2013; Elmberg et al. 2017). Furthermore, due to their migratory behaviour, geese can transport infectious diseases over long distances. For example, it is suggested that migratory geese including Barnacle Geese carry *T. gondii* from the temperate regions to the high Arctic environment where it is transferred to top predators like Polar Bears *Ursus maritimus*

[35] Belgium and the Netherlands.

and Arctic Foxes via their predation of adult geese (Prestrud et al. 2007; Sandström et al. 2013). Disease loading is higher in the temperate-breeding Barnacle Geese compared to the Arctic breeding birds (as measured in goslings) (Sandström 2017). The fact that Arctic and sedentary Barnacle Geese mix at shared wintering sites and that birds are known to exchange between subpopulations, implies that the infection loading in the population as a whole is likely to increase (C. Sandström pers. comm.). Hence, with continuous growth in the populations, it can be expected that the spread and transfer of diseases to the Arctic ecosystems will increase. Nevertheless, disease transfer is a naturally occurring phenomena and its importance is still poorly understood. Therefore, more information/research is needed to better understand its management implications for the population.

Three[36] out of 11 Range States report fouling of amenity areas as a management issue, which is related to local brood-rearing and moulting birds in parks and on beaches. However, these represent only relatively localised issues.

1.3 Literature review

Many of the general ecosystem services or disservices provided by geese have been summarised by Buij et al. (2017), but those specific influences accruing from Barnacle Geese are briefly set out below.

Defaecation – propagule dispersal and depletion

Small scale propagule dispersal was common in Barnacle Goose faeces at breeding areas in Svalbard, mainly grasses and Cyperacean species, but also forbs (especially Arctic Bistort *Bistorta vivipara*) and berries (Bruun et al. 2008), suggesting geese could potentially assist selected species to extend their native range in response to climate change. In contrast, intensive Barnacle Goose grazing in the High Arctic has been shown to deplete seed stocks, influencing the long-term potential for vegetation recovery after disturbance and therefore the long-term plant species diversity and dynamics (Kuijper et al. 2006).

Defaecation – nutrient cycling

Highly selective foraging and low levels of digestion of plant foods make goose droppings nutritionally attractive to other herbivores. Hence, sheep and cattle eat Barnacle Goose faeces on the Scottish islands of Coll and Gunna (Ingram 1933), while Svalbard Reindeer *Rangifer tarandus platyrhynchos* consume their droppings because this elevates their own food intake rates above normal grazing (van der Wal and Loonen 1998). N and P contributions from Barnacle and Pink-footed Geese *Anser brachyrhynchus* to ultra-oligotrophic shallow tundra ponds had little impact on phytoplankton biomass on Svalbard because high biomass of the efficient zooplankton grazer *Daphnia*, in the absence of fish and invertebrate predators limited phytoplankton growth (van Geest et al. 2007).

Human value

The presence of large flocks of Barnacle Geese generates a range of benefits, both in terms of non-use (people that gain pleasure from simply knowing they exist, passive use (viewing by birdwatchers and outdoor enthusiasts) as well as consumptive use (hunting) (McMillan et al. 2004). Non-monetary societal values also embrace (i) geese as features of our "heritage" (equivalent to great works of art or architecture); and (ii) humans as custodians of the environment that bear a moral responsibility to avoid local and population extinctions of wild geese, not least because of our lack of understanding of the implication of such loss and because of their value as indicators of environmental change (e.g. Williams 1991).

While hunters most often financially contribute directly to governments and landowners in order to have the opportunity to shoot geese, societal benefits of passive and non-use are more difficult to quantify. Hunters, like other users of nature, often spend sizeable amounts of money on participating in their activities, which can bring direct and indirect economic benefits to rural areas of Europe during the winter months (Kenward et al.

[36] Finland, Norway and Sweden.

2008). Estimates from 1997 suggested that goose watching on Islay brought between £269,000 (303,088 EUR) and £346,000 (389,846 EUR) to the island's economy per annum, which at that time supported Barnacle Geese that caused an estimated £337,000 (379,705 EUR) to £788,000 (887,856 EUR) damage annually to farmers there (Reyment et al. 1998). Furthermore, assessments of "willingness-to-pay" surveys suggest that the British public elsewhere was very willing to fund the maintenance of such goose aggregations that existed at the time, at levels that far outweighed the financial costs to maintaining them (e.g. through subsidies to farmers suffering damage, see McMillan et al. 2002, 2004; Hanley et al. 2003; McMillan and Leader-Williams 2008).

2 Threats to populations

2.1 General overview

The analysis has been based on feedback to a questionnaire sent to each of the Barnacle Goose Range States in April 2017. Country experts have provided national feedback, which has been synthesized by the EGMP Data Centre.

Threats have been identified based on IUCN - CMP Threats Classification Scheme (Version 3.2), which define threats as *the proximate human activities or processes that have impacted, are impacting, or may impact the status of the taxon being assessed (e.g., unsustainable fishing or logging). Direct threats are synonymous with sources of stress and proximate pressures* (IUCN Red List – Threat Classification scheme).

Hereafter, and according to BirdLife International standards, each threat in each country is assigned an "impact score" (0-3) for (Appendix A):

- Timing (ongoing or future);
- Scope (i.e. the proportion of the total population affected);
- Severity (the overall declines caused by the threat).

Based on country scores (scope and severity) the overall impact score for each population has been assigned (Appendix B; Table 6).

Table 6. *Final impact score for selected threats to the East Greenland/Scotland & Ireland, Svalbard/South-west Scotland and Russia/Germany and the Netherlands populations of the Barnacle Goose.* Threats with a current low impact are shaded.

Threats	East Greenland / Scotland & Ireland	Svalbard/South-west Scotland	Russia/Germany & Netherlands
1 Residential & Commercial Development			
1.1 Housing and Urban Areas (e.g. land claim or expanding human habitation that causes habitat degradation in riverine, estuary and coastal areas)	Negligible	Negligible	Negligible
1.2 Commercial & Industrial Areas (e.g. factories)	Negligible	Future unknown	Negligible
2 Agriculture & Aquaculture			
2.1 Annual & Perennial Non-Timber crops			
2.1.1 Shifting Agriculture			Negligible
2.1.2 Small-holder Farming	Future unknown	Future unknown	Negligible
2.1.3 Agro-industry Farming (e.g. increasing of the number of domestic Reindeer, degradation and erosion of habitats including salt marshes)	Future unknown	Future unknown	Negligible

Threats	East Greenland / Scotland & Ireland	Svalbard/South-west Scotland	Russia/Germany & Netherlands
2.2 Wood & Pulp Plantations			
2.2.2 Agro-Industry Plantations	Future unknown	Future unknown	Negligible
3 Energy Production & Mining			
3.1 Oil & Gas Drilling	Unknown		Negligible
3.2 Mining & Quarrying	Future unknown	Negligible	Unknown
3.3 Renewable Energy e.g. wind farms (birds flying into wind-turbines)	Negligible/ Future unknown	Negligible/ Future unknown	Negligible/ Unknown
4 Transportation & Service Corridors			
4.1 Roads & Railroads	Negligible		Negligible
4.2 Utility & Service Lines (e.g. pipelines, powerlines, electrocution of wildlife)	Negligible	Negligible	Negligible
5 Biological Resource Use			
5.1 Hunting & Collecting Terrestrial Animals			
5.1.1 Intentional Use (species taken is the target)	Low		Unknown
5.1.2 Unintentional effects (species taken is not the target)	Negligible	Negligible	Unknown
5.1.3a Persecution/Control (effect on flyway population size)	Low		Negligible
5.1.3b Persecution/Control (effect on national breeding population)			Low
6 Human Intrusions & Disturbance			
6.1 Recreational Activities	Negligible/ Future unknown	Negligible	Negligible
7 Natural System Modifications			
7.2 Dams & Water Management/Use			
7.2.3 Abstraction of Surface Water (agricultural use)			Unknown
7.2.10 Large dams	Unknown		Unknown
7.3 Other Ecosystem Modifications (actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare) (e.g. abandonment of agriculture, natural salt marsh succession (no grazing))	Unknown	Unknown	Negligible
8 Invasive & Other Problematic Species, Genes & Diseases			
8.2 Problematic native Species/Diseases			
8.2.2 Named Species (e.g. Polar Bear, White-tailed Eagle, Red Fox, Arctic Fox, Raccoon Dog)	Negligible	Low	Low

Threats	East Greenland / Scotland & Ireland	Svalbard/South-west Scotland	Russia/Germany & Netherlands
8.5 Viral/Prion-induced Diseases			
8.5.1 Named "Species" (Disease) (e.g. avian influenza)	Future unknown	Future unknown	Negligible/ Future unknown
9 Pollution			
9.2.1. Oil Spills	Future unknown		Negligible/ Unknown
9.3.3 Herbicides & Pesticides			Negligible
9.2.3 Lead shot (e.g. ingested by birds)	Unknown	Unknown	Unknown
11 Climate Change & Severe Weather			
11.1 Habitat Shifting & Alteration (e.g. sea level rise)	Future unknown	Future unknown	Future unknown
11.3 Temperature Extremes (e.g. resulting in mismatch of breeding cycle availability and quality)	Future unknown	Future unknown	Future unknown
11.4 Storms & Flooding		Future unknown	Unknown

Based on the aggregated results of the threat analysis, all known threats are either negligible or low. Threats that have been assessed as having a low impact, are 1) Hunting & Collecting Terrestrial Animals, specifically Intentional Use (species being assessed is the target) and Persecution/Control (effect on flyway population size) for the East Greenland/Scotland & Ireland population of Barnacle Geese and Persecution/Control (effect on national breeding population) for the Russia/Germany and Netherlands population and 2) Invasive & Other Problematic Species, specifically due to Polar Bears having been assessed as having a low impact on the Svalbard/South-west Scotland population of Barnacle Geese.

2.2 Hunting/Derogation shooting

Barnacle Goose is a huntable species in Russia, Greenland and Iceland. It is protected from hunting in Norway. In the EU, Barnacle Goose is not listed in Annex II of the Birds Directive, so it is not a huntable species. The species is listed in Annex I of the Birds Directive according to which Member States shall ensure the species is the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. However, it may be killed if the conditions for derogation set out by Article 9 of the Directive are satisfied. Currently, the species is subject to derogation taking in the UK, Estonia, Norway, Sweden, Belgium, Denmark, Germany and the Netherlands.

Numbers taken under derogation are reported to the European Commission each year. Hence, data on derogation are available throughout this process; in contrast, in Norway the availability of data on derogation taking varies between years.

East Greenland/Scotland & Ireland population

The East Greenland/Scotland & Ireland population is hunted in Greenland and Iceland; in addition, the population is subject to derogation shooting in the UK. The hunting season in Greenland starts in September and runs to 30 April during which period the species is largely absent. In addition, in the management area of Ittoqqortoormiit, there is an extended season on migrating Barnacle Geese from 1 September to 30 May, which also means that most Barnacle Geese in Greenland are shot here (91%). Harvest data on species level from East Greenland are available from 2006. The number of Barnacle Geese shot per year ranged from 0 in 2013 to 48 in 2007. Of geese shot, 63% were taken in May (Ministry of Fisheries & Hunting, Piniarneq database, 2017, Harvest of Barnacle Geese in East Greenland, Government of Greenland) (Table 7).

The hunting season in Iceland starts 1 September and extends to 15 March. Due to the growing number of breeding Barnacle Geese in Iceland, hunting has locally been delayed (until 25 September) to protect the breeding birds in Eastern and Western Skaftafellssýsla. Harvest data from Iceland are available on a species level from 1995, with a total of 2,240 shot in 2016 (latest estimate).

In the UK, Barnacle Geese have been subject to derogation shooting mainly on Islay since 2000 and more recently on Uist, Tiree and Luing. The total number shot is 2,210 (2015/2016) (Table 7).

The most recent estimates of harvest (hunting and derogation shooting) sum to a total of approximately 4,500 individuals being taken from the East Greenland/Scotland & Ireland population per year.

Svalbard/South-west Scotland population

The Svalbard/South-west Scotland population is protected from hunting throughout its flyway, in recent years, however, there have been small numbers shot (56; under derogation shooting) on the Solway (Table 7).

Russia/Germany & Netherlands population

The Russia/Germany & Netherlands population is hunted in Russia and is subject to derogation shooting and culling in Estonia, Sweden, Belgium, Denmark, Germany and the Netherlands. Based on the most recent estimates, the number of Barnacle Geese subject to derogation shooting reached a total of at least 47,286 individuals, in addition to the destruction of 2,991 eggs (Table 7).

In Russia the "official" hunting bag statistics of geese consist of mandatory hunting bag reports and a new method of differentiating the species of bagged waterbirds by pictures. Based on the mandatory hunting bag reports, an estimated 223,000 geese were shoot annually between 2014-2016. According to the picture survey 16,500 (7.4%) of these were Barnacle Geese (Solokha & Gorokhovsky 2017) (Table 7).

Furthermore, some data are available from Russia from the territory of Nenetsky Autonomous Okrug where hunters have reported their hunting bags. The reported numbers exclude birds harvested by local hunters and poachers and are only available from the autumn season. As the intensity of spring hunt is considered to be about eight times higher than the autumn hunt according to the ringing database, Russian hunting bag statistics may seriously underestimate the actual harvest (S. Rozenfeld pers. com.).

Due to the uncertainty about the harvest in Russia, the total harvest of the population cannot be reliably estimated. The two sources of known harvest total at least 67,000 individuals being taken from the Russia/Germany & Netherlands population per year.

Common to all three populations is that none of them currently show any sign of density dependent effects on overall population growth (Figures 6-8) and that the current harvest levels are not sufficient to stabilize the overall population sizes at current levels (Trinder 2014a, b; van der Jeugd and Kwak 2017).

Crippling due to shotgun shooting may cause a health problem to inflicted geese (sublethal injuries affecting fitness) and is an ethical concern (Noer et al. 2007) which has received attention in the ISSMP for the Pink-footed Goose (Madsen et al. 2017). In Barnacle Geese caught by canon-netting in Denmark in spring, 13% of adult geese and 6% of juvenile geese carried shotgun pellets in their tissue (Holm and Madsen 2013).

Table 7. *Availability of bag statistics/derogation reports and recent bag sizes for the Barnacle Goose.*

[1]East Greenland/Scotland & Ireland population, [2]Svalbard/South-west Scotland population. *For EU countries, derogation reports to the EU; ** Guestimate.

Range state	Annual statutory bag statistics*	Annual bag size (latest estimate)	Period	Responsibility
Russia	No	Brants (Barnacle+Brent): 2,004** 3,141**	 2015 2016	Hunting bag report from hunters in the territory of Nenetsky Autonomous Okrug
Russia	No	16,500 **	2014-2016	Solokha & Gorokhovsky 2017
Greenland	Yes	41	2016	Departementet for Fangst og Fiskeri
Iceland	Yes	2,240	2016	http://statice.is/
Ireland	Yes	0/NA	2008-2016	EU derogation report
UK[1]	Yes	2,210	2015/2016	EU derogation report
UK[2]	Yes	England: 23 Scotland:33	2016/2017	EU derogation report
Norway	Yes	980 eggs	2017	Oslo, Asker, Bærum and Nesodden Municipalities
Sweden	Yes	1,980 + 202 eggs	2016	EU derogation report
Denmark	Yes	17,258	2016	EU derogation report
Germany	Yes	1,271+1,120 eggs + 300 nests	2016	EU derogation report
Netherlands	Yes	24,155 + 671 eggs + 2,368 nests	2016	EU derogation report
Belgium	Yes	18 eggs	2016	EU derogation report
Finland	Yes	0	2008-2016	EU derogation report
Estonia	Yes	2,622	2016	EU derogation report
Latvia	Yes	0	2008-2016	EU derogation report
Lithuania	Yes	0	2008-2016	EU derogation report

2.3 Problematic species

In recent decades, the habitats of Polar Bears have changed. Traditionally, Polar Bears have been dependent upon sea ice to hunt seals; however, as the Arctic becomes warmer, resulting in less sea ice, it has been suggested that Polar Bears are now forced to hunt for alternative terrestrial food (Prop et al. 2015). One such alternative food resource is eggs from colonial breeding birds e.g. Barnacle Geese. Prop et al. (2015) found that when the Polar Bears arrived at a nesting island well before hatch, more than 90% of all nests in a colony could be predated. Offshore island colonies are especially vulnerable, as Polar Bears have no problems swimming to these more remote areas, which Arctic Foxes may find more difficult to reach (Black et al. 2014). Additionally, Polar Bears have been observed stalking and chasing flocks of adult flightless Barnacle Geese (Stempniewicz 2006). Depending on how well the Barnacle Geese are able to cope with this new challenge,

the impact may increase in the future. However, Barnacle Geese cliff-nesting in inland areas are probably less vulnerable to Polar Bear predation and this may buffer the overall population impact.

In the Baltic region, the population of White-tailed Eagle *Haliaeetus albicilla* has recovered in recent decades. It has been observed that White-tailed Eagles increasingly prey on nesting Barnacle Geese in the colonies around Öland and Gotland in Sweden and that this has led to a decline in the numbers breeding at these colonies (K. Larsson pers. comm.). The same situation is observed in the Russian Tundra in territory of Nenetsky Autonomous Okrug and in the UK, e.g. on Islay. The population impacts of this increasing phenomenon have not yet been investigated but one consequence might be that breeding Barnacle Geese will abandon traditional nesting sites and spread to new coastal areas and to inland lakes, which has recently been observed in both Finland and Sweden.

3 Management measures and their effectiveness

3.1 General overview

The Barnacle Goose is listed in Appendix 2 of the Bern Convention, which means the species is protected from hunting. As it is not listed in Annex II of the Birds Directive, it is therefore not huntable species in the EU. Mortality rates have declined substantially after hunting stopped (see Annex 1). This has probably contributed to a recovery of the populations, which then expanded their range from the semi-natural coastal habitats to more intensively cultivated agricultural crops. As the population size has benefited from the practically unlimited food availability and availability of an extensive network of safe roost sites, particularly the Russia/Germany & Netherlands population has both increased in numbers and has been continuously expanding its wintering range farther inland over the last two decades.

Respecting the international conservation status of the species, most Range States have applied a mix of non-lethal management measures particularly to reduce conflicts associated with agricultural damages and the risk to air safety.

A combination of scaring and land management measures can make the surroundings of airports less attractive to geese and thus significantly reduce the risks to air safety locally (Bradbeer et al. 2017). A further reduction of bird strike risks can be achieved by implementing 3D radar systems at airports. Local measures can also be applied to protect other flora and fauna at small scale.

Damage to farmland is the most widespread cause of goose-human conflicts (see Fox et al. 2017 for a review of the evidence and underlying causes). Stroud et al. (2017) provide a review of the effectiveness of measures used to alleviate damages to crops and the rest of this paragraph is based on their review. Scaring geese away from sensitive areas can be applied locally, but geese habituate quickly at any location to stationary scaring devices. In addition, scaring should be coordinated across large geographic areas to avoid geese relocating to another equally sensitive location and to avoid detrimental disturbance to other species, which is difficult to organise and expensive. Providing sacrificial crops involves significant costs to establish and can cause spill over to adjacent farmland. Displacement of geese from sensitive areas with the combination of disturbance free refuge areas accompanied by disturbance at other areas has been also tried in several countries with some success (Cope et al. 2003; Madsen et al. 2014) or variable success (Koffijberg et al. 2017), depending on the instruments used. The ultimate weakness of the above-mentioned measures that they do not constrain the population growth, and this leads to a situation when the effectiveness of accommodation areas declines as the increasing population spills over into even more farmland areas (Koffijberg et. al. 2017).

Agricultural conflicts can be also reduced by offering financial incentives or compensation to farmers, but this becomes financially less sustainable when the growing population size and expanding range leads to continuous increase of management costs. It also becomes progressively more difficult to justify spending increasing amounts of public resources on populations that are less and less threatened.

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. At present there is no sign of density dependent regulation of population growth at the level of the three populations although density dependence can be observed at a local scale to which the species responds with range expansion (Black et al. 2014, van der Jeugd & Kwak 2017).

It is not surprising that an increasing number of countries have invoked derogation shooting after the gradual change in the emphasis of Barnacle Goose management from total protection, to agricultural conflict resolution through non-lethal management methods and financial payments. This logic agrees well with Table 8 that summarises the expert assessment of the various management measures in their respective countries (responses provided by representatives of Range States to questions sent out before the Barnacle Goose management planning workshop, spring 2017). In general, local measures are only deemed to be effective when the problem occurs in relatively small areas but do not alleviate the issue anymore when it becomes more widespread. Control of land use was considered to be effective only when a large proportion of the population is concentrated on relatively small areas as on Islay or Solway. However, even there conflicts increase as the populations grow and expand their range (Black 1998).

Table 8. *Assessment of the effectiveness of management provided by the national delegates of the 2017 Barnacle Goose management planning workshop.*

Scoring: 0: Unknown; 1: The measure does not mitigate the problem; 2: The measure could possibly help to mitigate the problem; 3: The measure mitigates the problem; 4: The measure completely resolves the problem; n.a.: Not applicable
[1]East Greenland/Scotland & Ireland, [2] Svalbard/South-west Scotland, [3] Schleswig-Holstein, [4] Lower Saxony, [5] Temperate zone breeding birds.

Measures	**UK[1]**	**UK[2]**	**NO**	**SE**	**DK**	**DE SH[3]**	**DE LS[4]**	**NL**	**FI**
Population control	3	n.a.			2			2	
Killing for scaring				2	2	2	n.a.	2	
Scaring	2	3	1	2			2	1	2
Control of land use / site protection	4	4				3			
Compensation or management payments		3	3	2		3	3-4	1	2
Egg destruction			0[5]	2?				1	
Sacrificial crops				2					
Fencing (in city parks in Helsinki)									0

The core demographic driver of the exponential growth of the Barnacle Goose populations is a mortality rate that is about half than it was before the species' strict protection. Furthermore, survival may have been aided by improved winter-feeding conditions, which were sometimes even improved by management applied by conservation organisations and supported subsidy schemes such as application of fertilisers and reseeding to divert geese from other fields. Therefore, an effective management strategy could be to increase mortality again, permitting the regulation of the population under derogation. The legitimacy of this approach is recognised in Article 2 of the Birds Directive. Otherwise, conflicts and management costs will continue increasing with the population growth, even if the effectiveness of certain measures can be somewhat improved.

Increasing mortality could be implemented in full compliance with Article 9 of the Birds Directive and through an adaptive management framework with clear targets that respond to national and international objectives, based on science and coordinated across multiple scales and jurisdictions. The current system of derogations lacks the mechanism to provide many of the above-mentioned guidance and coordination elements; gaps, which this international management plan aims to fill.

Annex 3 Projection of Population Size at Different Survival Rates

1 Population analysis

The purpose of this annex is to inform the decision-makers of what can be expected if no action is taken and to provide scenarios to stabilise the population. However, these crude calculations are only presented to illustrate what can be expected under these scenarios. Concrete decisions whether a population should be adjusted to a particular level at an appropriate scale and what management actions to apply are to be determined by the Range States on an annual basis according to the provisions of Article 9 of the Birds Directive and other relevant legal instruments as appropriate (see Annex 4), supported by the assessment of the cumulative impact of their actions and informed by the results of modelling work to be carried out in the framework of the EGM IWG.

Thus, in this chapter, we explore a) the potential growth of the three populations of Barnacle Geese for the coming 25 years[37] under a scenario in which no further management measures are taken to control the populations, and b) the harvest rate theoretically needed to stabilize the three population at the most recent population estimates.

The Svalbard/South-west Scotland and the Islay part of the East Greenland/Scotland & Ireland populations of Barnacle Geese are well studied, in terms of population counts, age ratios (proportion of juveniles in the population), mean brood size and survival. The resulting data enables estimates of survival and reproduction rates. Based on these estimates, Population Viability Analyses (PVA), including estimates of growth rate and harvest rate, have been produced, the latest being from 2014 (Trinder 2014a, b).

The East Greenland/Scotland & Ireland as well as the Russia/Germany & Netherlands populations are less studied and no PVAs have been performed. Due to the remoteness of some wintering areas, a full survey of the East Greenland/Scotland & Ireland population is conducted approximately every five years, with the latest results being from 2013. For this reason, the PVAs have only been produced for the part of the population wintering on Islay. The Russia/Germany & Netherlands population is much larger, and it is spreading fast over a much larger area covering several countries. Hence, it is more complex to obtain reliable total population estimates and demographic information that can be used to estimate growth rate and harvest rate.

As an alternative method to obtain estimates of growth rate,[38] as well as harvest rate[39] needed to stabilize the population and to predict population trajectories, a log-linear regression model of the form $\log N_t = a + b\ (t)$ has been used in this assessment. This model can be solved based only on population size (N) and time (t), which is available for the Russia/Germany & Netherlands population.

The applied model assumes exponential growth (no density dependence). In terms of estimating the growth rate, we believe that applying exponential growth is realistic for the foreseeable future, as both the Svalbard/South-west Scotland and the Islay part of the East Greenland/Scotland & Ireland population have shown no evidence of being regulated by density dependent effects at the population level (Trinder 2014a, b). The same characteristics should hold true for the Russia/Germany & Netherlands population.

In terms of predicting population trajectories for 25 years and using a density independent model, this could be a serious problem as one might expect some sort of density dependence to become manifest at some future point. However, especially for the Russia/Germany & Netherlands population it will be truly difficult to say when density dependent effects are expected to become operative, as this population continues to establish new breeding colonies and exploit new habitats not formerly occupied. This also seems to hold true for the other two populations, which have started to establish in areas outside the former ranges, e.g. the Faroe Islands and Iceland as well as being naturalised elsewhere in the UK. Furthermore, omitting the age structure could

[37] The 25 years' time frame is used based on the revised AEWA Action Planning guidelines which has been already applied in the EuroSAP project.
[38] Growth rate $\lambda = e^b$, where b = the slope of a linear regression model.
[39] Harvest rate $h = (\lambda - 1)/\lambda$; λ = growth rate.

cause issues, as it is documented that significant age structure in a population can have important implications for e.g. harvest management (Hauser et al. 2006).

To investigate the usefulness of the log-linear regression model, we first compare results from the more complex PVA analysis for the Svalbard/South-west Scotland and Islay part of the East Greenland/Scotland & Ireland population with model results from the log-linear regression model.

1.1 Svalbard/South-west Scotland population

Growth rate and harvest rate using estimates of survival and reproduction

Growth rate and harvest rate for the Svalbard/South-west Scotland population have been estimated based on data obtained on the wintering grounds in southwest Scotland and northwest England, where the entire population overwinters. The analysis was produced based on data collected from 1985 to 2011[40]. With these data, Trinder (2014b) developed a range of stochastic density independent population models based on estimates of survival and reproduction. The population models were used to predict how the population would develop as well as assessing the potential impact of management changes e.g. introducing harvest.

Based on the best-fit model Trinder (2014b) generated a mean annual population growth rate of 4.9% (Trinder (2014b): mean annual observed growth rate: 4.6%) and found that the population growth remained positive until the number of geese harvested exceeded approximately 5%. Thus, the simulation suggested that if 1% of the population is shot, a 1% reduction in the growth rate would follow. Currently this population is not a subject for considerable derogation shooting (56 in 2016/2017).

Growth rate and harvest rate using population counts

By using population counts, collected from 1985 to 2011, applied in the log-linear regression model, a growth rate of 4.9% is predicted, roughly identical to the growth rate produced from the model using survival and reproduction. Further, the model predicts that a harvest rate of 4.7 % will be necessary to stabilize the population, very close to the harvest rate produced by Trinder (2014b). If the analysis is extended to include the most recent population estimates, hence using data up until 2016, a growth rate of 4.6% is predicted, which corresponds to a harvest rate of 4.4 % if the population is to be stabilized.

Predicted population trajectories for 25 years

Based on the log-linear regression model (data 1985 to 2016; mean growth rate of 4.6%), the Svalbard/South-west Scotland population is predicted to increase from 41,700 birds in 2016 to a population size in 2040 ranging from 110,000 to 135,000 birds (95% ci), and with a median of 122,000 birds (Figure 11) under a scenario of no further management measures are taken to control the population. It should be noted that the population will cease to qualify for being listed in Category 3(a) of Column A once its size exceeds 100,000 individuals and will be listed in Column B or C, subjecting it to different management regime under the provisions of AEWA.

[40] The reason for using data since 1985 is that at this point there are indications that density dependent regulation was not acting to regulate population growth, at least not to an extent to be detected at the population level.

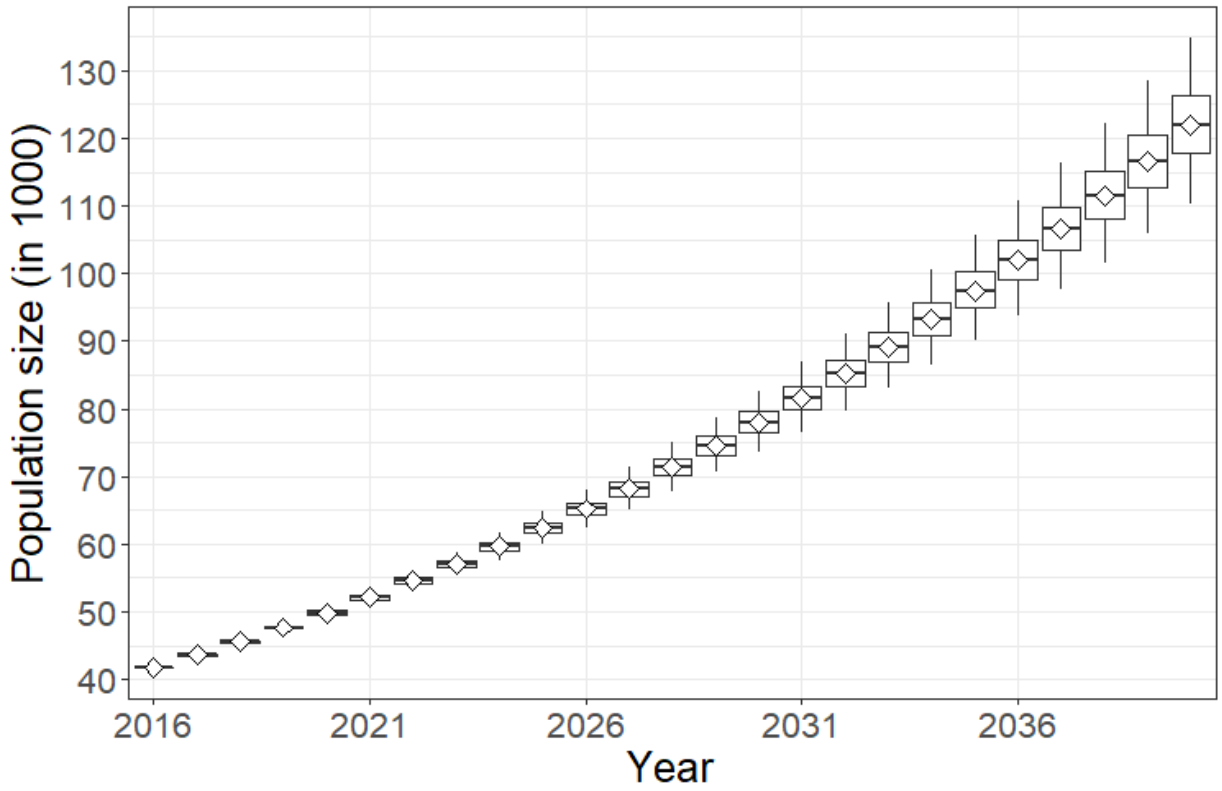

Figure 11. *Predicted population trajectories for 25 years (2016-2040) for the Svalbard/South-west Scotland population of Barnacle Geese starting from a starting population size of 41,700 and using a log-linear regression model based on population data from 1985 to 2016. Diamonds represent the median population size, boxes represent the interquartile range, and whiskers represent the 95 % confidence interval (Data: See text for explanation).*

1.2 Islay (East Greenland/Scotland & Ireland) sub-population

Growth rate and harvest rate using survival and reproduction

Growth rate and harvest rate for the East Greenland/Scotland & Ireland population, wintering on Islay (which regularly supports over 50% of the population (Mitchell et al. 2008)), have been estimated based on survival and reproduction data from Islay during 1995 to 2011. The data goes back to 1952, but not until 1995 did harvest data become available for Iceland (where it is hunted).

As for the Svalbard/South-west Scotland population, Trinder (2014a) developed a range of stochastic density independent population models based on estimates of survival and reproduction for the Islay sub-population. The model accounts for harvest on Iceland and Islay and makes predictions for how changes in harvest rate on Islay may influence future population growth. Harvest mortality is both simulated as a harvest rate and as an absolute number. The estimated average harvest rate for Iceland and Islay during 2000-2011 was 1.5% (sd: 0.003) and 1.4% (sd: 0.003), respectively. The total harvest was estimated at 593 adult birds (sd: 101) on Iceland and 585 adult birds (sd: 121) on Islay.

Based on the model showing harvest against harvest rate, Trinder (2014a) generated a mean annual population growth rate of 2.6% between 2000 and 2011, corresponding to the period with harvest on Islay as well as on Iceland (Trinder (2014b): mean observed growth rate: 2.3%). Further, the model predicted that, on average, the population growth rate (simulated from the population's initial 2011 size) would remain positive until the proportion harvested on Islay exceeds 3.8%, while maintaining a harvest rate of 1.5% on Iceland. This combines to a total harvest rate of 5.3% required to stabilize the population with a growth rate of 2.6%. At this level, 50% of simulations predicted a decline, while 50% predicted an increase.

Growth rate and harvest rate using population counts

Using the log-linear regression model on data from 2000-2011, a growth rate of 2.1% is obtained, and a harvest rate of 2.1% is estimated to stabilize the population. This harvest rate is in addition to the harvest that already occur, respectively 1.5% on Iceland and 1.4% on Islay. Thus, a combined harvest rate of 5.0 % (2.1% + 1.5% + 1.4%) is needed. The estimated growth rate and harvest rate is a bit lower than the predicted estimates by Trinder (2014a), respectively, a growth rate of 2.6% and a harvest rate of 5.3%. When the analysis is extended to include the most recent population estimates for the Islay sub-population, an average growth rate of 1.0% is obtained between 2000[41] and 2017, suggesting some levelling off, and a harvest rate of 1.0% is predicted to stabilize the population, which gives a total harvest rate of 3.9 % (1.0% + 1.5% + 1.4%).

Predicted population trajectories for 25 years

Based on the log-linear regression model (data 2000-2017; mean growth rate of 1.0%), the Islay sub-population is predicted to increase from 41,700 birds in 2017 to a population size in 2041 ranging from 42,000 to 66,000 birds (95% ci), and with a median of 57,000 birds (Figure 12), under a scenario of no further management measures are taken to control the population. It should be noted however, that the most recent population estimates for the Islay sub-population suggest that the population has stabilized (with some fluctuations), which supports the predictions by Trinder (2014a); however, it is uncertain whether emigration from Islay to other wintering sites also contributed to the observed stabilisation.

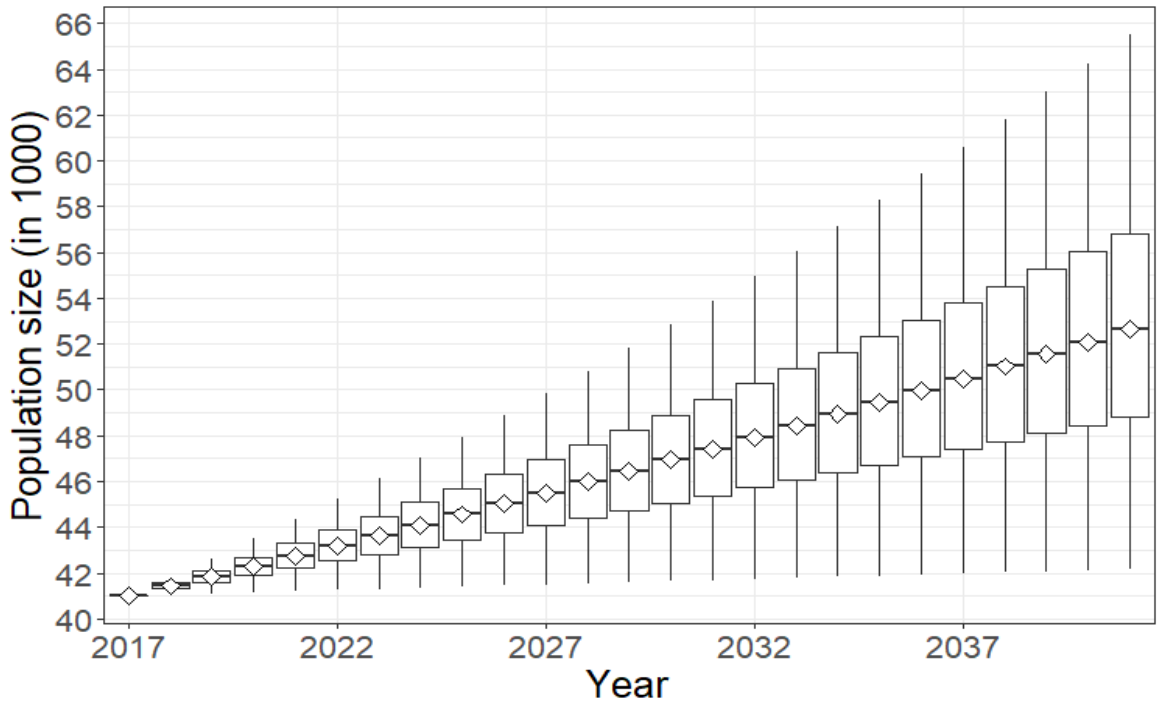

Figure 12. *Predicted population trajectories for 25 years (2017-2041) for the Islay sub-population of the East Greenland/Scotland & Ireland Barnacle Goose population starting from a population size of 41,700 and using a log-linear regression model based on population data from 2000 to 2017.* Diamonds represent the median population size, boxes represent the interquartile range, and whiskers represent the 95% confidence interval (Data: See text for explanation).

[41] Licenced shooting started again on Islay in 2000.

1.3 Total East Greenland/Scotland & Ireland population

Growth rate and harvest rate using population counts

There are no estimates of survival and reproduction rates for the total East Greenland/Scotland & Ireland population available; hence, we opt to rely on the log-linear regression model. However, the comparable results obtained for the Svalbard/South-west Scotland population and the Islay part of the East Greenland/Scotland & Ireland population lend support to the belief that these results can be used as an approximation.

Thus, if the data from the total population counts of the East Greenland/Scotland & Ireland population from 1998-2013[42] is applied in the count-based model, a growth rate of 2.9% is obtained. To stabilize this population, a harvest rate of 2.8% will be needed on the total population, in addition to the take that already occurs on Iceland, Islay and on Greenland, where this population is harvested. The population is not harvested in Ireland.

Hunting bag data from Greenland is only available from 2006 to 2016. During this period, the average harvest rate is 0.03%. On Iceland, the average observed harvest rate from 1998-2013 is 2.7%. On Islay, the observed average harvest rate from 2000-2013 is 1.7 %, but only on 63% of the population, corresponding to an average harvest rate of 1.1 % on the total population. By adding the harvest rate for the three areas (Greenland, Iceland and Islay), we get a total harvest rate of 3.8% (0.03% + 2.7% + 1.1%). Hence, it is predicted that an overall harvest rate of 6.6% is needed to stabilize the Greenland population (i.e. the existing harvest of 3.8% plus an additional harvest of 2.8%).

Predicted population trajectories for 25 years

Based on the log-linear regression model (data 1998 to 2013; mean growth rate of 2.9%), the East Greenland/Scotland & Ireland population is predicted to increase from 81,000 birds in 2013 to a population size in 2037 ranging from 133,000 to 194,000 birds (95% ci) and with a median of 161,000 birds (Figure 13), under a scenario of no further management measures are taken to control the population.

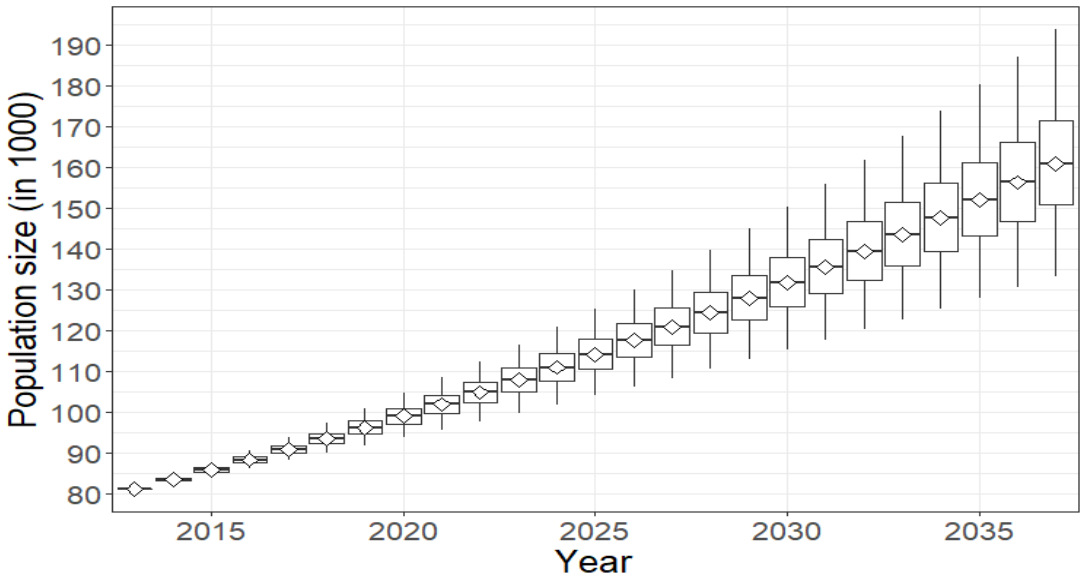

Figure 13. *Predicted population trajectories for 25 years (2013-2037) for the East Greenland/Scotland & Ireland population of Barnacle Geese starting from a population size of 81,000 and using a log-linear regression model based on population data from 1998 to 2013 (mean of 8.4% growth rate).* Diamonds represent the median population size, boxes represent the interquartile range, and whiskers represent the 95% confidence interval (Data: See text for explanation).

[42] 2013 is the last time a total population count was performed.

1.4 Russia/Germany & Netherlands population

Growth rate and harvest rate using population counts

The structure and metapopulation dynamics of the Russia/Germany & Netherlands population is complex. Therefore, available survival and reproduction rates cannot be used directly to construct a demographic model, which is why we have to rely on the log-linear regression model.

Applying the model to a long-term data set from 1960 to 2014, a growth rate of 8.6% is obtained, corresponding to a harvest rate of 7.9%, to be added to the harvest that already occurs, if the population is to be stabilized. If we apply it to the most recent population estimates, ranging from 2000-2014, a growth rate of 10.4% is obtained, corresponding to a harvest rate of 9.5%, to be added to the harvest that already occurs if the population is to be stabilized.

Predicted population trajectories for 25 years

Based on the log-linear regression model (data 1960 to 2014; mean growth rate of 8.6%), the Russia/Germany & Netherlands population is predicted to increase from 1.2 million birds in 2014 to a population size in 2038 of 7.3 million to 10.4 million birds (95% ci), with a median of 8.7 million (Figure 14), under a scenario of no further management measures are taken to control the population. As the growth rate seems to have increased in recent years (mean growth rate of 10.4% from 2000-2014), this estimate may be conservative.

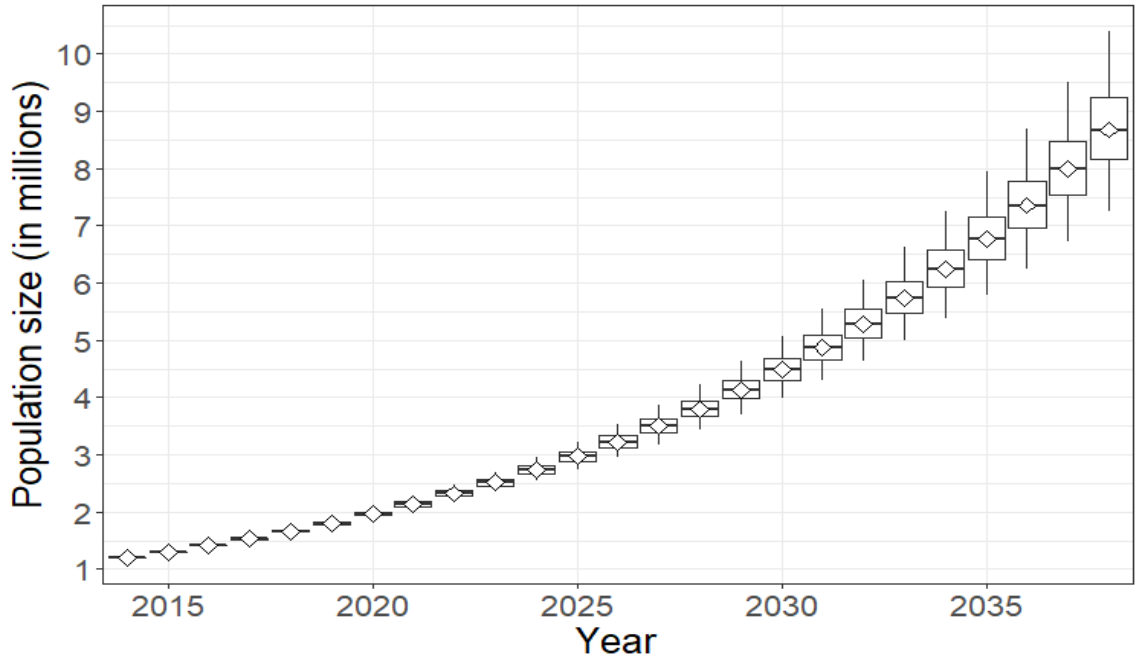

Figure 14. *Predicted population trajectories for 25 years (2014-2038) for the Russia/Germany & Netherlands population of Barnacle Geese starting from a population size of 1.2 million and using a log-linear regression model based on population data from 1960 to 2014 (mean of 10.4% growth rate).* Diamonds represent the median population size, boxes represent the interquartile range, and whiskers represent the 95% confidence interval (Data: See text for explanation).

A growth rate of 10.4% for this population is predicted to increase the population from 1.2 million birds in 2014 to a population size in 2038 ranging from 8.1 million to 21.1 million birds (95% ci), with a median of 13 million (Figure 15), under a scenario of no further management measures are taken to control the population.

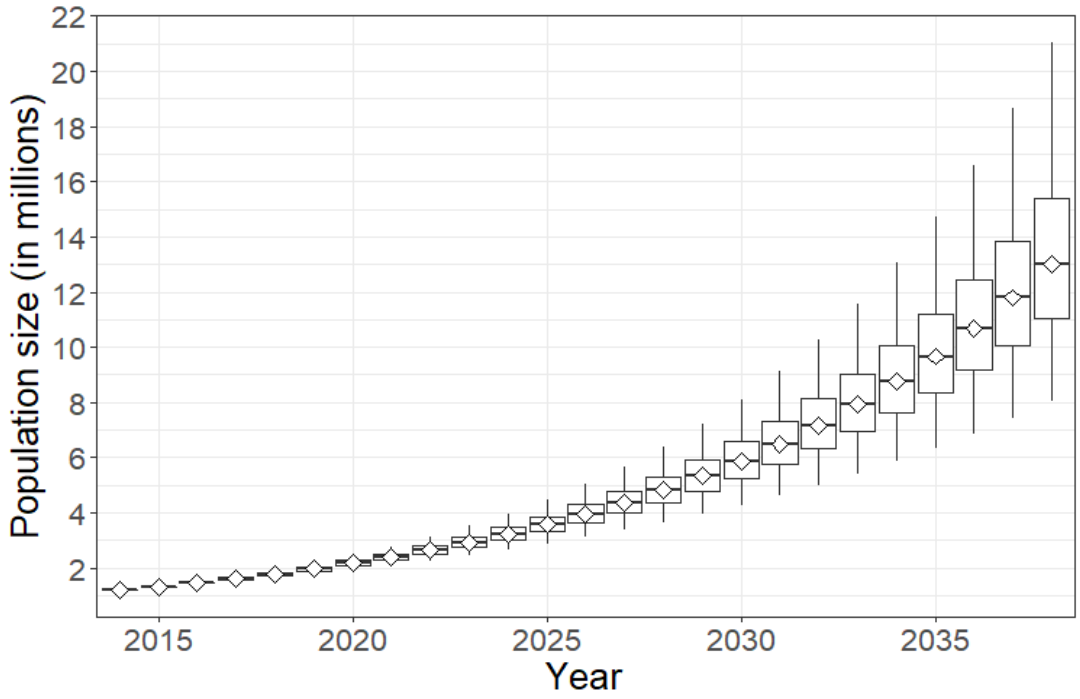

Figure 15 *Predicted population trajectories for 25 years (2014-2038) for the Russia/Germany & Netherlands population of Barnacle Geese starting from a population size of 1.2 million and using a log-linear regression model based on population data from 2000 to 2014.* Diamonds represent the median population size, boxes represent the interquartile range, and whiskers represent the 95% confidence interval (Data: See text for explanation).

Annex 4 Legal Status of Barnacle Goose and Implications for Population Management[43]

Table 9. *Status of the Barnacle Goose populations on AEWA, the Bern Convention and the EU Birds Directive*

	AEWA		Bern Convention	EU Birds Directive
Barnacle Goose *Branta leucopsis*	Svalbard/South-west Scotland	Col. A	Appendix II	Annex I
	East Greenland/Scotland & Ireland	Col. B		
	Russia/Germany & Netherlands	Col. C		

1 AEWA[44]

The **Svalbard/South-west Scotland** population of Barnacle Geese currently satisfies the conditions for inclusion in Category 3(a) of Column A of AEWA's Table 1 and is not marked with an asterisk. Per paragraph 2.1.1 of the AEWA Action Plan, Parties are therefore required to prohibit the taking of birds and eggs belonging to this population unless the conditions for exemption set out by paragraph 2.1.3 are satisfied.

The deliberate killing of birds with the purpose of preventing serious damage to crops, or in the interests of air safety, public health and safety, or for other imperative reasons of overriding public interest (including beneficial consequences of primary importance to the environment) is therefore permissible, provided that there exists no other satisfactory solution for addressing the conflict and the cumulative effects of such exemptions do not operate to the population's detriment (i.e. do not prevent the population from being maintained at a Favourable Conservation Status). Detailed guidance on satisfying the conditions of paragraph 2.1.3 of the AEWA Action Plan has been drafted by the AEWA Technical Committee and will be presented to the seventh session of the Meeting of the Parties to AEWA. This draft guidance is broadly consistent with the guidelines on interpreting and applying similar legal text in the Birds Directive and Bern Convention (see below).

The existence and implementation of a scientifically rigorous International Single Species Management Plan may assist Parties in demonstrating that the conditions for exemption have been satisfied. However, such a plan will not absolve Parties of their individual responsibilities under paragraph 2.1.3 – including the requirements to inform the Agreement Secretariat of any exemptions granted and to ensure that these are "*precise as to content and limited in space and time*". Once this population exceeds 100,000 individuals, it will cease to qualify for inclusion in Category 3(a) of Column A and will be downlisted to Column B or C, resulting in greater flexibility for Parties to allow taking. If the current categorization were ever amended through the addition of an asterisk, this would also result in greater flexibility for adaptive harvest management (see paragraph 2.1.1 of the AEWA Action Plan).

The deliberate killing of birds belonging to the **East Greenland/Scotland & Ireland** population of Barnacle Geese is permissible (including for management purposes) but must be regulated in a manner that ensures the maintenance of the population's Favourable Conservation Status (Article II.1; Action Plan, para. 2.1.2). The killing of birds from this population during their stages of reproduction and rearing, or during their return to

[43] The original version of this document was compiled by the UNEP/AEWA Secretariat in consultation with the Bern Convention's Secretariat and the European Commission and was presented at the first AEWA international management planning workshop for the Barnacle Goose (June 2017). Portions of the document have since been elaborated following discussions at the first and second management planning workshops, comments received from Range States and other stakeholders on subsequent drafts of the international species management plan, and responses from the European Commission to questions raised by the AEWA Secretariat concerning goose management in the context of the EU Birds Directive. A section has also been added on states' legal obligations concerning the collection and communication of data.

[44] This document's analysis of Parties' responsibilities under AEWA is based on the provisions of the Agreement and its legally-binding Action Plan (AEWA 2018).

their breeding grounds, is permissible if this does not have an unfavourable impact on the population's conservation status. However, achieving damage prevention by using the various modes of taking prohibited by paragraph 2.1.2(b) of the AEWA Action Plan is only permissible if the conditions for exemption set out by paragraph 2.1.3 are satisfied.

The deliberate killing of birds belonging to the **Russia/Germany & Netherlands** population of Barnacle Geese is permissible (including for management purposes), provided that the cumulative impact thereof does not prevent the population from being maintained at a Favourable Conservation Status (Article II.1). Caution must further be taken to ensure that management measures do not breach the Parties' commitments in respect of populations with a higher Table 1 categorization (e.g. by causing the significant disturbance, or accidental taking, of birds belonging to a Column A population). Any impacts on non-target species must similarly be considered under the other legal instruments discussed in this document.

AEWA's *Conservation Guidelines on National Legislation for the Protection of Species of Migratory Waterbirds and their Habitat* (Slobodian et al. 2015) provide guidance on implementing the Agreement's provisions on taking, and the exemptions thereto, through national legislation; and the AEWA *Conservation Guidelines on Sustainable Harvest of Migratory Waterbirds* (Madsen et al. 2015) provide guidance concerning sustainable use and adaptive management under the Agreement.

2 EU Birds Directive[45]

The Barnacle Goose falls within the general system of protection provided by Article 5 of the Birds Directive, in terms of which Member States are required to prohibit, *inter alia*, "*deliberate killing or capture by any method*" and taking or deliberate destruction of eggs. It is also listed in Annex I of the Directive, which requires EU Member States to take special conservation measures concerning this species' habitat, and, in particular to classify the most suitable territories as Special Protection Areas (SPA) (Article 4). The Barnacle Goose is not listed as a huntable species in Annex II to the Birds Directive.

Member States may derogate from the strict species protection provisions applying to the Barnacle Goose if the conditions for derogation set out by Article 9 of the Directive are satisfied. The grounds for justification set out in Article 9(1)(a) are especially relevant in a management context.

Birds Directive, Article 9

1. Member States may derogate from the provisions of Articles 5 to 8, where there is no other satisfactory solution, for the following reasons:

(a) – in the interests of public health and safety;

- in the interests of air safety;

- to prevent serious damage to crops, livestock, forests, fisheries and water;

- for the protection of flora and fauna;

[…]

2. The derogations referred to in paragraph 1 must specify:

(a) the species which are subject to the derogations;

(b) the means, arrangements or methods authorised for capture or killing;

[45] This document's analysis of EU Member State's responsibilities under the Birds Directive is based on the provisions of the Birds Directive (2009) (and, for Special Protection Areas, the Habitats Directive 1992), read with relevant decisions of the Court of Justice of the European Union, and European Commission (2007), European Commission (2008), and European Commission (2013). It is further informed by comments received from the European Commission in the course of the management planning process.

(c) the conditions of risk and the circumstances of time and place under which such derogations may be granted;

(d) the authority empowered to declare that the required conditions obtain and to decide what means, arrangements or methods may be used, within what limits and by whom;

(e) the controls which will be carried out.

3. Each year the Member States shall send a report to the Commission on the implementation of paragraphs 1 and 2.

4. On the basis of the information available to it, and in particular the information communicated to it pursuant to paragraph 3, the Commission shall at all times ensure that the consequences of the derogations referred to in paragraph 1 are not incompatible with this Directive. It shall take appropriate steps to this end.

The definitive interpretation of the Birds Directive is the sole prerogative of the Court of Justice of the European Union (CJEU), which has emphasized the need for the Directive's derogation system to be applied appropriately to deal with precise requirements and specific situations.[46] When derogations are used for damage control purposes, the European Commission has further advised that "*the first approach should be to make the control local in time and place to where the damage is occurring*".[47] Notably, however, different problems have different spatial dimensions, and the geographic scale of a specific situation will therefore differ from one case to the next. This is also recognized in the Commission's guidance, which explains that, in the case of widespread species that can cause damage over large areas, it may be justifiable for a Member State to grant derogations that are more generalized in their territorial scope.[48] What is important is therefore that the scale of derogations is justified by the nature and scale of the problems they aim to address.

As is explained below, this ISSMP, and the AFMPs it envisages, will assist EU Member States to make better informed decisions regarding derogations. However, applying derogations within the framework of the Birds Directive will remain the responsibility of the individual Member States. Member States that decide to grant derogations aimed at the prevention of serious damage to, *inter alia*, crops, or with the prevention of risks to public health, air safety risks, or flora and fauna,[49] by means of population reduction, must ensure that the following conditions are fulfilled:

(1) A precondition for the use of derogations is that the population concerned must be maintained at a satisfactory level. Any agreed adjustments to population levels must not jeopardize the objective of the Birds Directive, as identified in Article 2: to maintain the population of the species at, or adapt it to "*a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements*". Notably, this objective is formulated in a way that gives ecological requirements priority over economic and recreational requirements.

[46] E.g. *Case C-118/94 Associazione Italiana per il World Wildlife Fund and Others v. Regione Veneto*, para. 21. ("*Although Article 9 therefore authorizes wide derogations from the general system of protection, it must be applied appropriately in order to deal with precise requirements and specific situations*.")
[47] European Commission (2008) at § 3.5.15.
[48] European Commission (2008) at §3.5.15. As to the flexibility of the Directive's provisions, note also the conclusion of Milieu, IEEP and ICF (2016) at §5.4.3.5 that, although the Birds and Habitats Directives require protection measures in respect of some species that are widespread, or whose conservation status has changed, and which have the potential to cause damage to human interests, the Directives "*offer sufficient flexibility to deal with the challenges presented*".
[49] Importantly, the Birds Directive does not allow population reduction as an end in itself (see European Commission (2013): "*a derogation scheme is not intended to reduce the population, but just to prevent serious damage or to protect fauna and flora*").

(2) One of the permissible grounds for justifying derogations must be present and it must be demonstrable that population management is able to address the problem(s) in question (i.e. that this response would be preventative). To justify a population's reduction on the basis of Article 9(1)(a), it must therefore be factually demonstrable that the population being targeted presents a threat to public health, air safety, or the protection of flora and fauna, and/or a risk of serious damage to crops, and that this threat/risk of serious damage is linked to the size of the population. As regards, the use of derogations to prevent serious damage to crops, it is clear that this ground relates to an economic interest.[50] However, the Directive does not specify whether damage should be assessed in financial or production terms. Nor does it define what constitutes 'serious damage', and this concept needs to be understood in relative terms.[51] As noted above, where actual/anticipated damages are widespread, this may provide a justification for Member States granting derogations that are more generalized in their territorial scope. Notably, this ground of justification "*is not a response to already proven damage but of the strong likelihood that this will take place in the absence of action*".[52]

(3) There is no other satisfactory solution for addressing the conflict, and this is demonstrated through strong and robust arguments, based on the scientific and technical evaluation of objectively verifiable factors.[53] In other words, all possible non-lethal measures, compatible with Article 5 of the Birds Directive, must have been seriously examined, and it must be demonstrated that such measures do not provide a satisfactory solution to the problem in question. Other solutions might, for instance, be considered unsatisfactory because they are not as effective as population adjustment or are excessively costly in comparison to their effectiveness (it is insufficient that they would merely cause greater inconvenience or compel a change in behaviour[54]). Even if non-lethal measures do not provide a satisfactory solution on their own, or in the short term, it can be appropriate to use combinations of responses to address a specific problem.

(4) It follows from the 'no other satisfactory solution' requirement that derogations must only allow deviation from the Birds Directive's species protection provisions to the extent that this is necessary for resolving the problem concerned.[55] Any population reduction must therefore be proportionate to the damage prevention needed. [56]

This International Single Species Management Plan does not determine whether it is necessary to adjust the levels of certain populations of Barnacle Geese in order to prevent serious agricultural damage, air safety risks or damage to flora and fauna (although it recognizes that this could, theoretically, be recommended at a later stage as part of a suite of management responses). Rather, the processes envisaged by the Plan – in particular, the development of AFMPs and the adaption of these on the basis of information collected and assessed periodically – will provide a framework for addressing the problems posed by Barnacle Geese in a coordinated manner and ensuring that the cumulative impact of national derogation schemes is not detrimental to populations' conservation status. The information compiled in AFMPs may further assist Member States in assessing the need for derogations and in demonstrating that management measures are consistent with the conditions identified in Article 9(1) of the Birds Directive. [57] However, Member States will remain individually

[50] European Commission (2008) at § 3.5.7.
[51] European Commission (2013) at p. 10.
[52] European Commission (2008) at § 3.5.7.
[53] European Commission (2008) at § 3.4.12.
[54] European Commission (2008) at § 3.4.11.
[55] European Commission (2008) at § 3.4.12.
[56] European Commission (2013) at p. 15.
[57] Notably, in its guidance on derogations under the Habitats Directive, the European Commission has recommended that "*one way of implementing a flexible and proportional derogation system as part of a strict protection system is the preparation of species conservation plans*" and that such plans may provide guidance on the implementation of derogation schemes at the transboundary population level and "*could be considered as a tool for demonstrating that the derogation system is in line with the objectives of the Directive*". The Commission has further stressed that such plans "*would*

responsible for ensuring that they meet the requirements of Article 9 – including the technical requirements prescribed by Article 9(2) and the annual reporting requirements on the application of derogations prescribed by Article 9(3).

Article 9 does not allow Member States to derogate from the requirements of Article 4 of the Birds Directive (as amended by Article 7 of the Habitats Directive). Management measures therefore must not result in the deterioration of Special Protected Areas or the disturbance of species for which they have been designated in so far as this would be significant having regard to the objectives of the Directive.

The *Guide to Sustainable Hunting under the Birds Directive* (European Commission 2008) provides further guidance on the hunting provisions of the Directive and the derogation provisions under Article 9.

3 Bern Convention[58]

The Barnacle Goose is listed in Appendix II of the Bern Convention as a strictly protected fauna species. Parties to the Convention are therefore required to prohibit, *inter alia*, the deliberate killing of birds belonging to this species and the deliberate destruction or taking of their eggs (Article 6) unless the conditions for exception set out by Article 9 of the Convention are satisfied.

Bern Convention, Article 9:

1. Each Contracting Party may make exceptions from the provisions of Articles 4, 5, 6, 7 and from the prohibition of the use of the means mentioned in Article 8 provided that there is no other satisfactory solution and that the exception will not be detrimental to the survival of the population concerned:

– for the protection of flora and fauna;

– to prevent serious damage to crops, livestock, forests, fisheries, water and other forms of property;

– in the interests of public health and safety, air safety or other overriding public interests;

[…]

2. The Contracting Parties shall report every two years to the Standing Committee on the exceptions made under the preceding paragraph. These reports must specify:

– the populations which are or have been subject to the exceptions and, when practical, the number of specimens involved;

– the means authorised for the killing or capture;

– the conditions of risk and the circumstances of time and place under which such exceptions were granted;

– the authority empowered to declare that these conditions have been fulfilled, and to take decisions in respect of the means that may be used, their limits and the persons instructed to carry them out;

– the controls involved.

Given the overlap between this provision and Article 9 of the Birds Directive, it can be assumed that an approach that complies with the Birds Directive will also satisfy the requirements of the Bern Convention,

naturally have to be adapted regularly in the light of improved knowledge and monitoring results". (European Commission (2007) at para. 54.)

[58] This document's analysis of Parties' responsibilities under the Bern Convention is based on the provisions of the Convention (Bern Convention 1979), read with the Standing Committee's Revised Resolution No. 2 (1993) on the interpretation of Articles 8 and 9 of the Convention (Bern Convention 2011).

although the Convention offers greater flexibility in several of its grounds for exception. The active adjustment of Barnacle Goose populations, based on the recommendations of a periodically-amended AFMP would, in principle, be legally permissible if all the following conditions are fulfilled:

(1) There is no other satisfactory solution for addressing the conflict and the reasoning underlying the choice of approach is objective and verifiable.

(2) Such adjustment is not detrimental to a population's survival, based on current data on the state of the population, including its size, distribution, habitat and future prospects (it must, in particular, be guaranteed that each populations' status satisfies Article 2 of the Convention[59]).

(3) The population presents a threat to public health and safety, air safety or other overriding public interests, or to the protection of flora and fauna, and/or a risk of serious damage to property, and the seriousness of this threat/damage is demonstrably linked to the size of the population. The Convention's Standing Committee has agreed that whether or not damage is 'serious' must be evaluated "*in terms of the intensity and duration of the prejudicial action, the direct or indirect links between that action and the results, and the scale of the destruction or deterioration committed*". [60]

(4) Any reduction of the population is proportionate to the damage prevention needed.

Should the Barnacle Goose ever be moved to Appendix III of the Convention, its exploitation would be permissible, provided that it is regulated in a manner that ensures that populations are not reduced below the level required by Article 2. In addition, Parties would be required to prohibit the means of killing referred to in Article 8 of the Convention unless the conditions of Article 9 were satisfied.

Even if an International Single Species Management Plan is in place, Parties will remain individually responsible for meeting their commitments under the Convention – including their commitment in Article 9(2) to report every two years to the Convention's Standing Committee on the exceptions they have allowed in terms of Article 9(1).

Revised Resolution No. 2 (1993) of the Bern Convention's Standing Committee (Bern Convention 2011) provides further guidance on the exceptions allowed by Article 9.

4 States' Obligations Concerning the Collection and Communication of Data

Regardless of the types of management measures that are proposed by AFMPs, continued research and monitoring are essential for determining whether progress is being made towards meeting management objectives, and for adjusting management measures to better meet these objectives. The importance of continued data collection is further reflected in Box 1 (page 16) of this Plan.

AEWA requires that Parties endeavour to collect various types of data and that they make this available. Relevant provisions of the AEWA Action Plan include the following:

- Paragraph 4.1.3 – requiring Parties to "*cooperate with a view to developing a reliable and harmonized system for the collection of harvest data in order to assess the annual harvest of populations listed in Table 1*" and to "*provide the Agreement secretariat with estimates of the total annual take for each population, when available*";
- Paragraph 4.3.2 – requiring Parties to "*endeavour to gather information on the damage, in particular to crops and to fisheries, caused by populations listed in Table 1, and report the results to the AEWA Secretariat*";

[59] 'The Contracting Parties shall take requisite measures to maintain the population of wild flora and fauna at, or adapt it to, a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements and the needs of sub-species, varieties or forms at risk locally.' Notably, this objective is formulated in a way that gives ecological requirements priority over economic and recreational requirements.
[60] Bern Convention (2011).

- Paragraph 5 – which contains various obligations concerning research and monitoring, including, *inter alia*, the requirement that Parties "*endeavour to monitor the populations listed in Table 1*" and that the results of such monitoring "*be published or sent to appropriate international organizations, to enable reviews of population status and trends*".

The Bern Convention also obliges Parties to "*encourage and co-ordinate research related to the purposes of [the] Convention*" (Article 11(1)(b)); while the Birds Directive requires EU Member States to encourage research, paying particular attention to, *inter alia*, research which assesses the influence of methods of taking wild birds on population levels and research which develops or refines ecological methods for preventing the type of damage caused by birds (Article 10, read with Annex V).

Annex 5 Concept of Management Units

Bijlsma et al (2018) defines management units (MUs) as **functionally independent population segments,** i.e. exhibiting distinct demographic processes and showing reduced exchange (migration/dispersal) rates over a few generations.

MUs can be characterized by genetic markers, life history parameters, distribution, behaviour, movements (i.e. connectivity) and possibly morphology, and are appropriate short-term targets for conservation. The concept is used in conservation management (e.g. Olea et al., 2013 but especially well-developed for migratory or otherwise mobile, marine species such as turtles, cetaceans and seals (Palsbøll et al., 2007; Evans & Teilmann, 2009; Wallace et al., 2010; Olsen et al., 2014; Sveegaard et al., 2015). Bijlsma et al. (2018) also recognises flyways as a similar concept and refers to Scott & Rose (1996), Delany et al. (2009) and the Critical Site Network Tool that are the key sources of the population delineations used by AEWA.

The principles of AEWA's approach to flyway definition are set out in AEWA/MOP 3.12 (AEWA (2005a) and Resolution 3.2 (AEWA 2005b). Flyway or biogeographic populations can be biologically discrete (e.g. subspecies or same subspecies but having completely separate breeding and wintering areas (e.g. the populations of Barnacle Goose breeding in Svalbard and East Greenland), but can have a more or less continuous distribution (e.g. populations of the nominate form of Greylag Goose) and the definition of flyway populations in this case is primarily driven by practical management considerations.

Further work on internationally coordinated actions for the recovery and management of Taiga Bean Goose (Marjakangas et al. 2015) has led to the recognition of MUs for this subspecies as a pragmatic tool to respond to the clearly different management needs of different entities with different migration routes, different growth rates within the same biogeographic population even if some interchange of individuals amongst these populations may take place.

Figure 16 provides an example of the MUs in a more complex situation. In this example the flyway population consists of three potential MUs with partially overlapping breeding (solid lines), staging (dotted lines) and wintering areas (dashed lines). Yellow indicates only breeding countries, green where the species would be considered resident and blue would indicate the wintering range. In reality, the green zone is transitional, as there are both resident, staging and wintering birds occurring there.

MU1 is partly resident in countries D, E and F, but part of the population winters in countries G and H.

MU2 breeds in countries A and B. It is fully migratory. Part of the population remains in the breeding range of MU1 in countries D and E. Part of MU2 migrates further to countries H to winter together with MU1 and MU3.

MU3 breeds only in country C and it moults in country E where it mixes with individuals from MU1. Then it continues to winter in countries I and H where it mixes with the other two MUs. It returns to the breeding grounds through a different route in spring.

In case management objectives were defined at national level, MU2 and MU3 could be overharvested in countries D, E, H and I. There is a similar risk if management objectives are only defined at the flyway population level. On the other hand, countries D-I should cope with increased damages if countries A, B and C would allow MU2 and MU3 to grow up to carrying capacity.

Subdividing the population into management units helps to apply differentiated management amongst these different segments of the population and to set management targets and time management actions in a way that (1) minimises the risks for the smaller MUs and (2) takes into account the interests across the flyway. This approach is more in line with the flyway concept than setting management objectives only at national level. However, these management units are still part of the same biological population. Consequently, there is no need to treat them separately when the population favourable reference value is defined.

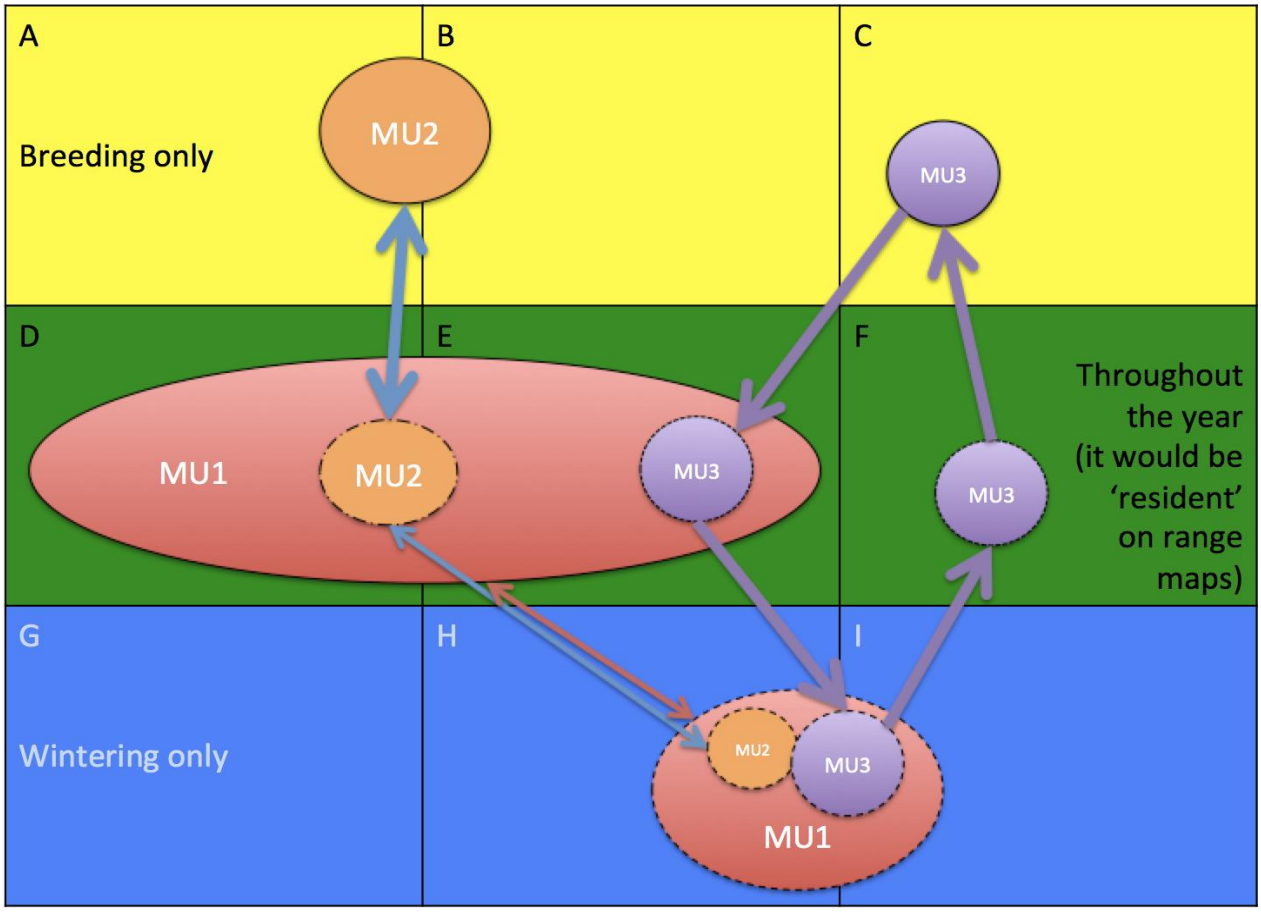

Figure 16. *A theoretical representation of the management units concept. See explanation in the text above.*

Management units are applied in a similar fashion in the draft Barnacle Goose ISSMP.

Barnacle Goose Management Units

In case of Barnacle Goose, the Arctic breeding and the temperate breeding segments of the Russia/Netherlands & Germany population are treated separately because, although these birds still have considerable genetic interchange, they are subject of different pressures, e.g. hunting in Russia, and pose different management challenges, e.g. the Arctic breeding birds are not responsible for summer damages to agriculture in the temperate zone while temperate-breeding birds are not contributing to the grazing pressure in the Arctic.

Conclusions

Managing the flyway population according to MUs will require 1) sufficient scientific knowledge about the geographic and temporal extend and overlap of MUs, 2) demographics, harvest, including killing under derogation and sizes of MUs, 3) flexible hunting regulations in the Range States to allow for seasonal regulation of shooting, including closure, at the relevant geographic scale.

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Appendix A Threat Scoring System

1 Timing and impact score

According to BirdLife standards, each threat is assigned an "impact score" (0-3) for respectively:

- Timing (ongoing or future),
- Scope (i.e. the proportion of the total population affected)
- Severity (the overall declines caused by the threat)

Description	Impact score
Only in the past and unlikely to return	Not included in BirdLife standards
In the past but now suspended and likely to return	Not included in BirdLife standards
Ongoing	3
Future (long term)	1
Unknown	Not included in BirdLife standards

2 Scope and impact score

Description	Impact score
Affects the whole (>90%) population	3
Affects the majority (50-90%) of the population	2
Affects the minority (<50%) of the population	1
Affects a negligible proportion of the population	0
Unknown	n/a

3 Severity and impact scores

Description	Impact score
Causing or likely to cause very rapid declines (>30% over 10 years or three generations)	3
Causing or likely to cause rapid declines (20-30% over 10 years or three generations)	2
Causing or likely to cause relatively slow, but significant, declines (<20% over 10 years or three generations)	1
Causing or likely to cause fluctuations	1
Causing or likely to cause negligible declines	0
No decline	0
Unknown	n/a

			Severity			
			Very rapid	**Rapid**	**Slow**	**Negligible**
			3	2	1	0
Scope	Whole	3	6	5	4	3
	Majority	2	5	4	3	2
	Minority	1	4	3	2	1
	Negligible	0	3	2	1	0

High
Medium
Low
Negligible

Appendix B Threat Classification Matrix

Table B1. *Threat Classification Scheme for the East Greenland/Scotland & Ireland population of Barnacle Geese.* Yellow indicates that numbers have not been verified nationally.

n/a = information is not available to our knowledge.	EAST GREENLAND/SCOTLAND & IRELAND POPULATION											
	Greenland			Iceland			UK			Ireland		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
1 Residential & Commercial Development												
1.1 Housing and Urban Areas (e.g. land reclamation or expanding human habitation that causes habitat degradation in riverine, estuary and coastal areas)	1	0	0	1	0	0	3	0	0	3	0	0
1.2 Commercial & Industrial Areas (e.g. factories)	1	0	0	1	0	0	3	0	0	3	0	0
2 Agriculture & Aquaculture												
2.1 Annual & Perennial Non-Timber crops												
2.1.1 Shifting Agriculture												
2.1.2 Small-holder Farming							1	n/a	n/a	1?	n/a	n/a
2.1.3 Agro-industry Farming (e.g. increasing of the number of domestic reindeers, degradation and erosion of habitats including the salt marches)							1	n/a	n/a	1?	n/a	n/a
2.2 Wood & Pulp Plantations												
2.2.2 Agro-Industry Plantations							1	n/a	n/a	1?	n/a	n/a
3 Energy Production & Mining												
3.1 Oil & Gas Drilling	1	1	n/a				n/a	n/a	n/a			
3.2 Mining & Quarrying	1	0	n/a	1	n/a	n/a	n/a	n/a	n/a			
3.3 Renewable Energy e.g. wind farms (birds flying into windmills)				1	n/a	n/a	3	0	0	3	0	0

n/a = information is not available to our knowledge.	EAST GREENLAND/SCOTLAND & IRELAND POPULATION											
	Greenland			**Iceland**			**UK**			**Ireland**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
4 Transportation & Service Corridors												
4.1 Roads & Railroads	1	0	0									
4.2 Utility & Service Lines (e.g. pipelines, powerlines, electrocution of wildlife)	1	0	0				3	0	0			
5 Biological Resource Use												
5.1 Hunting & Collecting Terrestrial Animals												
5.1.1 Intentional Use (species being assessed is the target)	3	0	0	3	1	1						
5.1.2 Unintentional effects (species being assessed is not the target)	3	0	0	3	0	0						
5.1.3a Persecution/Control (effect on flyway population size)				1	n/a	n/a	3	1	1			
5.1.3b Persecution/Control (effect on national breeding population)												
6 Human Intrusions & Disturbance												
6.1 Recreational Activities	3	0	0	1	n/a	n/a	3	0	0	3	0	0
7 Natural System Modifications												
7.2 Dams & Water Management/Use												
7.2.3 Abstraction of Surface Water (agricultural use)												
7.2.10 Large dams				3	n/a	n/a						
7.3 Other Ecosystem Modifications (actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare) (e.g. abandonment of agriculture, natural salt marsh succession (no grazing))				1	n/a	n/a	3	n/a	n/a	3	n/a	n/a

n/a = information is not available to our knowledge.	EAST GREENLAND/SCOTLAND & IRELAND POPULATION											
	Greenland			**Iceland**			**UK**			**Ireland**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
8 Invasive & Other Problematic Species, Genes & Diseases												
8.2 Problematic native Species/Diseases												
8.2.2 Named Species (e.g. polar bear, white-tailed eagle, red fox, racoon dogs)*							3	0	0			
8.5 Viral/Prion-induced Diseases												
8.5.1 Named "Species" (Disease) (e.g. avian influenza)	1	n/a	n/a	1	n/a	n/a	1	n/a	n/a	1	n/a	n/a
9 Pollution												
9.2.1. Oil Spills	1	n/a	n/a									
9.3.3 Herbicides & Pesticides												
9.2.3 Lead shot (e.g. ingested by birds)	3	0	0	3	n/a	n/a	3	n/a	n/a	3?	n/a	n/a
11 Climate Change & Severe Weather												
11.1 Habitat Shifting & Alteration (e.g. sea level rise)	1	n/a	n/a	1	n/a	n/a						
11.3 Temperature Extremes (e.g. resulting in mismatch of breeding cycle availability and quality)	1	n/a	n/a	1	n/a	n/a						
11.4 Storms & Flooding												

Table B2. *Threat Classification Scheme for the Svalbard/South-west Scotland population of Barnacle Geese.*

n/a = information is not available to our knowledge.	**SVALBARD/SOUTH-WEST SCOTLAND POPULATION**								
	Svalbard			**Mainland Norway**			**UK**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
1 Residential & Commercial Development									
1.1 Housing and Urban Areas (e.g. land reclamation or expanding human habitation that causes habitat degradation in riverine, estuary and coastal areas)							3	0	0
1.2 Commercial & Industrial Areas (e.g. factories)							1	n/a	n/a
2 Agriculture & Aquaculture									
2.1 Annual & Perennial Non-Timber crops									
2.1.1 Shifting Agriculture									
2.1.2 Small-holder Farming							1	n/a	n/a
2.1.3 Agro-industry Farming (e.g. increasing of the number of domestic reindeers, degradation and erosion of habitats including the salt marches)							1	n/a	n/a
2.2 Wood & Pulp Plantations									
2.2.2 Agro-Industry Plantations							1	n/a	n/a
3 Energy Production & Mining									
3.1 Oil & Gas Drilling									
3.2 Mining & Quarrying	3	0	0						
3.3 Renewable Energy e.g. wind farms (birds flying into windmills)				1	n/a	n/a	3	0	0
4 Transportation & Service Corridors									
4.1 Roads & Railroads									
4.2 Utility & Service Lines (e.g. pipelines, powerlines, electrocution of wildlife)							3	0	0
5 Biological Resource Use									
5.1 Hunting & Collecting Terrestrial Animals									
5.1.1 Intentional Use (species being assessed is the target)									
5.1.2 Unintentional effects (species being assessed is not the target)	3	0	0	3	0	0			
5.1.3a Persecution/Control (effect on flyway population size)									
5.1.3b Persecution/Control (effect on national breeding population)									

n/a = information is not available to our knowledge.	SVALBARD/SOUTH-WEST SCOTLAND POPULATION								
	Svalbard			Mainland Norway			UK		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
6 Human Intrusions & Disturbance									
6.1 Recreational Activities	3	1	0	3	1	0	3	0	0
7 Natural System Modifications									
7.2 Dams & Water Management/Use									
7.2.3 Abstraction of Surface Water (agricultural use)									
7.2.10 Large dams									
7.3 Other Ecosystem Modifications (actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare) (e.g. abandonment of agriculture, natural salt marsh succession (no grazing))				3	1	0	3	n/a	n/a
8 Invasive & Other Problematic Species, Genes & Diseases									
8.2 Problematic native Species/Diseases									
8.2.2 Named Species (e.g. polar bear, white-tailed eagle, red fox, racoon dogs)*	3	1	1	3	0	0			
8.5 Viral/Prion-induced Diseases									
8.5.1 Named "Species" (Disease) (e.g. avian influenza)	1	n/a	n/a	1	n/a	n/a	1	n/a	n/a
9 Pollution									
9.2.1. Oil Spills									
9.3.3 Herbicides & Pesticides									
9.2.3 Lead shot (e.g. ingested by birds)							3	n/a	n/a
11 Climate Change & Severe Weather									
11.1 Habitat Shifting & Alteration (e.g. sea level rise)	1	n/a	n/a	1	0	0			
11.3 Temperature Extremes (e.g. resulting in mismatch of breeding cycle availability and quality)	1	n/a	n/a	1	n/a	n/a			
11.4 Storms & Flooding	1	n/a	n/a	1	n/a	n/a			

Table B3. *Threat Classification Scheme for the Russia/Germany & Netherlands Population of Barnacle Geese.* Yellow indicates that numbers have not been verified nationally.

n/a = information is not available to our knowledge.	**RUSSIA/GERMANY & NETHERLANDS POPULATION**											
	Russia			**Finland**			**Estonia**			**Sweden**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
1 Residential & Commercial Development												
1.1 Housing and Urban Areas (e.g. land reclamation or expanding human habitation that causes habitat degradation in riverine, estuary and coastal areas)												
1.2 Commercial & Industrial Areas (e.g. factories)												
2 Agriculture & Aquaculture												
2.1 Annual & Perennial Non-Timber crops												
2.1.1 Shifting Agriculture				3	0	0	3?	n/a	n/a			
2.1.2 Small-holder Farming				3	0	0	3?	n/a	n/a			
2.1.3 Agro-industry Farming (e.g. increasing of the number of domestic reindeers, degradation and erosion of habitats including the salt marches)	3	1	n/a	3	0	0	3?	n/a	n/a			
2.2 Wood & Pulp Plantations												
2.2.2 Agro-Industry Plantations												
3 Energy Production & Mining												
3.1 Oil & Gas Drilling	3	2	0									
3.2 Mining & Quarrying	3	1	n/a									
3.3 Renewable Energy e.g. wind farms (birds flying into windmills)				3	0	0	3?	n/a	n/a	3	n/a	n/a
4 Transportation & Service Corridors												
4.1 Roads & Railroads				3	0	0	3?	n/a	n/a			
4.2 Utility & Service Lines (e.g. pipelines, powerlines, electrocution of wildlife)	3	2	0	3	0	0	3?	n/a	n/a	3	0	0

n/a = information is not available to our knowledge.	RUSSIA/GERMANY & NETHERLANDS POPULATION											
	Russia			**Finland**			**Estonia**			**Sweden**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
5 Biological Resource Use												
5.1 Hunting & Collecting Terrestrial Animals												
5.1.1 Intentional Use (species being assessed is the target)	3	2	n/a									
5.1.2 Unintentional effects (species being assessed is not the target)	3	n/a	n/a									
5.1.3a Persecution/Control (effect on flyway population size)							3	0	0	3	3	0
5.1.3b Persecution/Control (effect on national breeding population)										3	3	0
6 Human Intrusions & Disturbance												
6.1 Recreational Activities												
7 Natural System Modifications												
7.2 Dams & Water Management/Use												
7.2.3 Abstraction of Surface Water (agricultural use)												
7.2.10 Large dams												
7.3 Other Ecosystem Modifications (actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare) (e.g. abandonment of agriculture, natural salt marsh succession (no grazing))							3?	n/a	n/a			

n/a = information is not available to our knowledge.	RUSSIA/GERMANY & NETHERLANDS POPULATION											
	Russia			**Finland**			**Estonia**			**Sweden**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
8 Invasive & Other Problematic Species, Genes & Diseases												
8.2 Problematic native Species/Diseases												
8.2.2 Named Species (e.g. polar bear, white-tailed eagle, red fox, racoon dogs)*	3	3	n/a				3	n/a	n/a	1	n/a	n/a
8.5 Viral/Prion-induced Diseases												
8.5.1 Named "Species" (Disease) (e.g. avian influenza)	1	n/a	n/a	1	n/a	n/a	1	n/a	n/a	1	n/a	n/a
9 Pollution												
9.2.1. Oil Spills	3	2	n/a									
9.3.3 Herbicides & Pesticides												
9.2.3 Lead shot (e.g. ingested by birds)	3	n/a	n/a				3?					
11 Climate Change & Severe Weather												
11.1 Habitat Shifting & Alteration (e.g. sea level rise)	1	n/a	n/a									
11.3 Temperature Extremes (e.g. resulting in mismatch of breeding cycle availability and quality)	1	n/a	n/a									
11.4 Storms & Flooding	3	1	n/a									

	RUSSIA/GERMANY & NETHERLANDS POPULATION											
	Norway			**Denmark**			**Germany**			**Netherlands**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
1 Residential & Commercial Development												
1.1 Housing and Urban Areas (e.g. land reclamation or expanding human habitation that causes habitat degradation in riverine, estuary and coastal areas)				3	0	0						
1.2 Commercial & Industrial Areas (e.g. factories)				3	0	0						
2 Agriculture & Aquaculture												
2.1 Annual & Perennial Non-Timber crops												
2.1.1 Shifting Agriculture				3	0	0	3	0	0	3	0	0
2.1.2 Small-holder Farming				3	0	0	3	0	0	3	0	0
2.1.3 Agro-industry Farming (e.g. increasing of the number of domestic reindeers, degradation and erosion of habitats including the salt marches)				3	2	0	3	0	0	3	0	0
2.2 Wood & Pulp Plantations												
2.2.2 Agro-Industry Plantations				3	0	0	3	0	0	3	0	0
3 Energy Production & Mining												
3.1 Oil & Gas Drilling												
3.2 Mining & Quarrying												
3.3 Renewable Energy e.g. wind farms (birds flying into windmills)	1	n/a	n/a	3	0	0	3	0	0	3	0	0
4 Transportation & Service Corridors												
4.1 Roads & Railroads				3	0	0	3	0	0	3	0	0
4.2 Utility & Service Lines (e.g. pipelines, powerlines, electrocution of wildlife)				3	0	0	3	0	0	3	0	0

	RUSSIA/GERMANY & NETHERLANDS POPULATION											
	Norway			**Denmark**			**Germany**			**Netherlands**		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
5 Biological Resource Use												
5.1 Hunting & Collecting Terrestrial Animals												
5.1.1 Intentional Use (species being assessed is the target)												
5.1.2 Unintentional effects (species being assessed is not the target)	3	0	0	3	0	0	3	n/a	n/a	3	0	0
5.1.3a Persecution/Control (effect on flyway population size)				3	0	0	3	0	0	3	1	0
5.1.3b Persecution/Control (effect on national breeding population)										3	1	1
6 Human Intrusions & Disturbance												
6.1 Recreational Activities	3	1	0	3	1	0	3	0	0	3	0	0
7 Natural System Modifications												
7.2 Dams & Water Management/Use												
7.2.3 Abstraction of Surface Water (agricultural use)												
7.2.10 Large dams												
7.3 Other Ecosystem Modifications (actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare) (e.g. abandonment of agriculture, natural salt marsh succession (no grazing))	3	1	0							3	1	0

	RUSSIA/GERMANY & NETHERLANDS POPULATION											
	Norway			Denmark			Germany			Netherlands		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
8 Invasive & Other Problematic Species, Genes & Diseases												
8.2 Problematic native Species/Diseases												
8.2.2 Named Species (e.g. polar bear, white-tailed eagle, red fox, racoon dogs)*	3	0	0							3	n/a	n/a
8.5 Viral/Prion-induced Diseases												
8.5.1 Named "Species" (Disease) (e.g. avian influenza)	1	n/a	n/a	3	n/a	n/a	1	0	0	1	n/a	n/a
9 Pollution												
9.2.1. Oil Spills												
9.3.3 Herbicides & Pesticides				3	0	0						
9.2.3 Lead shot (e.g. ingested by birds)												
11 Climate Change & Severe Weather												
11.1 Habitat Shifting & Alteration (e.g. sea level rise)	1	0	0	1	n/a	n/a	1	n/a	n/a	1	n/a	n/a
11.3 Temperature Extremes (e.g. resulting in mismatch of breeding cycle availability and quality)	1	n/a	n/a	1	n/a	n/a						
11.4 Storms & Flooding	1	n/a	n/a	1	n/a	n/a						

	RUSSIA/GERMANY & NETHERLANDS POPULATION								
	Belgium			Latvia			Lithuania		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
1 Residential & Commercial Development									
1.1 Housing and Urban Areas (e.g. land reclamation or expanding human habitation that causes habitat degradation in riverine, estuary and coastal areas)							3	0	0
1.2 Commercial & Industrial Areas (e.g. factories)							3	0	0

	RUSSIA/GERMANY & NETHERLANDS POPULATION								
	Belgium			Latvia			Lithuania		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
2 Agriculture & Aquaculture									
2.1 Annual & Perennial Non-Timber crops									
2.1.1 Shifting Agriculture	3	0	0	3	0	0	3	0	0
2.1.2 Small-holder Farming	3	0	0	3	0	0	3	0	0
2.1.3 Agro-industry Farming (e.g. increasing of the number of domestic reindeers, degradation and erosion of habitats including the salt marches)	3	0	0	3	0	0	3	0	0
2.2 Wood & Pulp Plantations									
2.2.2 Agro-Industry Plantations	3	0	0	3	0	0	3	0	0
3 Energy Production & Mining									
3.1 Oil & Gas Drilling							3	0	0
3.2 Mining & Quarrying							n/a	n/a	n/a
3.3 Renewable Energy e.g. wind farms (birds flying into windmills)	3	0	0	3	0	0	3	0	0
4 Transportation & Service Corridors									
4.1 Roads & Railroads	3	0	0	3	0	0	3	0	0
4.2 Utility & Service Lines (e.g. pipelines, powerlines, electrocution of wildlife)	3	0	0	3	0	0	3	0	0
5. Biological Resource Use									
5.1 Hunting & Collecting Terrestrial Animals									
5.1.1 Intentional Use (species being assessed is the target)									
5.1.2 Unintentional effects (species being assessed is not the target)							n/a	n/a	n/a
5.1.3a Persecution/Control (effect on flyway population size)	3	0	0				n/a	n/a	n/a
5.1.3b Persecution/Control (effect on national breeding population)	3	?	?				3	0	0
6 Human Intrusions & Disturbance									
6.1 Recreational Activities	3	0	0	3	0	0	3	0	0

	RUSSIA/GERMANY & NETHERLANDS POPULATION								
	Belgium			Latvia			Lithuania		
Threats	Timing	Scope	Severity	Timing	Scope	Severity	Timing	Scope	Severity
7 Natural System Modifications									
7.2 Dams & Water Management/Use									
7.2.3 Abstraction of Surface Water (agricultural use)							n/a	n/a	n/a
7.2.10 Large dams							n/a	n/a	n/a
7.3 Other Ecosystem Modifications (actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare) (e.g. abandonment of agriculture, natural salt marsh succession (no grazing))							3	0	0
8 Invasive & Other Problematic Species, Genes & Diseases									
8.2 Problematic native Species/Diseases									
8.2.2 Named Species (e.g. polar bear, white-tailed eagle, red fox, racoon dogs)*							3	0	0
8.5 Viral/Prion-induced Diseases									
8.5.1 Named "Species" (Disease) (e.g. avian influenza)	1	n/a	n/a	1	n/a	n/a	3	0	0
9. Pollution									
9.2.1. Oil Spills							3	0	
9.3.3 Herbicides & Pesticides							3	0	0
9.2.3 Lead shot (e.g. ingested by birds)							n/a	n/a	n/a
11 Climate Change & Severe Weather									
11.1 Habitat Shifting & Alteration (e.g. sea level rise)	1	n/a	n/a				n/a	n/a	n/a
11.3 Temperature Extremes (e.g. resulting in mismatch of breeding cycle availability and quality)							n/a	n/a	n/a
11.4 Storms & Flooding							3	0	0

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