Doc. AEWA/EGMIWG/Inf.9.9
Date: 2 May 2024

AEWA EUROPEAN GOOSE MANAGEMENT PLATFORM

9th MEETING OF THE
AEWA EUROPEAN GOOSE MANAGEMENT
INTERNATIONAL WORKING GROUP

18-20 June 2024, Tromsø, Norway

AEWA INTERNATIONAL SINGLE SPECIES MANAGEMENT PLAN FOR THE GREYLAG GOOSE

(Northwest/Southwest European Population)

(Anser anser)

TECHNICAL SERIES No.71

AEWA
UNEP

International Single Species Management Plan for the Greylag Goose

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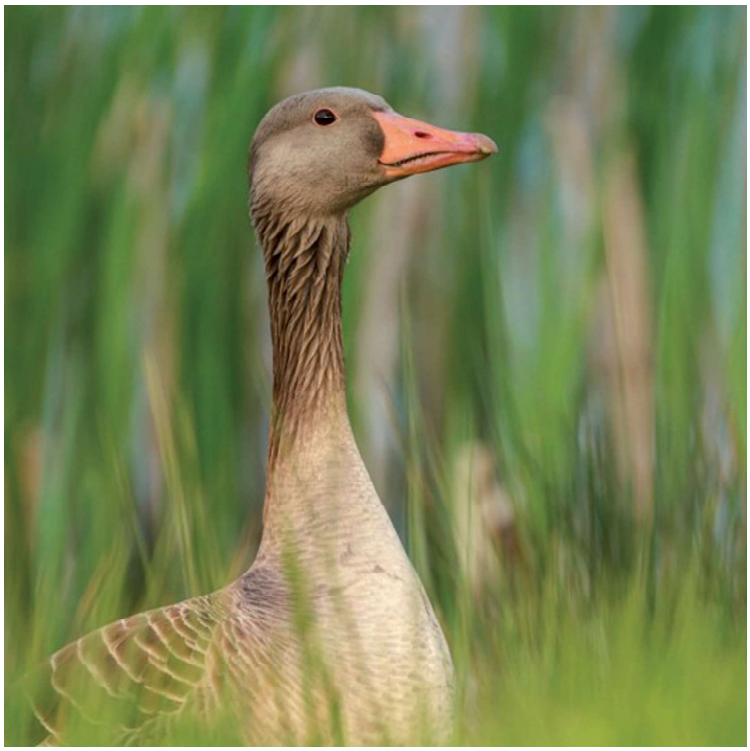
Anser anser



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

International Single Species Management Plan for the Greylag Goose

(Northwest/Southwest European Population)

Anser anser

AEWA Technical Series No. 71

December 2018

Lifespan of Plan
10 years (2019 – 2028)

Prepared by
European Institute for the Management of Wild Birds and their Habitats (OMPO), Aarhus University/AEWA European Goose Management Platform Data Centre and Rubicon Foundation

Prepared and printed with financial support from
French Ministry for the Ecological and Inclusive Transition (Ministère de la Transition écologique et solidaire), Norwegian Environment Agency, French National Agency for Wildlife (ONCFS), François Sommer Foundation, French National Hunting Federation, Danish Environmental Protection Agency within the Ministry of Environment and Food, Dutch Ministry of Agriculture, Nature and Food Quality and Province of Friesland, the Netherlands

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

The preparation of the International Single Species Management Plan for the Northwest/Southwest European population of the Greylag Goose (*Anser anser*) was co-financed by the French Ministry for the Ecological and Inclusive Transition (Ministère de la Transition écologique et solidaire), the Norwegian Environment Agency, the French National Agency for Wildlife (ONCFS), the François Sommer Foundation, the French National Hunting Federation, the Danish Environmental Protection Agency within the Ministry of Environment and Food, the Dutch Ministry of Agriculture, Nature and Food Quality, as well as the Province of Friesland, the Netherlands.

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1st AEWA International Management Planning Workshop for the Greylag Goose (*4-6 October 2017, Paris, France*):
Participants list: https://www.unep-aewa.org/news/2017/ggmp-ws

2nd AEWA International Management Planning Workshop for the Barnacle Goose and the Greylag Goose (NW/SW population) (*19 June 2018, Leeuwarden, the Netherlands*):
Participants list : https://www.unep-aewa.org/news/2018/egm-iwg3

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Date of adoption: 8 December 2018

Lifespan and Review of the Plan: The lifespan of this International Single Species Management Plan is 10 years (2019 – 2028). It should be reviewed every 10 years (first revision in 2028). An emergency review will be undertaken if there is a significant change to the NW/SW European population, covered in this plan, before the next scheduled review.

Milestones in the preparation of the Plan:

1st draft:	Presented to participants of the 1st AEWA International Management Planning Workshop for the Greylag Goose, *4-6 October 2017, Paris, France*
2nd draft:	Presented for consultation with the Range States and stakeholders on 9 *March 2018;* Submitted to the 14th Meeting of the AEWA Technical Committee, *10-13 April 2018, Bonn, Germany*
3rd draft:	Presented to the Range States for discussion at the 2nd Species Management Planning Workshop for the Barnacle Goose and the Greylag Goose (NW/SW European Population) on *19 June 2018 in Leeuwarden, the Netherlands* and the 13th meeting of the AEWA Standing Committee on *03-05 July 2018, the Hague, the Netherlands*

4th draft:	Circulated for formal consultation with the governments of the Range States on *18 July 2018*
Final draft:	Submitted to the 7th Session of the Meeting of the Parties to AEWA (MOP7) *4-8 December 2018, Durban, South Africa*

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Please send any additional information or comments regarding this Management Plan to the AEWA European Goose Management Platform Coordinator, Eva Meyers (eva.meyers@unep-aewa.org)

Photo cover: Greylag Goose (*Anser anser*) © Szabolcs Nagy

Recommended citation:
Powolny, T., Jensen, G.H., Nagy, S., Czajkowski, A., Fox, A.D., Lewis, M., Madsen, J. (Compilers) 2018. *AEWA International Single Species Management Plan for the Greylag Goose (Anser anser) - Northwest/Southwest European population.* AEWA Technical Series No. 71. Bonn, Germany.

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 NW/SW European population of the Greylag Goose 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).

Contents

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
CMS	Convention on the Conservation of Migratory Species of Wild Animals
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 paragraph 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 Management Units for the Greylag Goose are 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, i.e. *Northwest/Southwest European* 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 human health, 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 occur in such habitats.
Serious/ Significant damage	In those instances, in which birds can only be legally killed by way of derogation/exception from the ordinary provisions of the Birds Directive or Bern Convention, 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.14) 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 Greylag Goose (*Anser anser*) 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, Greylag and Barnacle (*Branta leucopsis*) Geese.

1 Basic Data

Within Europe, two subspecies of the Greylag Goose (*Anser anser)* have been recognised: *Anser anser anser* divided into four bio-geographic populations (Iceland, British/Irish resident, Northwest/Southwest (NW/SW) Europe and Central Europe) and *Anser anser rubrirostris* with two populations (Black Sea and Caspian Sea) (Madsen et al. 1999; Mitchell et al. 2012).

This International Single Species Management Plan (ISSMP) covers the NW/SW European population of Greylag Geese, for which the principal Range States are: Norway, Sweden, Finland, Denmark, Germany, Netherlands, Belgium, France and Spain (Figure 1, Table 1).

Geese from this population also occur regularly in Poland, Czech Republic and Portugal, but as the numbers are below 1% of the population[1], they are not included as principal Range States.

This management plan covers the wild and naturalised[2] individuals of the nominated subspecies within the range of the population but does not include the domestic form or its phenotypically or otherwise (e.g. location, behaviour) recognisable descendants.

The Greylag 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] According to the AEWA guidance on species action planning, 1% of the population is defined as the threshold for determining Principal Range States.

[2] The term 'naturalised' 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.

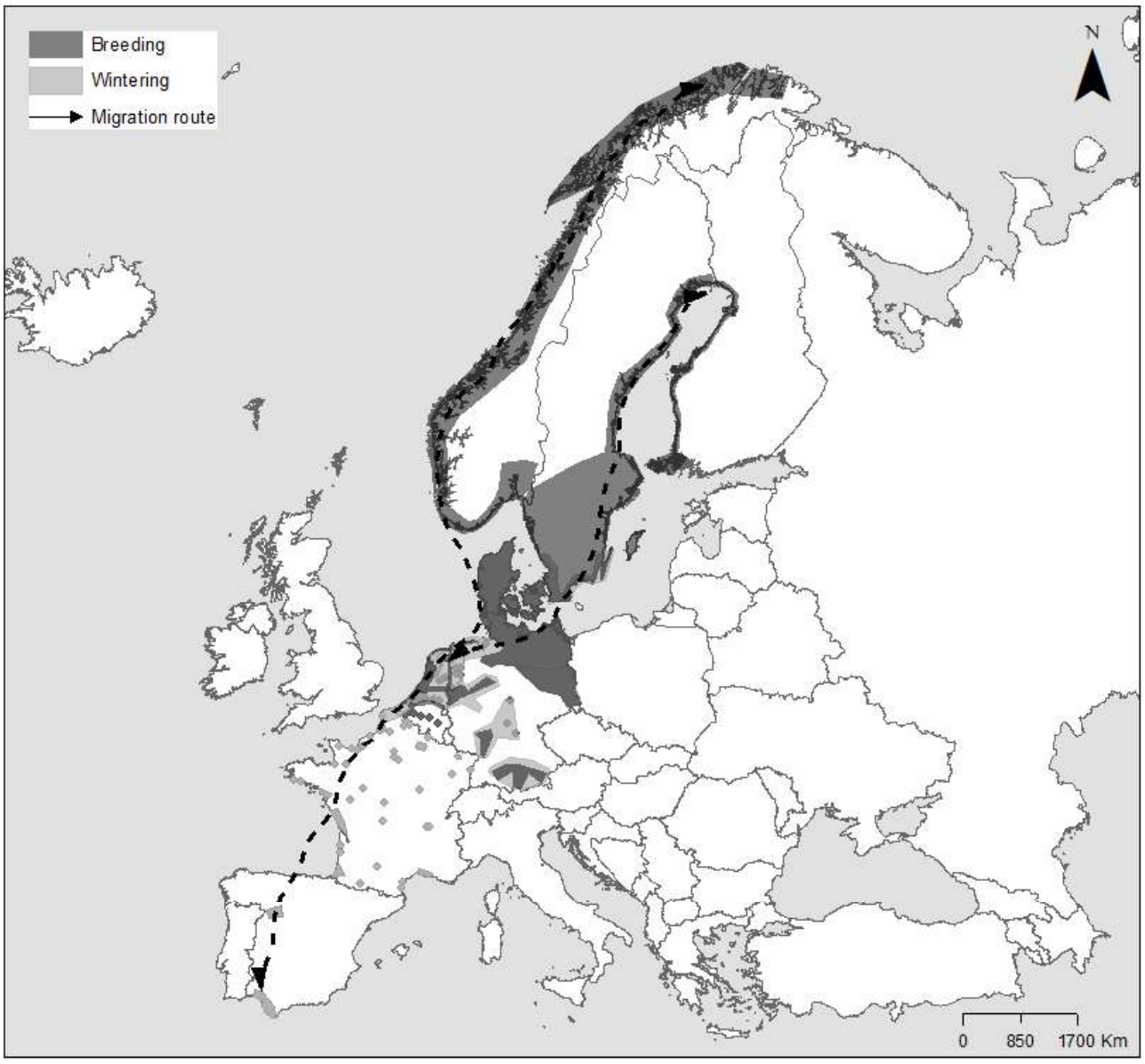


***Figure 1**. Annual distribution and main migration routes for the NW/SW European population of the Greylag Goose including breeding (grey) and wintering (light grey) areas, as well as areas which are both used during the breeding and wintering period (dark grey).*

As described in Annex 1, the population includes migratory and resident segments that may require differentiated management throughout their annual cycle. Based on the preliminary review of migratory connectivity, the participants of the 2nd management planning workshop proposed to use the following Management Units (MUs)[3]:

- **MU1:** Breeding population from Norway that is subsequently observed in the Netherlands and neighbouring countries (Germany, Belgium), being used as wintering areas and staging areas during pre/post-nuptial migration from/to more southern wintering sites (France/Spain);
- **MU2:** Breeding population from Sweden that is subsequently observed in the Netherlands and neighbouring countries (Germany, Belgium), being used as wintering areas and staging areas during pre/post-nuptial migration from/to more southern wintering sites (France/Spain);
- **MU3:** Netherlands, Belgium and Germany (mainly sedentary MU).

Due to the lack of data from Finland, a specific MU for Finnish birds could not be delineated. However, it was decided as a first step to integrate these into the MU2. Within the flyway, Denmark is positioned as a staging

[3] The assignment of countries to each MU may be revised by the AEWA European Goose Management International Working Group (EGM IWG) in the light of new information or analyses.

and moulting area for birds from Norway and Sweden (Andersson et al. 2001, Nilsson et al. 2001). Because of its positioning at the crossroad of MU1 and MU2 and of the low sighting proportion from individuals breeding in the Netherlands, no settlement within the scheme was currently decided for Denmark.

The delineation of MUs for the Greylag Goose is explained in more detail in Annex 5 to this document.

Table 1. *Status of the Greylag Goose in the principle Range States*

Range states	**Resident individuals**	**Migratory individuals**		
		Breeding	***Stop-over***	***Wintering***
Belgium	x	x	x	x
Denmark		x	x	x
Finland		x		
France	x	x	x	x
Germany	x	x	x	x
Netherlands	x	x	x	x
Norway		x	x	x[4]
Spain	x	x	x	x
Sweden	x	x	x	x

Table 2. *Summary of international conservation and legal status of the Greylag Goose*[5]

	NW/SW European population
IUCN Red List status	Least Concern (LC)
AEWA Table 1 status	C1
CMS	Appendix II
CITES	This species is not currently listed in the CITES Appendices
Bern Convention	Appendix III
EU Birds Directive	Annex IIA; Annex IIIB

[4] The number of wintering Greylag Geese in Norway varied between less than 1,000 and more than 10,000, however based on colour-ring/neckband readings the vast majority of these birds are from the Icelandic population and have therefore not been included (A. Follestad *pers. comm.*).

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

2 Framework for Action

2.1 Introduction[6]

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*"[7], 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 Greylag (*Anser anser*) and Barnacle (*Branta leucopsis*) Geese.

Development of an ISSMP for the NW/SW European population of the Greylag Goose was deemed necessary because it has increased by more than seven times, from an estimated 120,000-130,000 individuals in the 1980s (Madsen 1987) to around 960,000 individuals in the 2010s (Fox and Leafloor 2018) and concerns have been expressed regarding increasing agriculture conflicts and air safety (see Annex 1 and Annex 2 for details). Figure 2 shows large differences in the growth of national breeding numbers in the period of 1980 - 2012. Most national populations have at least doubled, but the breeding numbers have increased by 19 times in Sweden and by 102 times in the Netherlands, where all goose species have been protected since 2001, but are subject to killing under derogations since 2002. There is a close correlation between the abundance of the species and compensation payments to farmers (Figure 5 in Annex 2). Risk to air safety is also increasing with higher goose numbers, especially in the vicinity of large international airports such as Kastrup in Copenhagen, Denmark (Figure 6a in Annex 2) and Schiphol in Amsterdam, the Netherlands (Figure 6b in Annex 2). These conflicts are set to rise with the further rapid increase of the population. According to the provisional calculations presented in Annex 3, the population is projected to double by 2023 (i.e. in five years) and exceed 6 million individuals within 25 years (Figure 7 in Annex 3). This projection matches well with the results of a spatially explicit population model produced for the Netherlands and predicts that Greylag Goose numbers in the country can grow up to 2.8 million individuals (Baveco et al. 2012). Although the vast majority of the Dutch birds are resident, the Netherlands is also an important staging and wintering area for birds breeding further north and east with some of them migrating further south, particularly to Spain. Similar overlap between resident and migratory individuals happen also in other countries. Harvest and derogation killing measures need to be coordinated across the flyway of the population to accommodate the diverse ecological, recreational and economic interests associated with this flyway population that comprise multiple management units partially overlapping at least during some part of the year.

[6] 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.

[7] 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 Single Species Management Plan for the Greylag Goose suggests that they consider the damage being sufficiently significant to be addressed through coordinated action. *See description in Key Terms (page 7-8).*

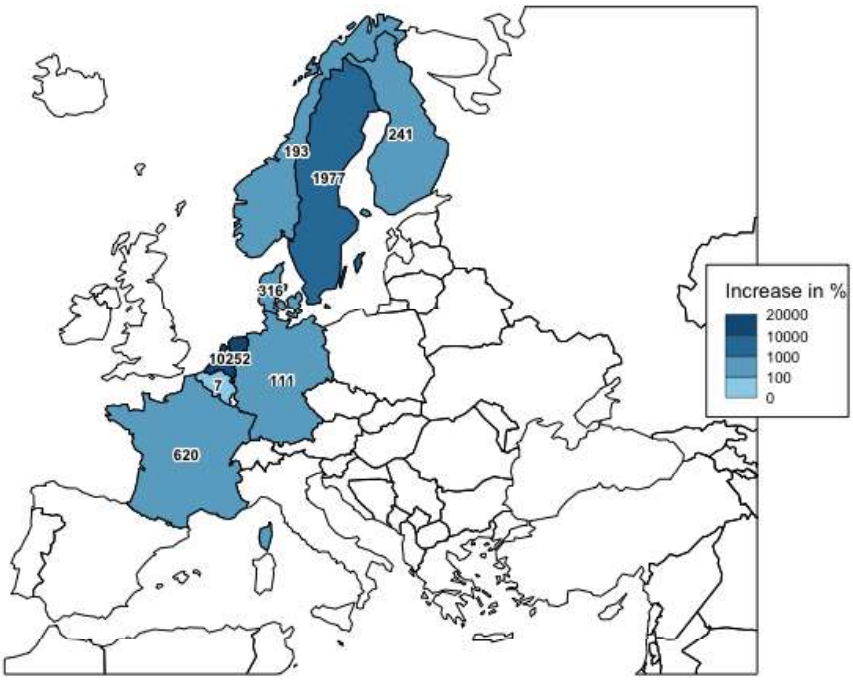


Figure 2. *Reported long-term (i.e. 1980 - 2012) national breeding population trends for the NW/SW European population of Greylag Goose based on the supplementary material[8] to BirdLife International (2015). The figures presented in the map are the geometric means of the reported minimum and maximum percentage increase in Table 2 of the supplementary material.*

This ISSMP and the related Adaptive Flyway Management Programme (AFMP) (Figure 3) aim to establish an agreement amongst Range States on the strategic goal and objectives of the conservation and management of the NW/SW European population of the Greylag Goose and its management units[9]. This intention is fully compatible with the provisions of both Article II (1) of AEWA[10] and Article 2 of the Birds Directive[11] and Bern Convention on the Conservation of European Wildlife and Natural Habitats.[12] The compatibility of the plan with these international instruments is further elaborated in the rest of this chapter and in Annex 4.

[8] BirdLife International 2015.
[9] Application of differential treatment to management units within the population will be further assessed and decided by the EGM IWG during the development of the AFMPs.
[10] "Parties shall take co-ordinated measures to maintain migratory waterbird species in a favourable conservation status …"
[11] "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."
[12] "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."

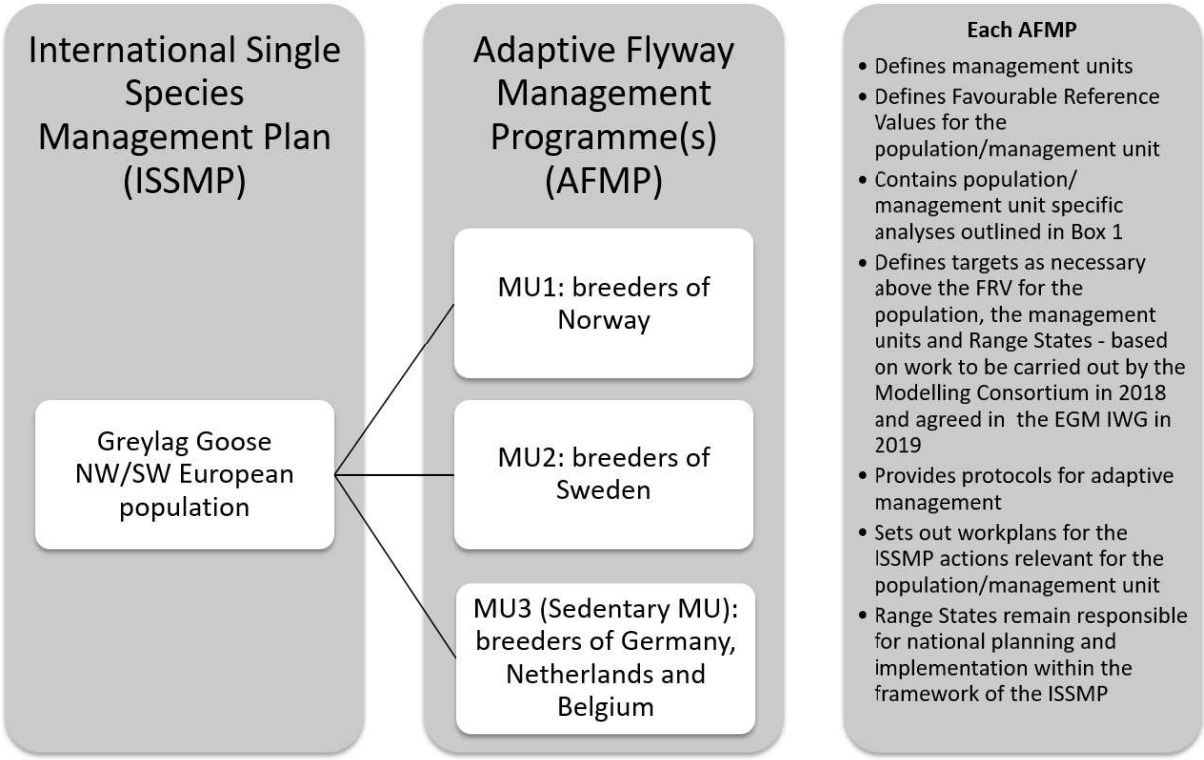


Figure 3. *Relationship between this management plan and the Adaptive Flyway Management Programme(s) (AFMPs).*

This ISSMP only addresses the strategic issues in general terms to provide a mandate for developing AFMPs. These AFMPs will be adopted and then revised annually by the EGM IWG. Therefore, implementation details or issues that may require revision in the future, such as Favourable Reference Values (FRVs), indicators, management targets for the population/management units and tasks related to the actions agreed in the management plan, will be elaborated in the AFMPs (Figure 3 and Box 1 below).

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

To the extent that derogations from the provisions of Articles 5-8 of the Birds Directive (or the protections prescribed by the Bern Convention) may be appropriate for addressing the problems posed by Greylag Geese, AFMPs have the potential to assist Range States in assessing whether such derogations are necessary 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 human health and 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. A 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(2) of the Birds Directive:

i. List of SPAs and other protected areas designated for the Greylag Goose;
ii. Management of the species and the damage inside and outside SPA;
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.

The identified fundamental objectives can be achieved through various means and process objectives. One means objective may contribute to several fundamental objectives (e.g. protection of the Special Protected Areas (SPAs) not only provides protection to a significant proportion of the population, it also provides ecosystem services linked to recreation for people who enjoy watching geese and for hunting in adjacent areas).

2.2 Goal

Maintain the population in a favourable conservation status while taking into account ecological, economic and recreational interests.

Favourable reference values for population size, habitat and range are to be established in the population-specific AFMPs by the EGM IWG, respecting the requirements of international instruments listed in Table 2 above.

The Birds Directive, AEWA and the Bern Convention allow the hunting of Greylag Geese in all Range States, including the EU Member States. The ISSMP, and the AFMPs developed thereunder, will allow the better co-ordination of hunting at flyway level and keep the population between agreed lower and upper limits.

In addition to hunting, derogations are also used to deal with the damage or risks related to this species. In that context, an additional value of the AFMPs will be to address these problems in a more co-ordinated and efficient way between Range States, due to better knowledge of the status of population and the other issues defined in Box 1. The AFMPs will also help to ensure that the derogations granted at Range State and EU Member State level will not be detrimental to the population's conservation status. They will provide contextual information to EU Member States when considering granting derogations thanks to a better assessment of the situation (damage, population level, link between damage and population in each MU of each Range State).

These two aspects of the plan (i.e. hunting and derogations) have different legal bases (in the Birds Directive context, Articles 7 and 9 respectively).

2.3 Fundamental Objectives

This plan recognises seven fundamental objectives[13] based on the stakeholders' perspectives expressed at the management planning workshop (Paris, October 2017). Fundamental objectives do not need to be shared by all stakeholders, they express what is important for certain interest groups. Following the standards of structured decision-making 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. <u>Maintain the population at a satisfactory level</u>[14]

Satisfactory level of the population is to be agreed by the Range States in the EGM IWG above the favourable reference values and taking into account the other requirements of fundamental objectives II-VII based on multi-criteria analysis.

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

[14] A satisfactory level means 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.

II. Minimise agricultural damage and conflicts

Those derogations from the provisions of Articles 5-8 of the Birds Directive or from the relevant protections in the Bern Convention (see Annex 4), 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 addressing the conflict, rather than the damage alone, the plan takes a more holistic 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. This also provides the opportunity for a more flexible approach to mitigating the conflict with a gradient of possible balance between the interdependent elements described above.

III. Minimise the risk to public health and air safety

It is recognised that these risks are either mainly localised (as air safety) or not 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[15]

It is recognised that this risk is rather localised and local actions may suffice at current population levels.

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 5 (in Annex 2) shows, the cost of Greylag 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 population at a satisfactory level

The Greylag Goose is listed on Annex II (Part A) of the Birds Directive and consequently it can be legally hunted under Member States' national legislation throughout the territory of the European Union, in accordance with the provisions of Article 7 of the Directive. Hunting is similarly allowed under the species' listing on Appendix III of the Bern Convention and the NW Europe/SW Europe population's inclusion in Column C of AEWA's Table 1 (for further detail, see Annex 4). This fundamental objective is linked to satisfying legitimate interest in hunting the species sustainably in the long-term and it is recognised that the hunting opportunity might be higher during the period of

[15] Including habitats, ecosystem functions.

adjusting the population to a level that better satisfies other fundamental objectives, depending on the methods agreed to achieve certain population levels.

Appropriate indicators for assessing the progress towards achieving the fundamental objectives will be developed by the EGM IWG during the development of the AFMP.

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(2) of the Birds Directive and similar provisions of the Bern Convention and AEWA, (2) prevent or (3) manage damages to agriculture, other flora and fauna and risks to human health and 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, were considered but not suggested for immediate application. The potential impact of agriculture extensification on goose populations and the society is complex and yet insufficiently understood. Strengthening natural predator populations to control the species 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 meadow birds, cf. the International Multi-Species Action Plan for the conservation of breeding waders of wet grasslands in Europe (Leyrer et al. 2017), should be also carefully considered. Therefore, increasing the understanding on how agricultural extensification and strengthening predator's populations could help in goose management is included into this ISSMP 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 population's range***

   This means 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(2) 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 population above the FRVs and ensures that it continues to provide valued ecosystem services. This objective also addresses the obligations of EU Member States to maintain SPAs in good ecological condition 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***[16]

   This objective aims to avoid damages to agriculture and other flora and fauna and risks to human health and air safety by using various means, such as deterring, diverting e.g. through habitat

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

management, or avoiding, locally in areas determined by the national authorities as being 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. The population is kept between agreed minimum and maximum targets

This objective recognises that several of the fundamental objectives are linked to the population size and therefore suggests maintaining the population between agreed minimum and maximum targets. On the one hand, setting a minimum target for each management unit would aim to guarantee that the population is maintained in favourable conservation status (and that Range States consequently remain in compliance with Article II (1) of AEWA, Article 2 of the Birds Directive, and Article 2 of the Bern Convention), while providing ecosystem goods and services, including hunting opportunities. On the other hand, setting maximum targets (at least for certain management units) might be important to prevent widespread damage to agriculture or to reduce the risk to air safety in case of an exponentially growing population while there is still sufficient capacity to control them, and to limit the further growth of goose management costs.

Importantly, although the killing of Greylag Geese is allowed under AEWA, the Bern Convention and the Birds Directive, these instruments impose limits on the periods during and the methods by which this can occur. Parties to the Agreement and the Convention, and EU Member States, resorting to use lethal control measures (including within the context of an ISSMP) must ensure that these measures comply with their legal obligations. In particular derogations must only be permitted insofar as the conditions identified in Article 9 of the Birds Directive (and, where relevant, Article 9 of the Bern Convention) are satisfied and must be proportionate to the problem they seek to address (see Annex 4 for further detail).

In addition, Article 7 of the Birds Directive requires EU Member States to ensure that the practice of hunting "*complies with the principles of wise use and ecologically balanced control of the species of birds concerned*", and the European Commission has advised that "'*Ecologically balanced control' implies that the measures taken should be ecologically sound and in proportion to the problem to be solved, taking into account the conservation status of the species involved*".[17] This need for proportionality should be taken into consideration in the formulation of any maximum population targets.

[17] European Commission (2008), Guidance document on hunting under Council Directive 79/409/EEC on the conservation of wild birds "The Birds Directive" at para. 2.4.33.

2.5 Process objectives

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

A. Knowledge is available to support shared goose management

The adaptive management of the shared population 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

Implementation of a dynamic management framework requires frequent update of hunting regulations and derogations regulations in the light of monitoring data.

E. Sufficient resources are secured on long-term basis

Adaptive management of the population 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[18]	Time scale[19]	Organisations responsible
I V VII	1. A network of safe key sites is maintained and managed throughout the population's range	1.1 Provide adequate protection and management to key sites of international importance under Article 4(2) of the Birds Directive in the EU and other relevant instruments in other Range States throughout the range of the population 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[20]	High	Immediate / Rolling	National authorities
		2.2. Provide accommodation areas to reduce risks and conflicts at sensitive areas through e.g. subsidies[21]	Medium	Medium/ Rolling	National authorities
		2.3 Apply scaring and land management techniques to reduce the attractiveness of sensitive areas, monitoring the implications of such local displacement for conflicts at wider scale[22]	High	Short / Rolling	National authorities, Airport authorities

[18] *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.
[19] *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.
[20] Avoidance.
[21] Diversion.
[22] Deterrence.

FOs	Means/Process objectives	Actions	Priority[18]	Time scale[19]	Organisations responsible
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[23]	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. The population is kept between minimum and maximum targets	4.1 Establish hierarchical population targets at flyway, management unit and national levels iteratively to ensure national targets are consistent with the flyway targets and with legal requirements at all levels	Essential	Short	AEWA EGM IWG
		4.2 Establish an internationally coordinated population management programme (including both hunting and, if necessary, killing under derogations) for the transboundary management units encompassing monitoring, assessment and decision-making protocols	Essential	Short	AEWA EGM IWG
		4.3 Improve effectiveness of population control 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

[23] Adaptation

FOs	Means/Process objectives	Actions	Priority[18]	Time scale[19]	Organisations responsible
		4.4 Promote best practices of goose hunting 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 Develop hunting techniques to further reduce crippling	Medium	Long / Rolling	Research institutes, National hunting federations
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 harvested by any means	Essential	Ongoing / Rolling	AEWA EGMP DC
		A.3 Maintain a spatially explicit database on goose damage to agriculture, other 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

FOs	Means/Process objectives	Actions	Priority[18]	Time scale[19]	Organisations responsible
		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	Long	National authorities, Research institutes
		A.6 Assess the role of predators (e.g. White-tailed Eagle *Haliaeetus albicilla*, Red Fox *Vulpes vulpes*) in regulating goose populations	Medium	Long	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

FOs	Means/Process objectives	Actions	Priority[18]	Time scale[19]	Organisations responsible
		B.5 Share experience concerning methods to prevent damage to agriculture and risks to human health, 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
All	D. Relevant national legislation is harmonised	D.1 Range States review their national legislation in the light of the framework legal guidance document developed under the EGMP	High	Short	National authorities
All	E. Sufficient resources secured on long-term basis	E.1 Range States contribute on a regular basis to the budget of the EGMP	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

Annex 1 Biological Assessment

1 Distribution throughout the annual cycle

Individuals from the NW/SW European population of Greylag Goose breed mainly in Norway, Sweden, Finland, Denmark, Germany, the Netherlands and Belgium (Nilsson et al. 1999). Traditionally, Finnish breeding Greylag Geese have been assigned to the Central European population. However, ring recoveries show that birds caught in western Finland belong to the NW/SW flyway and birds from the Gulf of Finland region belong to the Central flyway (Saurola et al. 2013). Additionally, it is suggested that there is an exchange between individuals of the NW/SW European population and the Central European population from other geographical areas (British or Black Sea populations) (Calderon et al. 1991; ONCFS 2014). Following Huntley et al. (2007), the potential current range of Greylag Geese based on climatic conditions matches well their actual distribution.

During autumn migration, Norwegian breeding birds migrate to staging areas in Sweden, Denmark, Germany and the Netherlands (Figure 1), where they arrive between September (or even late July/early August in Germany) and in late November (ONCFS 2014). Neck banding and GPS tracking of Greylag Geese breeding in north-eastern Norway shows that geese leave their breeding areas in late August/early September flying along the Bothnian coast of Sweden and possibly the western coast of Finland before staging in southern Sweden for a month and then move to Denmark and the Netherlands (Boos 2016; Boos and A. Follestad *pers. comm.)*. Finnish breeders in the Bothnian Bay and Swedish breeders along the Baltic coast either skip staging areas in Denmark and migrate directly to the Netherlands (Nilsson et al. 1999), or they stay in south Sweden during winter.

In recent years, overwintering migratory geese have increasingly been observed amongst resident breeding birds in Germany, Denmark and southern Sweden. During the autumn migration in November, a high proportion of the Greylag Goose flyway population is staying in the Netherlands (K. Koffijberg *pers. comm.*). Many of these birds are thought to be resident Dutch breeders, out of which less than 10% of individuals have been estimated to migrate further south in winter, mainly to Belgium and Germany (Voslamber et al. 2010). Norwegian Greylag Geese leave the Netherlands after mid-November and migrate to the traditional core wintering areas in France and Spain (Andersson et al 2001; ONCFS 2014). However, not all Norwegian geese migrate to France or Spain but now winter in the Netherlands, Germany and Denmark. It is suggested that individual migration strategies may change from year to year (Boos 2016) and transition probabilities in Capture-mark-recapture analyses are currently being computed to properly evaluate such variability. Despite an observed northward shift during the wintering period among birds breeding in Sweden, some Swedish breeders still winter in Spain. More than 25% of the Swedish autumn population now remains in Sweden during mild winters (Nilsson 2013). Wintering numbers in Spain have increased annually by 4% between 1987 and 2009, compared to 13% in the Netherlands, 19% in France, 32% in Denmark and 36% in Sweden (Ramo et al. 2015). These results confirm a shift in the centre of gravity of the winter range to the northeast, confirmed by earlier studies in Sweden, Norway and the Netherlands (Nilsson 2006). Wintering birds are also increasingly dispersed in northern countries, compared to the more concentrated aggregations within Spain and France. Furthermore, autumn migration is occurring later in the year (Nilsson 2006; Ramo et al. 2015), while spring migration occurs earlier in the year (Fouquet et al. 2009).

Data obtained from neck-banded and GPS tagged birds (Boos 2016) suggests that during spring migration, geese leaving Spain and France move into staging areas in the Netherlands, staying in the Netherlands between mid-February and mid-April, before returning to their breeding areas, with a trend towards an earlier arrival (Pistorius et al. 2006a, b, Nilsson 2007, 2008). Geese that are wintering further north, e.g. in the Netherlands, Denmark or Germany, may arrive in early March to southern Norway (A. Follestad *pers. comm.*).

This shift in centre of gravity and change in the migratory propensity in general may have been stimulated by the introduction of feral Greylag Geese to some extent. In the 1950-60s, Greylag Geese were successfully reinforced in the Netherlands and Belgium (Lensink et al. 2013) and in the 1970s, in some places along the

Channel and the Atlantic coast in France (Issa & Muller 2015). Hereafter the Dutch breeding population grew at an average rate of 20% per year between 1961 and 2009, with most of these birds being resident (Voslamber et al. 2010). In Belgium, the reintroduction has attracted an increasing number of wild Greylag Geese, many of which have stayed there to breed (Nilsson et al. 1999). Overall, the NW/SW European population of Greylag Geese shows no clear genetic structure (Pellegrino et al. 2015).

Non-breeding immature geese and unsuccessful adult breeding geese traditionally undertake a moult migration to replace their flight feathers at sites that are generally remote from nesting concentrations throughout the flyway. Significant aggregations which occurred at different time in recent decades include those at Oostvaardersplassen in Flevoland, the Netherlands, which formerly supported up to 62,000 geese from Germany, the Baltic region and southern Sweden (Dubbeldam & Zijlstra 1996), up to 50,000 on Saltholm in Øresund between Denmark and Sweden (Aarhus University, Denmark unpubl.), 27,000 in Hornborgasjön, Sweden, and up to 30,000 along the Norwegian coast (NINA, Norway unpubl.) drawing predominantly from local breeders, but also individuals from southern Scandinavia. However, more recently, smaller much more widely distributed moulting concentrations have become established, at least in the Netherlands, Germany and Denmark, indicating an emergence of more local moulting sites (K. Koffijberg, J. Madsen *pers. comm.*).

2 Habitat requirements

Greylag Geese nest in dense emergent vegetation or on inaccessible small islands in all types of wetlands ranging from relatively nutrient-rich to oligotrophic character, from the sub-arctic, through the boreal to wetlands, in even the most intensified agricultural areas within Europe. In the Netherlands and parts of western Germany, Greylag Geese also increasingly inhabit urban habitats. Outside the breeding season, Greylag Geese tend to feed on a wide range of farmland, semi-natural and wetland habitats, but aggregate to roost on wetlands with open water, including freshwater, brackish and estuarine areas as well as sheltered marine bays. For this reason, their foraging sites can be highly diverse, including wet grassland and flooded meadows, coastal salt marshes, stubble fields, growing or unharvested crops and areas of waste root crop where geese glean grains and tubers, but they increasingly also exploit dry reseeded grasslands.

3 Survival and productivity

Greylag Geese pair in their first or second year and first breeding occurs from the age of three years (Cramp and Simmons 1977; Kampp and Preuss 2005). Studies of captive and collar-marked free-living birds suggest lifelong monogamy, as long as partners survive, with pairs remaining together throughout the calendar year (Nilsson and Persson 2001a). Without any distinction between naturalised and wild birds, egg-laying begins in February in France (Schricke 2018), late March to early April in Denmark (Kampp and Preuss 2005) and mid-April to early May in central Norway (Pistorius et al. 2006b). Females lay a single clutch of 4-7 (average 6) eggs (Cramp and Simmons 1977) annually, although destroyed clutches can be replaced (especially if lost early in the season). Scandinavian birds produce an average of 3.1 fledglings from a mean clutch size of 5.3 eggs per pair (Schricke 2018). Incubation lasts 27-28 days and goslings fly after 50 to 60 days (Cramp and Simmons 1977). The parents moult before goslings are capable of flight (non-breeders earlier), so the main flightless period is from late June to mid-July in Denmark, from late May to late June in western part of Germany and the Netherlands (Loonen et al. 1991), and until early August in Norway. Juveniles remain with their parents until the adults return to breeding sites in spring (Cramp and Simmons 1977; Ogilvie 1978; Rutschke 1987).

Long-term local productivity data is available since 1984/1985 from southern Sweden, where the breeding population was established in the late 1960s. These data show declines in productivity as the population continues to increase, suggesting density dependent effects on the production of young, primarily driven by reduced propensity rather than declines in clutch/brood sizes (Nilsson 2016). A similar trend has been observed in the breeding population in the Netherlands (B. Voslamber, unpubl.). Age-ratio data from the Netherlands suggest declining percentage of first-year birds in late summer over the years (Hornman et al. 2016), but there

is a large variation among regions with different stages of colonisation (saturated versus recently established populations).

In the Netherlands, data from van Turnhout et al. (2003) in Ooijpolder indicated a juvenile survival ranging from 0.87 to close to 1 in the course of the year (lowest in late summer, while in late autumn it is comparable to adult survival). However, adult survival (higher than 0.95) is relatively stable. A long-term population study in Denmark from 1954 to 1994 showed an increase in annual juvenile survival rate from *c.*0.50 to *c.*0.64, while adult survival slightly increased, with greater annual fluctuations (mean of 0.70 for females and 0.77 for males, Kampp and Preuss 2005). Juvenile survival rates in the southern Sweden and Norwegian populations since 1984/1985 have varied between 0.49 (and declining in Norway) and 0.60 (and increasing in Sweden). Declining and variable adult survival rates over the same period in the Norwegian population contrasted constant adult survival rates amongst the Swedish population (Pistorius et al. 2007). A significant inverse relationship was found between summer survival and breeding latitude in Norway, with northern birds having lower survival rates than those from southern areas (Pistorius et al. 2006a). Annual survival rate also varied between different parts of the winter quarters. During 1985/86 to 1991/92, adult survival rate of Swedish neck collared geese was higher among Dutch wintering birds (0.92 amongst adults, 0.85 for juveniles) than those wintering in Spain (0.81 and 0.71 respectively, Nilsson and Persson 1993, 1996; Nilsson et al. 1999), probably due to differences in hunting pressure. Likewise, in a mainly sedentary local population in the Netherlands survival was higher in years without shooting (0.90 and 0.87 for adults and juveniles, respectively) than in years with offtake (0.85 and 0.80, respectively, Baveco et al. 2013), suggesting a greater effect of hunting on juvenile survival. However, other factors such as predation pressure, food availability and shorter migration distance (and therefore an earlier return to breeding sites) may also contribute to differences in survival rate (Nilsson and Persson 1993; Pistorius et al. 2006a, 2007).

4 Population size and trends

The NW/SW European population increased from *c.* 30,000 individuals in the mid-1960s to 120,000-130,000 in the mid-1980s (annual growth of *c*. 13%) (Madsen 1987), the January count totals reaching *c.*700,000 in 2012 (Figure 4). However, January counts tend to underestimate the true size of the population, since not all sites (particularly agricultural fields hosting increasing geese number) can be counted annually. The sum of the breeding pairs[24] is 152,876-293,188 (1998-2012) based on national estimates submitted to the Article 12 reporting under the EU Birds Directive (EEA 2015), *i.e.* 588,573-1,128,774 post-breeding season individuals using a multiplier factor of 3.85 (Schekkerman 2012) to convert pairs into total individuals. Koffijberg (in litt., 2014), using a partly different dataset, has estimated 692,162-1,168,407 individuals. The average number of geese reported from the regularly counted sites of the International Waterbird Census (IWC) was 526,673 individuals in the period between 2008 and 2012. After accounting for missing counts, the average was estimated to be 897,898 individuals. These numbers are in line with the total national estimates of wintering birds that add up to 649,782-904,739 individuals in mid-January (European Topic Centre on Biological Diversity, in prep.). Based on this information and accounting for individuals outside of the counting areas, Wetlands International (2015) has estimated the population size at 900,000-1,200,000 individuals. This estimate is in line with the estimate of 960,000 individuals in 2014 by Nilsson (in prep), who extrapolated from 2005-2008 data of Ebbinge (2009) using the long-term population growth rate. However, the number of shot or otherwise taken geese per year suggests that even these estimates are likely to underestimate the real pre-harvest population size (see below).

Between 1980 and 2009, the annual growth rate was estimated at 8.5%, compared to 9.1% for 1995-2009 (Fox et al. 2010; Fox and Leafloor 2018). Wintering numbers have increased in all Range States, particularly in Germany, Denmark, Sweden, France and the Netherlands and to a lesser extent in Spain, where large inter-

[24] Based on the Article 12 reports (European Topic Centre on Biological Diversity Eionet 2014) (2008-2012) from Belgium, Denmark, Finland, France, Germany, the Netherlands, Spain and Sweden with estimates for Norway from the European Red List of Birds (BirdLife International, 2015). It should be noted that an unknown proportion of the Finnish population belongs to the CE population.

annual fluctuations in wintering numbers have been observed in recent years. In the early 1980s, Spain hosted 82% of the total wintering population (*c.*120,000), but the proportion of birds wintering there had fallen to no more than 20% by 2009 (out of 610,000) (Ramo et al. 2015) despite increases in the absolute numbers. This is largely due to the drought conditions experienced by Spanish wetlands and to the changing wintering strategies associated with climate change (Ramo et al. 2015). Some individuals have been observed migrating to Spain one year and staying in Northern Europe the next winter and vice versa (Boos 2016).

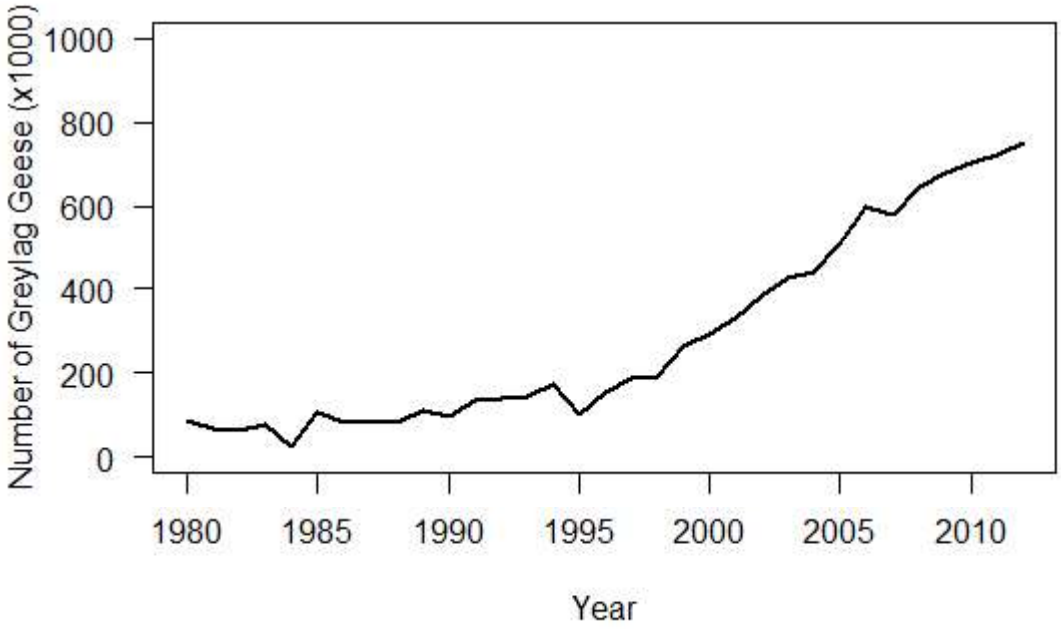


***Figure 4**. Estimated trend of the NW/SW European Greylag Goose population (mid-January counts), between 1980 and 2012.* Data represent national count totals not adjusted for missing counts for all range states in January, with the exception of Norway and Finland (Data source: Sweden: L. Nilsson; Denmark: Aarhus University; Germany: Dachverband Deutscher Avifaunisten; the Netherlands: K. Koffijberg/Sovon Vogelonderzoek Nederland; Belgium: Institute for Nature and Forest (Flanders); France: V. Schricke; Spain: A. Green and Ramo et al. 2015).

***Table 4**. Population size and trends of Greylag Geese. [1]A. Follestad; [2]L. Nilsson; [3]Tiainen et al. 2015; [4]Aarhus University; [5]Gedeon et al. 2014; [6]DDA, unpublished; [7]Breeding bird atlas from Sovon, the Netherlands; [8]Institute for Nature and Forest (Flanders); [9] LPO France/IWC; [10] A. Green/B. Molina*

Range State	Breeding numbers (individuals or 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
Norway[1]	20,000-25,500 pairs	Moderate	2016	Increase	Moderate	>100,000	Moderate	2016
Sweden[2]	41,000 pairs	Good	2008	Increase	Good	240,000	Good	2017
Finland[3]	5,600-9,000 individuals	Good	2015	Increase	Good	~2,200-3,600	Expert estimate based on partial regional data	2015
Denmark[4]	15,000-17,000 pairs	Good	2015	Increase	Good	170,000 (September)	Good	2004-2015
Germany[5,6]	26,000-37,000 pairs	Good	2005-2009	Increase	Good	80,000 (Dec./Jan.)	Good	2001-2005
The Netherlands[7]	67,000-111,000 pairs	Good	2013-2015	Increase	Good	520,000-580,000 (Nov./Dec.)	Good	2009/10-2013-2015
Belgium (Flanders)[8]	1,500 pairs	High	2002-2015	Stable	High	22,000	High	1991-2016
France[9]	176-221 pairs	Good	2012	Increase	Good	17,756	Good	2016
Spain[10]	minimum 25 pairs and a minimum population of 250 individuals	NA	2016	Stable	NA	86,825 (Andalucia and Castilla Leon)	NA	2017

Annex 2 Problem Analysis

1 Services and disservices

1.1 General overview

The analysis of services and disservices provided by Greylag Goose is primarily based on responses from Greylag Goose Range States to a questionnaire sent out by the EGMP Data Centre in March 2017, with additional information provided by specific countries and stakeholders. All Range States have replied to the questionnaire. However, it should be noted that the response from Spain is limited to the experiences from the Doñana wintering population. Furthermore, many of the general ecosystem services or disservices provided by geese have been summarised by Buij et al. (2017), with the specific influence accruing from Greylag 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.

Damage to agricultural crops caused by Greylag Geese has been reported by six of the nine Range States (Belgium, Denmark, Germany, Norway, Sweden, the Netherlands). Five of these (Denmark, Norway, Sweden, the Netherlands and Germany (Lower Saxony)) report an increasing trend in the extent of the damage, in the Netherlands also increasingly during the breeding season. Particularly cereals are subject to damage, for instance in Denmark (ripening cereal), Norway (spring cereal), Belgium (winter cereals) and in a large part of the distribution in Germany (winter cereal), whereas permanent grassland is the most affected crop in the Netherlands and Sweden, and vegetables in Finland. Less affected crops include grass seed, new-sown grassland and beet.

In five Range States (Belgium, Finland, Germany, the Netherlands, Sweden) subsidy schemes or compensation payments have been instigated to alleviate the conflict and/or compensate farmers for losses. In three of these (Belgium, the Netherlands and Sweden), the degree of agricultural damage caused by geese is systematically recorded. For example, in the Netherlands, assessors measure the length of the damaged (grazed) grass swards using a so-called “grass height meter” and compare these measurements with those taken at undamaged reference points, 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 of dry matter for the spring cut and 120 kilograms 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.

In Belgium, which supports *c.* 1% of the breeding and *c.* 3% of the wintering population, the total annual average level of compensation from 2009 to 2016 was 8,460 EUR (including damages for wintering cereals (19 cases), fertilized grassland (5 cases), permanent grassland (4 cases), grass seeds (4 cases) and beet crops (4 cases)) representing the average damage caused in all compensated cases where Greylag Geese were involved. In Sweden, which supports *c.* 20% of the breeding population and *c.* 32% of the winter population mainly during migration, the estimated costs covering damage (all crop types) was *c.* 65,000 EUR in 2009 in whole country. However, due to changes in policy, damage by Greylag Geese has generally not been subject

to compensation since 2010, hence the cost in 2015 had fallen to *c.* 9,300 EUR in Sweden. Indirect costs are reported in Lower Saxony in Germany, where EU agri-environment subsidy schemes are used in the main wintering areas to create undisturbed foraging areas for the geese. Approximately 24,000 ha of grasslands and tillage are managed under these schemes at a cost of *c.* 7.0 million EUR/year (for all geese species; however, costs for Greylag Geese only represent a small proportion). In the Netherlands, supporting far the largest national breeding population in the flyway and a high proportion of the non-breeding population at some stage, time series of compensation payments and wintering Greylag Geese numbers are available from 2006/07-2014/15. Preliminary analysis suggests a close correlation between goose abundance and compensation payments both in Sweden[25] and the Netherlands. During this period, the annual compensation paid for damage caused by Greylag Geese has increased from *c.* 2 million EUR to over 5 million EUR while goose numbers have increased from *c.* 180,000 to *c.* 330,000 in the latter (Pearson correlation, r=0.76, Figure 5). In the Netherlands, compensation paid for Greylag Goose both during winter and spring/summer in 2017 had increased to 9,4 million EUR (Annual report Dutch Fauna Fund). The data support the hypothesis that costs of managing the conflict with agriculture changes with abundance of Greylag Geese, even if economic compensation does not exactly reflect the goose damage, 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.

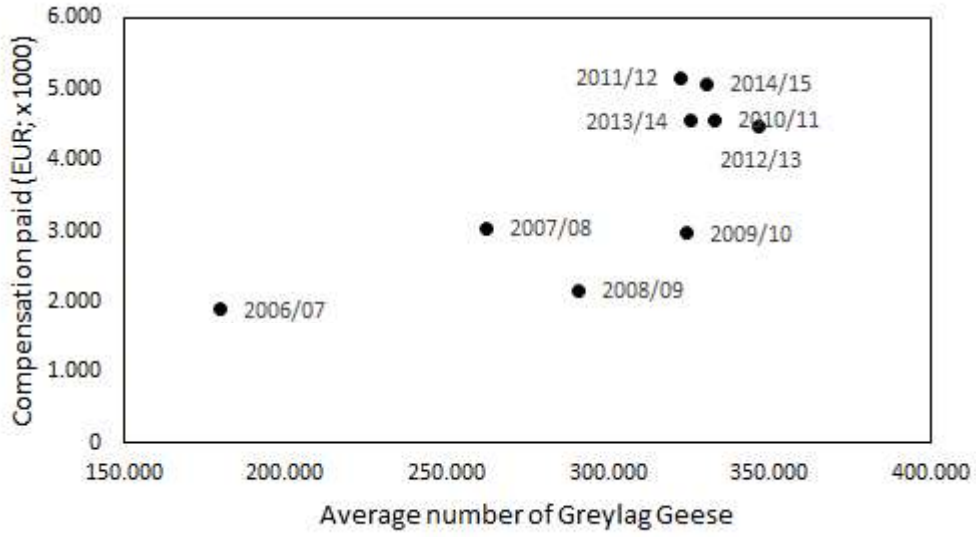


Figure 5. *Relationship between the estimated monthly average number of Greylag Geese from September to March and sum of compensation paid from September to March (Euro) in the Netherlands from 2006/07-2014/15.* Sources: Faunafund (level of damage) and Sovon Vogelonderzoek Nederland (goose data) (K. Koffijberg unpubl. data).

Other (but currently not costed) management actions used to alleviate the problem include local scaring, derogation shooting for crop protection, provision of alternative feeding areas and control of geese in summer (e.g. culling of adults and young, egg collection, egg oiling/pricking and shaking of eggs, Table 5).

Few countries have implemented national strategies for the management of the Greylag Goose. In Norway[26], there is a national goose management strategy in place and in Lower Saxony (Germany), a goose management strategy is planned to better reduce conflict through coordination and cooperation. Management strategies are developed and implemented at provincial level also in the Netherlands.

[25] Due to changes in policy, damage by Greylag Geese has generally not been subject to compensation since 2010 in Sweden.
[26] Direktoratet for naturforvaltning (1996) Handlingsplan for forvaltning av gjess. DN-rapport 1996-2.

Table 5. *Management actions taken to alleviate agricultural conflict caused by Greylag Geese.* None of the actions are used in Dõnana, Spain. *since 2010.**Egg oiling/picking/shaking/collection, culling of adults under derogation.

Management action	Finland	Norway	Sweden	Denmark	Germany	Belgium	Nether-lands
Local scaring	x	x	x	x	x	x	x
Economic compensation to affected farmers			x*			x	x
Subsidy schemes	EU agro-environment		National		EU agro-environment		Regional
Alternative goose foraging areas	x		x		x	x*	x
Hunting (Game species with an open hunting season)	x	x	x	x	x	x	
Derogation shooting	x	x	x	x	x	x	x
Local population control**		x	x		x	x	x

In general, local measures, such as scaring, provision of sacrificial crops, and regional actions, such as provision of go and no-go areas, financial payments, ultimately fail to resolve the conflict with agriculture and may encourage further population growth thereby worsening the problem (see Table 1 in Stroud et al. 2017). Clearly all management actions to reduce the economic effects of goose damage on agriculture are most effective when the interventions have a set of objectives and are coordinated to maximum effect (Williams et al. 2009; Bainbridge 2017, Stroud et al. 2017).

Air safety (bird strike)

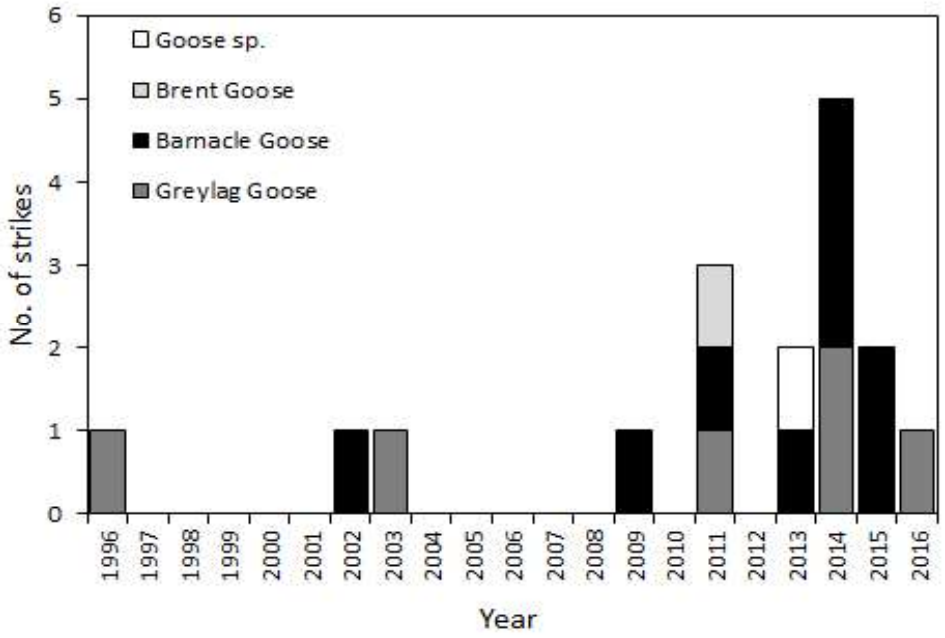
Four Range States (Belgium, Denmark, the Netherlands and Sweden) reported bird strikes with Greylag Geese as a management issue. In Denmark, at the Copenhagen Airport A/S (CPH), bird strikes with a Greylag Goose were recorded for the first time in 1996 and the frequency of bird strikes with geese in general has increased during the last 10 years (Figure 6a). This increase in frequency seems to be linked to an increase in numbers of geese migrating over the Copenhagen area between south Swedish staging areas and wintering sites (source: Eurostat Data; Bradbeer et al. 2017; Stroud et al. 2017). 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). Local breeding birds are already well managed.

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. Greylag Geese. Since the radar will not be used for sense-and-alert[27], a direct effect on bird strike numbers is not expected. However, it is expected that improved analysis of wildlife hazards and targeted management will lead to a reduction in the risk posed by them (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 6b), despite the fact that a comprehensive management scheme has been in place.

[27] 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.

a)



b)

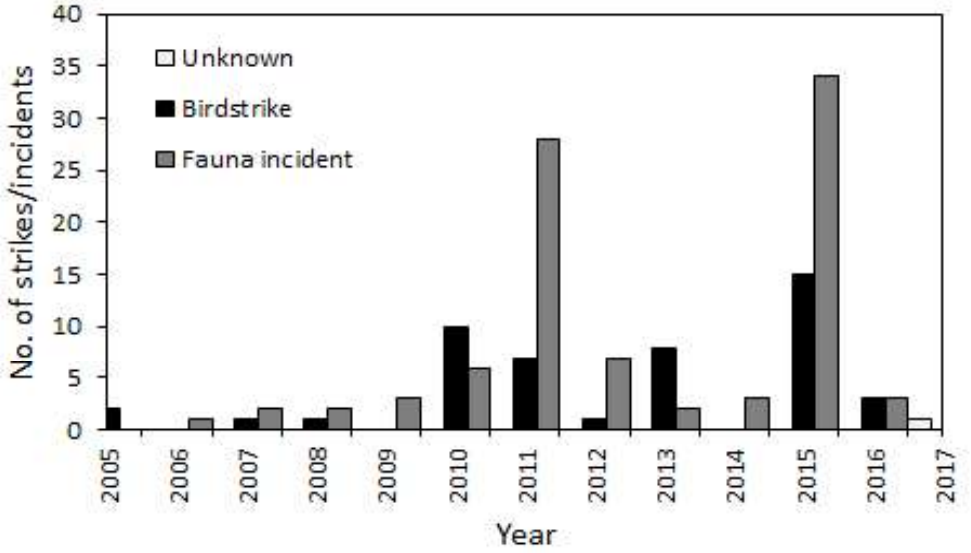


***Figure 6**. Annual number of bird strikes caused by geese in a) Copenhagen Airport 1996-2016 and b) Schiphol Airport 2005-2017 (sources: Copenhagen Airport & Bird Control Schiphol). At Schiphol Airport, bird strike is an actual collision of a goose with an airplane; fauna incident involves a found goose (often still intact) at the Schiphol site.*

Ecosystem impacts

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.

All Range States with the exception of France who did not report any ecosystem impacts, have reported some kind of ecosystem impacts caused by Greylag Geese; most of them at a few sites at a local level, but showing an increasing adverse effect (Table 6). In Finland the total breeding population is relatively small and dispersed along a long coast line, therefore the management concerns are relatively limited. There are local conflicts in Finland, associated with areas where Greylag Geese are present in greatest numbers. In general, however, the

situation is good and the abundance of geese and their effect can be seen by virtue of their grazing. Indeed, the effects are in most cases seen to be more positive as their grazing prevents the overgrowing of shore meadows and locally regulates overabundant reed.

Ecosystem impacts are summarized in Table 6.

***Table 6**. Summary of ecosystem impacts caused by Greylag Geese.* The summary is based on the questionnaire which was sent out to the Range States.

Management issues	Trend over last 10 years	Countries (effect at local (L) or regional (R) scale)	Remarks
Eutrophication of lakes (defaecation)	increasing	Denmark (L), Finland (L), Netherlands (L), Norway (L), Sweden (R)	negative but stable local effect in Norway (in Oslo and Jæren) and Finland
	no effect	Belgium, France, Germany, Spain (Doñana)	
	no information		
Grazing of lake vegetation (effects on reed vegetation)	increasing	Denmark (L), Germany (L, R), Belgium (L) Netherlands (R), Sweden (R), Spain (Doñana), Finland (L)	negative but stable local effect in Belgium; depending on federal state in Germany
	no effect	France	
	no information	Norway	
Grazing of lake vegetation (effects on breeding birds)	increasing	Sweden (R), Netherlands (L), Finland (L)	
	no effect	Belgium, France, Germany, Spain (Doñana)	
	no information	Denmark, Norway,	
Grazing of swards (effects on breeding meadow birds)	increasing	Netherlands (L), Sweden (R), Finland (L)	
	no effect	Belgium, France, Germany, Spain (Doñana)	
	no information	Denmark, Norway	
Grazing of swards (effects on terrestrial ecosystem)	increasing	Netherlands (R), Belgium (L), Finland (L)	negative but stable local effect in Belgium
	no effect	France, Germany, Spain (Doñana)	

Management issues	Trend over last 10 years	Countries (effect at local (L) or regional (R) scale)	Remarks
	no information	Denmark, Sweden, Norway	
Grazing of swards (effects on vegetation composition)	increasing	Netherlands (R), Belgium (L), Finland (L)	negative but stable local effect in Belgium
	no effect	France, Germany, Spain (Doñana)	
	no information	Denmark, Sweden, Norway	
Grazing of natural terrestrial habitats	increasing	Netherlands (L), Finland (L),	
	no effect	Belgium, Denmark, France, Germany	
	no information	Spain, Sweden, Norway	not studied in Spain, but geese share Doñana with a large number of livestock whose impact is of concern and likely to be much more important

Health/welfare issues

Only two of the Range States (Belgium and France; Germany only at a very local scale) have reported disease transmission as a management issue, whereas half of the countries have not provided any information. However, studies have shown that wild goose species may act as a reservoir for viral diseases that can impact birds (*e.g.* avian influenza, coronavirus) as well as carriers of pathogenic protozoans (*Toxoplasma gondii*) or Salmonella and *E. coli* and bacteria (*e.g. Camphylobacter*). These diseases have the potential to have effects on human health (Alexander 2000; Gorham and Lee 2016), although there is little evidence of transfer to livestock and humans (Elmberg et al. 2017). Furthermore, due to their migratory behaviour, geese can transport infectious diseases over long distances. Consequently, the risk is poorly understood, and formal risk assessment would be necessary to better evaluate the management implications.

Six out of nine Range States (Denmark, Germany, the Netherlands, Norway, Sweden and Finland) report fouling of amenity areas as a management issue. However, this represents a localised issue that can be dealt with locally.

A summary of environmental impacts is presented in Table 7.

***Table 7**. Summary of environmental impacts caused by Greylag Geese.* The summary is based on the questionnaire which was sent out to the Range States.

Management issues	Trend over last 10 years	Countries (effect at local (L), regional (R) or national (N) scale)	Remarks
Inside airport concerns	increasing	Denmark (L), Netherlands (L), Sweden (L)	
	no effect	France, Germany, Norway, Spain	In Norway (Trondheim airport), concerns about the risk of collisions between Greylag Geese and aircraft prevail
	no information		
Passing/migrating birds causing concern for air-safety	increasing	Belgium (L), Denmark (L), Norway (L), Sweden (L)	
	no effect	Germany, Netherlands, Finland (N), Spain	
	no information	France	
Fouling of amenity areas	increasing	Denmark (R), Germany (L), Netherlands (L), Norway (L), Sweden (N), Finland (L)	
	no effect	Belgium, Finland, France, Spain	
	no information		
Disease transmission	increasing	Belgium	Belgium: recorded possibility of transmission of *Chitryd fungus*, however the scale and trend is unknown
	no effect	Denmark, Finland, Germany, Netherlands, Spain	Germany: few documented cases of HPAI, but unclear, if the geese were victims or transmitters of the disease the Netherlands: but reports on negative effect by Highly Pathogenic Avian Influenza (HPAI) Denmark: but reports on negative effect by HPAI

Management issues	Trend over last 10 years	Countries (effect at local (L), regional (R) or national (N) scale)	Remarks
	no information	France, Norway, Sweden	France: negative local effect with 2 reported cases of death during the 2016-2017 epizootic episode Norway: evidence for corona-virus Sweden: but evidence for Chytridiomykosis problems for amphibians.

1.3 Literature review

Many of the general ecosystem services provided by geese have been summarized in a recent review (see Buij et al. 2017 for exhaustive list), but specific benefits and disservices accruing from Greylag Geese are briefly set out below. This description is however also applicable for other goose species than Greylag Goose.

Dispersal of plants and invertebrates

Plant propagule dispersal should be common in geese faeces from breeding to wintering areas, mainly grasses and *Cyperacean* species, suggesting geese could potentially assist selected species to extend their native range in response to climate change or habitat loss. In contrast, high goose densities resulting in intensive grazing has been shown to deplete seed stocks, influencing the long-term potential for vegetation recovery after a disturbance and therefore the long-term plant species diversity and dynamics (Kuijper et al. 2006) and potentially out compete other goose species where formerly allopatric species now overlap (Rozenfeld and Sheremetiev 2014). As well as plant propagules (Takacs et al. 2017), Greylag Geese are likely important dispersers of invertebrates (Buij et al. 2017) such as bryozoans (Figuerola et al. 2004).

Human value

The presence of large flocks of geese generates a range of benefits (economic and societal), both in terms of consumptive use by hunters (meat economic value or cultural experience), passive use (viewing by birdwatchers and outdoor enthusiasts) and non-use (by those that gain pleasure from simply knowing they exist, *e.g.* McMillan et al. 2004). The present extent of the Greylag Goose harvest in the Range States (see below) potentially represents a major source of game meat and a valued source of recreational sport shooting. Hunters, like other users of nature, often spend sizeable amounts of money participating in their activities, which can bring direct and indirect economic benefits to rural areas of Europe during the winter months (Kenward and Sharp 2008). Non-economic or societal values also embrace (*i*) geese as features of our "heritage" (equivalent to great works of art or architecture) and (*ii*) humans as environmental custodians who should avoid local and population extinctions of wild geese, not least because we cannot predict the consequences of their loss or their value as environmental change indicators (e.g. Williams 1991). While hunters most often financially contribute directly to landowners in order to have the opportunity to shoot geese, societal benefits (eco/hunting tourism at local scale) of passive and non-use are more difficult to quantify but these contributions should be estimable by counting visitors in nature reserves or geese hotspots and evaluating associated fees.

2 Threats to populations

2.1 General overview

This section is not intended as a full risk assessment but merely outlines the anticipated actual/potential risk.

Greylag Geese were once considered threatened by hunting throughout much of the range (Madge and Burn 1988) and were susceptible to lead poisoning from shot ingestion (Mateo et al. 1998; Mateo et al. 2007). However, creation of refuge areas (including Special Protection Areas under the EU Birds Directive), more hunting regulations (e.g. period shortening), decrease in the number of hunters (e.g. France) and population increases in many European countries may have currently greatly removed this threat. Furthermore, regulation of lead shot for hunting in wetlands and/or for the hunting of waterbirds in the 1990s and the beginning of the 2000s has reduced the risk of lead poisoning. Hence, as the NW/SW European population of Greylag Goose continues to increase in total and over all its Range States, thus the overall assessment is that the conservation status of this flyway population is secure (BirdLife International 2015).

One exception may be Spain, where large inter-annual fluctuations in wintering numbers have been observed in recent years in the south in Doñana, the main wintering grounds for Greylag Geese in Spain. The fluctuations seem to be related to changing climatic conditions (annually fluctuations and long-term climate change) and the highly variable level of flooding in the temporary marshes of Doñana (Rendón et al. 2008; Almaraz et al. 2012; Ramo et al. 2015; unpublished data from Equipo de Seguimiento de Procesos Naturales de la Estación de Doñana), combined with a growing demand for water extraction for agriculture, which may put the future of the Doñana marshes under threat, unless new climate change adaptation measures are taken (Green et al. 2017). There have been steady declines in wintering numbers also in the north of Spain during the last decade (Villafafila: from 24,600 wintering bird in 2004 to 6,800 in 2015; Zamora and Palencia, in Castilla-Leon: from 58,700 in 2004 to 13,100 in 2017; unpublished data from Junta de Andalucía). In addition, geese are not counted outside of wetlands in Spain, similar to many other countries in the flyway (B. Molina, National IWC coordinator in Spain, *pers. comm.*). However, recent data show an estimate of 73,367 wintering geese in Doñana (in 2017), suggesting an increase after a reduction observed between 2009 and 2012 on this site.

Besides regional threats in Spain, a number of other factors have the potential to become a threat to this flyway population, such as disturbance during the moulting period, where the geese are especially vulnerable (Kahlert 2006), outbreaks of avian influenza (Melville and Shortridge 2006) or botulism and predation pressure, which for some goose populations have had significant local effects (e.g. the effect of increasing white-tailed eagle populations). For now, however, the magnitude and reality of these threats at present and in the future remain speculative.

2.2 Hunting/Derogation shooting

The Greylag Goose is listed on Annex II/A of the EU Birds Directive, which means that Member States across the EU can allow its hunting. The species is protected in the Netherlands and Belgium (Walloon Region) and subject of temporary moratorium in inland areas in Finland and in northern Norway (eastern part of Finnmark) to avoid hunting pressure on other geese species (A. Follestad, *pers. comm.*). Elsewhere, the Greylag Goose is a legally huntable game species. The hunting periods vary between Range States and sometimes within the Range States, as is the case for Spain and Germany. In general, hunting is allowed from mid-August to the end of January (Table 8). Geese are hunted during the day, with preferences for sunrise and sunset. Night hunting is allowed in France in 27 departments at fixed sites.

Table 8. *Hunting status in Range States*

H: species is huntable with declared open season, P: protected species (not huntable).

**Hunting period according to national law, hunting season length varies widely between federal states. Maximal open season is reported (Nordrhein-Westfalen) ** Hunting periods may differ between regions and under specific restriction.*

Range states	Hunting status	Open season	Remarks
Belgium	H/P	15/08 – 30/09	H in Flanders; P in Walloon Region
Denmark	H	01/09 – 31/01	from 2018: start 01/08
Finland	H	20/08 – 31/12	a temporary moratorium is in place in inland areas in Finland
France	H	1st weekend of August (at sea) or 21st August (mainland)– 31/01	
Germany*	H	1/8 – 31/8 + 1/11 – 15/01	
The Netherlands	P		
Norway**	H	10/08 – 23/12	When a local management plan is available, the county governor can start the open season up to 15 days before the ordinary hunting start
Spain	H	31/10 – 31/01	
Sweden	H	11/08 – 31/12	

Derogations may be issued in accordance with country rules, for example in relation to problems associated with situations where agricultural damage and/or air safety are reported to meeting pre-agreed criteria. Such derogations have been issued from mid-April to mid-August in Norway, from early October to late December in Belgium (Flanders) and during the whole year in Sweden and in the Netherlands (since 2002/03). In Flanders (Belgium), in response to conflicts with nature conservation interests, destruction of eggs is permitted, as well as shooting. Also culling, during the moult period, from 1 June to 14 July, is allowed for the same reasons.

For all EU countries, numbers shot under derogation are reported to the European Commission each year. Hence, data on Greylag Geese actions undertaken under derogation are available through this process (Table 9). In Norway, derogation data are not directly gathered at the national level but collated at local/regional level. Currently there is no clear strategy for centrally aggregating these data. Destruction of a small number of eggs (less than 50 eggs per year) has also been allowed in several Norwegian regions between 2005 and 2012. Based on the most recent estimates, the number of Greylag Geese subject to derogation (capture and killing) reached a total of approximately 250,000 individuals and 100,000 eggs, in addition to the destruction of *c*. 16,000 nests (Table 9).

Reliable and long-term statistics on national hunting bag estimates are not available from all the Range States. However, from those where national estimates are available there is an increasing trend in the number of geese shot. For example, in Denmark, the Greylag Goose bags increased from 17,900 to more than 64,400 individuals

between 2007 and 2016, and in Sweden the hunting bags increased from 4,315 to 31,537 between 2000 and 2015. In the Netherlands, where derogation shooting is permitted, numbers of wintering birds taken increased from 7,049 in 2003/04 to 101,646 in 2015/16 (see Table 9 for details by Range States).

Despite the numbers harvested during the hunting season (*c.* 200,000) and by derogation (*c.* 250,000), totalling more than 450,000 geese, the overall population has continued to grow, at least up until 2012. However, the lack of up-to-date and reliable monitoring and harvest data combined with such a high level of harvest call for concerted and coordinated actions by the Range States based on solid monitoring data and dynamic regulation of harvest to ensure the long-term sustainability of the population. To assess the significance of changing climatic and wetland conditions and regulate hunting pressure according to the total harvesting rate on the entire flyway, monitoring of population size in Spain needs to be improved and hunting bag data must be collected frequently (preferable annually) throughout the population range, accurately and on a national scale.

Table 9. *Availability of bag statistics, derogation reports and recent bag sizes for the Greylag Goose.*

Range state	Annual statutory bag statistics	Annual hunting bag size (latest estimate)	Period	Annual derogation size (latest estimate)	Period
Finland	Yes	6,500	2015	67	2015
Belgium	Yes	2,183	2015	111	2016
Denmark	Yes	64,400	2016	2,046	2014
France	No	10,614	2014	0	-
Germany Lower Saxony	Yes	17,551	2015	0	-
Germany Mecklenburg Vorpommern	Yes	1,685	2015	0	-
Germany North-Rhine Westphalia	Yes	9,933	2015	25 individuals; ~ 1,000 eggs	2015
Germany Schleswig-Holstein	Yes	16,116	2015	7,429 eggs	2015
Germany Bavaria	Yes	7,750	2015	0	-
Germany Rhineland Palatinate	Yes	922	2015	0	-
Germany Brandenburg	Yes	~ 2,500	2015	0	-

Range state	Annual statutory bag statistics	Annual hunting bag size (latest estimate)	Period	Annual derogation size (latest estimate)	Period
The Netherlands	Yes	0	-	237,941 individuals; 106,422 eggs; 15,995 nests	2015/2016
Norway	Yes	19,020	2015	minimum 500	2016
Spain (Doñana)	No	7,529	2016	50	2013
Sweden	Yes	31,537	2015	3,435	2012
Overall		*~ 200,000*		251,604 individuals; 107,422 eggs; 15,995 nests	

Annex 3 Projection of Population Size and Harvest Rates needed to stabilise or reduce the Population

In this annex, we explore a) the level of harvest that is required to i) stabilize the population at its current level, and ii) reduce the population by 10% and 20%, respectively, as well as b) the potential growth of the NW/SW European population of Greylag Goose for the coming 25 years[28] under a scenario that no further management measures are taken to control the populations. The purpose of this annex is to inform the decision-makers what can be expected if no action is taken and the harvest rates would be required to achieve some possible management scenarios. However, these crude calculations are only presented to illustrate what can be expected under these various scenarios. Concrete decisions on target population size and required harvest are deferred to be determined in the AFMP based on more detailed analyses and to be agreed in the EGMP IWG.

Due to limited reliable data on total population size and demographic information, a linear regression model of the form *log Nt =a+b (t)* has been used as a basis to estimate overall population growth rate[29], harvest rate[30] as well as population projection. This linear regression model is based on only two parameters; population size *(N)* and time *(t)*, and assumes exponential growth in the overall flyway population. However, exponential growth, may not hold true, especially nationally, where a mixture of local density-dependent processes and colonization have been observed. Hence the estimated population growth rate, harvest rate and population projection are encompassed with major uncertainties due to lack of knowledge of the local density dependent processes.

Total population size estimate from January counts is available from 1992-2012 from Sweden, Denmark, Germany, the Netherlands, Belgium, France and Spain. Before this period, data are (except for a few years) available back until 1980 for the same Range States, with the exception of Belgium and Germany. After 2012, data are not all available for Spain and Germany, which in 2012 held a significant proportion of the population. For this reason, the analysis has been limited to the total population counts from 1980 to 2012.

1 Growth rate and harvest rate using population counts

When the above-mentioned population counts are used as input in a linear regression model, a growth rate of 9.7% is estimated. It follows that an increased harvest rate of 8.9 % to the hunting and derogation that already occurs will be necessary to stabilize the population, which is in addition to the hunting and derogation that already occur.

If the population is to be reduced by 10% or 20% in 5 years, an annual harvest rate increase of 11.2 or 13.8 percentage points respectively will be needed; again, in addition to the hunting and derogation that already occurs.

Currently limited data is available on the distribution of hunting in time and space, as well as how hunting and derogation killing has varied in time and space during 1980-2012. Hence, these limited data make an estimate of the total actual harvest needed and harvest quota per country to stabilize or reduce the population highly uncertain.

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

2 Predicted population trajectories for 25 years

Based on the log-linear regression model (data 1980 to 2012; mean growth rate of 8.9%), the NW/SW European Greylag Goose population is predicted to increase from c. 750,000 birds in 2012 to a population size in 2037 ranging from *c.* 5.1 million to 8.3 million birds (95% ci), and with a median of 6.5 million birds (Figure 7) under a scenario that no further management measures are taken to control the population.

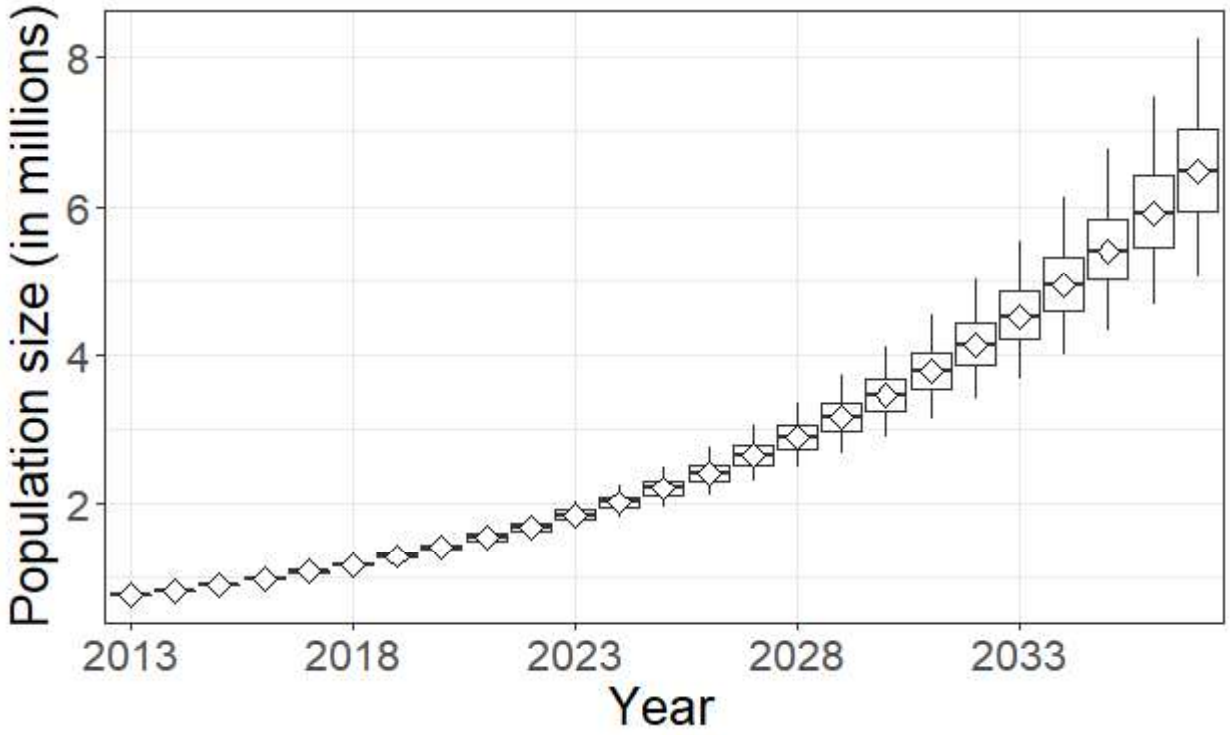


Figure 7. *Predicted population trajectories for 25 years (2013-2037) for the NW/SW European population of Greylag Goose starting from a population size of c. 750,00 birds and using a log-linear regression model based on population data from 1980 to 2012. Diamonds represent the median population size, boxes represent the interquartile range, and whiskers represent the 95% confidence interval (Data: See text for explanation).*

Annex 4 Legal Status of Greylag Goose and Implications for Population Management[31]

***Table 10**. Status of the NW Europe/SW European population of Greylag Goose on AEWA, the Bern Convention and the EU Birds Directive*

	AEWA		Bern Convention	EU Birds Directive
Greylag Goose *Anser anser*	NW Europe/SW Europe	Col. C	Ap. III	An. II (Part A)

1 AEWA

In principle, AEWA (AEWA 2018) allows the deliberate killing of birds belonging to the NW Europe/SW Europe population of Greylag Geese (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)). To this end, any use of the population must be based on an assessment of the best available knowledge of its ecology (Article III(2)(b)) and Parties to the Agreement "*shall cooperate to ensure that their hunting legislation implements the principle of sustainable use […], taking into account the full geographic range of [the population] and [its] life history characteristics*" (Action Plan, para. 4.1.1). This International Single Species Management Plan (ISSMP), and the Adaptive Flyway Management Programmes (AFMPs) developed thereunder, can assist Parties to comply with these legal obligations by ensuring that the cumulative impact of harvest is not detrimental to the population's conservation status.

Although AEWA affords Parties considerable flexibility in managing the NW/Europe/SW Europe population of Greylag Geese, caution must 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 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

The Greylag Goose is listed in Annex II of the Birds Directive 2009) and therefore may be hunted under national legislation in accordance with the provisions of Article 7 of the Directive. Hunting of Greylag Geese is therefore permissible, provided that this does not jeopardise conservation efforts in their distribution area. This may include population control measures where these are ecologically sound and are in proportion to the problem to be resolved and the species' conservation status.[32] It is especially important that populations are not reduced below the level required to satisfy Article 2 - i.e. "*a level which corresponds in particular to*

[31] 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 Greylag Goose (October 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. Although this version of the document does not include annexes with excerpts of each instrument's legal text, hyperlinks to these texts are provided for ease of reference.

[32] See European Commission (2008) at § 2.4.3.3.

ecological, scientific and cultural requirements, while taking account of economic and recreational requirements".[33] The processes provided for in this plan will assist Member States in complying with the requirements of Articles 7 and 2 of the Birds Directive by allowing the better coordination of hunting at flyway level. As discussed below, these processes will further facilitate compliance with Article 2 by facilitating better coordination of killing under derogation.

Article 7 of the Directive requires that Annex II species are not hunted during the period of reproduction or during the pre-nuptial return migration. Information on these sensitive periods is provided in the European Commission's *Key Concepts Document on Article 7 (4)* (European Commission 2014). In addition, birds belonging to these species may not be hunted using the non-selective and large-scale means prohibited by Article 8 of the Directive.

It is possible to derogate from the requirements of Articles 7 and 8 of the Directive if the conditions set out in Article 9 are satisfied (the most relevant grounds for derogation in the context of this ISSMP being those identified in Article 9 (1)(a)). In principle, it may therefore be permissible to apply justified control measures outside the normal hunting period or to introduce culling through means that are otherwise prohibited, as a damage prevention measure. However, all of the following conditions must be fulfilled:

(1) A precondition for the use of derogations is that the population concerned must be maintained at a satisfactory level. In particular, derogations must not result in populations being reduced below the level required by Article 2.

(2) One of the permissible grounds for derogation must be present and there must be a clear basis for concluding that the approach taken is appropriate for preventing the conflict for which the derogation is sought. Thus, where Article 9(1)(a) is relied upon to justify population regulation it must 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.[34] 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.[35] 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*".[36] As elaborated below, whether management measures are appropriate at the local or transboundary level will depend on the nature and scale of the conflict.

(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.[37] There are instances in which it is possible to fulfil this condition in relation to hunting (the use of which can, for example, be "*a legitimate means of safeguarding the interests mentioned in Article 9(1)(a)*" of the Directive[38]). However, it is clear from the existing case law and the guidance produced by the European Commission that if the hunting period under a derogation coincides with

[33] Notably, this formulation gives ecological requirements priority over economic and recreational requirements. Further, Article 2 does not constitute an independent derogation from the requirements of the Birds Directive (European Commission (2008) at § 1.4.1).

[34] European Commission (2008) at § 3.5.7.

[35] European Commission (2013) at p. 10.

[36] European Commission (2008) at § 3.5.7.

[37] European Commission (2008) at § 3.4.12. See also § 3.5.15 ("*there will be cases where hunting of birds to control damage is justified. In order to maximise damage prevention, control measures for a species that causes damage are most likely to be effective when the population is at its seasonal minimum and when there is the least availability of replacement birds – typically this is the breeding or pre-breeding period*").

[38] European Commission (2008) at § 3.4.19.

the periods in which the Directive aims to provide particular protection, there must be compelling reasons to justify this, and that such a derogation is not permissible "*where the sole purpose is to extend a hunting season for wild birds that are available to be hunted during a normal open season*".[39]

(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.[40] Where derogations are relied upon to achieve population reduction, such reduction must therefore be proportionate to the damage prevention needed.[41]

Since different problems have different spatial dimensions, the appropriate scale of management measures may differ from one case to the next. What is important is that the scale of derogations is justified by the nature and scale of the problems that they aim to address. Thus far, Article 9 derogations have not been relied upon to address conflicts occurring in a Member State other than the one granting the derogation. The definitive interpretation of the Birds Directive is the sole prerogative of the Court of Justice of the European Union, which has yet to consider whether such an approach is legally permissible. The text of Article 9 does not explicitly exclude such an approach and is arguably sufficiently flexible to accommodate it. However, it is clear from condition (2) above that such responses could only be permitted if they would demonstrably address the conflict in question; and satisfying condition (3) would require a robust justification of the need for applying control measures in areas other than those where the conflict occurs. As regards the latter, the European Commission's guidance on hunting under the Birds Directive advises that "*the first approach should be to make the control local in time and place to where the damage is occurring*", but recognizes that broader approaches may be justified in some instances.[42] During the management planning process, the Commission further indicated that it only envisages this approach as being acceptable if:

(1) the link between the serious damage/risk and the birds subject to the derogation is demonstrated;

(2) all other applicable conditions under Article 9 are fulfilled;

(3) it is demonstrated that a derogation in the Member State where the serious damage/risk takes place is not sufficient to prevent that serious damage/risk; and

(4) derogations are only granted at the request of and in consultation with the Member State where the serious damage/risk takes place.

The processes envisaged by this International Single Species Management Plan – in particular, the development of AFMPs and the adaption of these on the basis of information collected and assessed annually – will assist Member States to ensure that the cumulative impact of national derogation schemes is not detrimental to populations' conservation status. The information compiled in AFMPs (see Box 1) may further assist Member States in assessing the need for derogations. However, Member States will remain individually responsible for ensuring that they meet the requirements of Article 9 of the Directive – including their responsibilities to comply with the technical requirements prescribed by Article 9(2) and the annual reporting requirements on the application of derogations prescribed by Article 9(3).

Regardless of whether management measures occur in the context of Article 7 or Article 9, such measures must not result in the deterioration of Special Protection Areas or the disturbance of species for which these have been designated in so far as this would be significant having regard to the objectives of the Directive (Article 4[43]). Hunting activities within SPAs do not necessarily contravene this provision but must be

[39] European Commission (2008) at § 3.4.13-3.4.16.
[40] European Commission (2008) at § 3.4.12.
[41] European Commission (2013) at p. 15.
[42] European Commission (2008) at § 3.4.15 (referring specifically to justifying derogations that are more generalised in their territorial scope in instances where species are widespread and cause damage over large areas).
[43] As amended by Article 7 of the Habitats Directive (Habitats Directive 1992).

compatible with a site's conservation objectives and be managed and monitored in a manner that avoids significant disturbance.[44]

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

The exploitation of Greylag Geese is permissible under the Bern Convention (Bern Convention1979), provided that this is regulated in a manner that ensures that populations are not reduced below the level required by Article 2 of the Convention.[45]

Birds belonging to this species may not be killed through the means prohibited by Article 8 of the Convention unless the conditions for exception set out in Article 9 are satisfied.[46] Managing conflict by culling through means that are otherwise prohibited will therefore only be permissible if it is demonstrated that the birds being targeted present a threat to public health and safety, air safety or other overriding public interests, or the protection of flora and fauna, or a risk of serious damage to crops or other property, and that this threat/risk can be addressed by granting the exception; there are objective and verifiable grounds for concluding that there is no other satisfactory alternative; and the exception is not detrimental to the population's survival.

Parties will remain individually responsible for satisfying their commitments under the Convention, regardless of whether an international species management plan is in place. This includes 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) (Bern Convention 2011) of the Bern Convention's Standing Committee 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 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*".
- 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

[44] European Commission (2008) at §1.5.

[45] I.e. "*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 formulation gives ecological requirements priority over economic and recreational requirements.

[46] 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, although the Convention offers greater flexibility in several of its grounds for exception.

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 Delineation of preliminary Greylag Goose Management Units (NW/SW European Flyway)

In case of the NW/SW European population of the Greylag Goose, definition of MUs based on movement characteristics was suggested by the participants of the Species Management Planning Workshop in Paris (October 2017), because it was realised that treating them as one MU could lead to unwanted consequences and would make it more difficult to find management solutions that would satisfy the complex and interconnected interests of Range States.

As a first step, it was decided to approach MU delineation based on data from neckbanding programs, gathered at www.geese.org. In total, over 12,000 geese were captured and banded within five countries. Three major neckbanding programs were conducted in Sweden (3,526 individuals captured from 1984 to 2017), Norway (4,122 individuals captured from 1986 to 2017) and the Netherlands (4,234 individuals captured from 1997 to 2017)[47]. To a lower extent Greylag Geese were also captured in Germany (276 individuals from 2008 to 2018) and Denmark (115 individuals from 1986 to 1994). Capturing of birds was conducted primarily (98%) during the breeding season (May/June/July), and focused on adult breeders (48%), their goslings (48%) and occasionally on moulters with unknown breeding status (4%).

After the meeting of the EGMP International Modelling Consortium in Kalø, Denmark in January 2018, it was decided that a first approach to the analysis of the neckband data would be to conduct cluster analyses. Because of the broad scale of the study area and the migratory dynamics within the flyway, the spatio-temporal kernel approach (Calenge et al. 2010) was evaluated as the most appropriate way to assess MUs. A detailed description of the method is available in Calenge et al. (2010) and current results will be published in the form of a scientific article.

At first, a spatiotemporal kernel analysis was conducted on the overall dataset. Sightings of individuals during the very year of trapping were discarded to lessen potential bias from multiple local sightings at the trapping site. The results presented a clear NW/SW temporal dynamic of the sightings, with the core area used by the neckbanded birds gradually concentrating towards the Netherlands in the middle of winter, although with non-null sighting probabilities lasting all year round in southern Sweden, the Netherlands and the edges of this later country (Figure 8).

[47] It has to be noticed that, according to Voslamber et al. 2010, areas where geese have been most likely to migrate outside the Netherlands, were not used as ringing areas anymore since 1998 and 2005. This might lead to a bias/underestimation of the proportion of migrating. In addition, sighting effort is higher in the Netherlands than in other Range States, which causes additional bias.

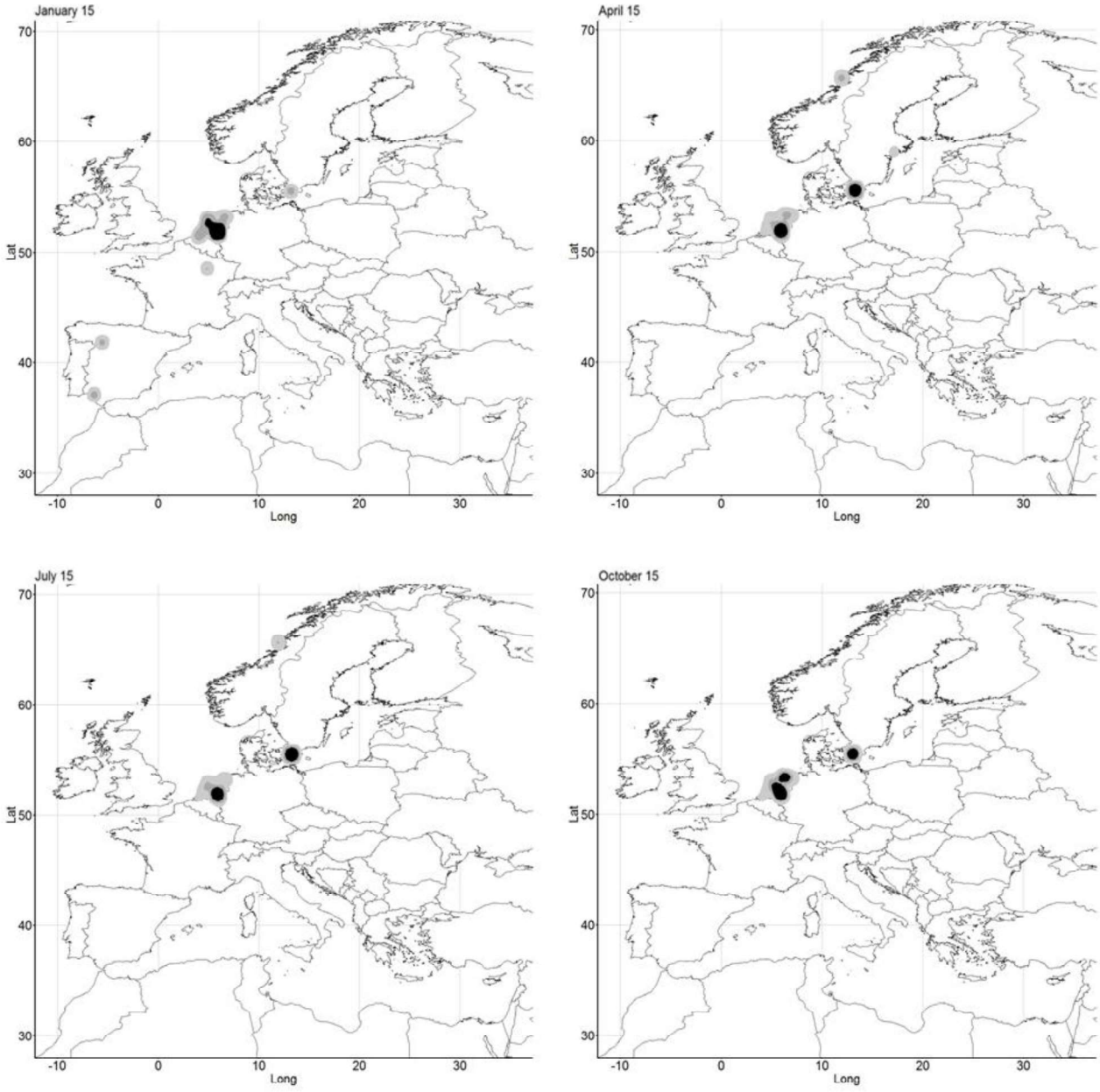


Figure 8. *Spatio-temporal kernel picture on 15 January, April, July and October for all Greylag Goose neckband sightings consecutive to the year of trapping.* The black areas correspond to the smallest area, where the probability of sighting a neckband, given that it is sighted at this date, is equal to 0.5. The dark grey areas correspond to the smallest area, where this probability is equal to 0.7. The light grey areas correspond to the smallest area, where this probability is equal to 0.9.

Previous studies have highlighted differences in wintering and migratory strategies for birds breeding in Norway, Sweden and the Netherlands (Andersson et al. 2001, Pistorius et al. 2006a, Voslamber et al. 2010). Based on this empirical knowledge, it was decided to split the spatio-temporal kernels based on the country of capture. Additionally, knowing that breeding individuals show a strong philopatry to the breeding sites (Nilsson & Persson 2001b), only sightings from individuals captured as adult breeders were selected (which ensured that the country of capture was the actual country of breeding). Therefore, the produced kernels would represent the spatio-temporal dynamic of the breeding population from each country where trapping occurred.

In short, at the national scale, sighting densities from birds breeding in the Netherlands did not vary in space and time, supporting the idea of a high proportion of sedentary individuals (Voslamber et al. 2010).

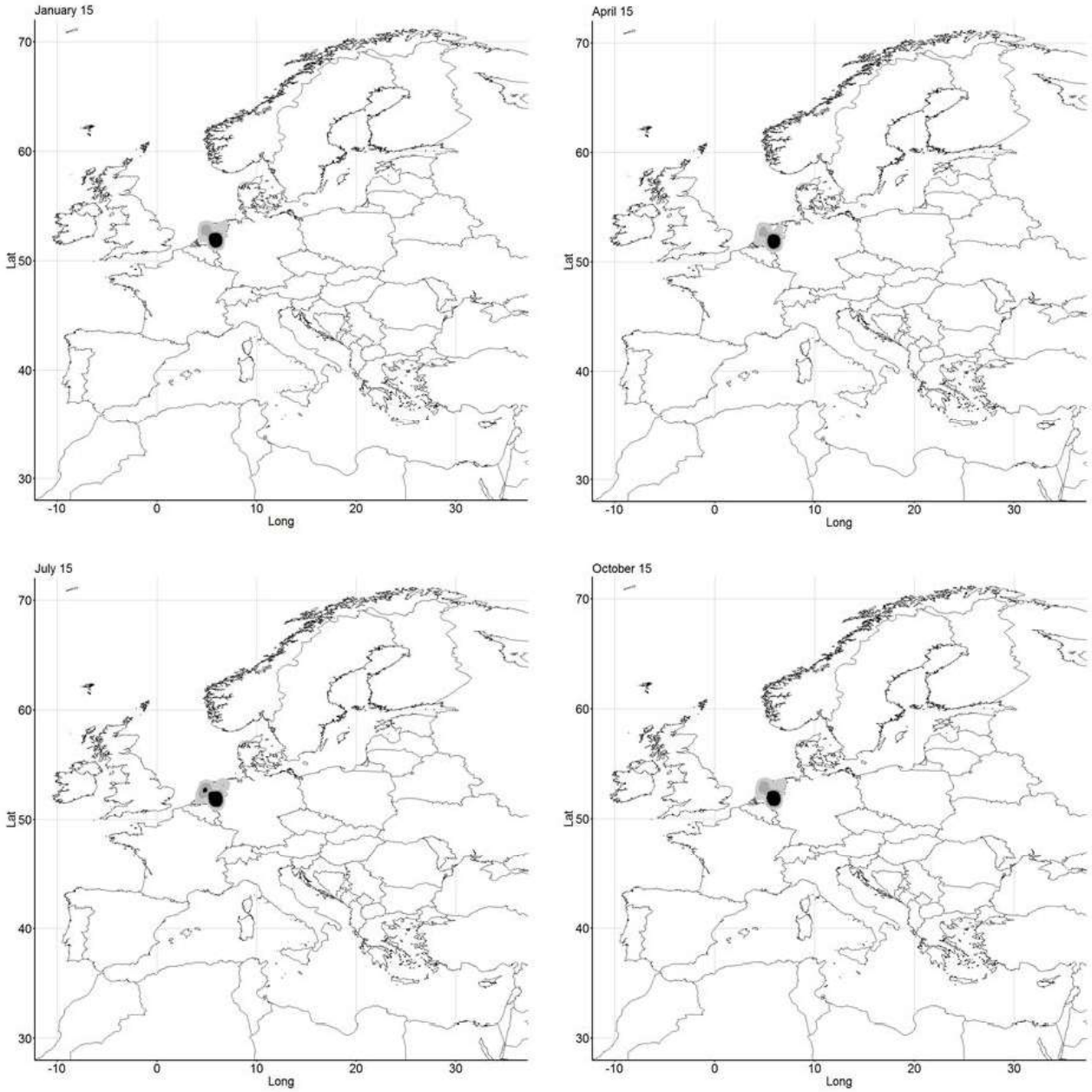


Figure 9. *Spatio-temporal kernel picture on 15 January, April, July and October for Greylag Goose neckband sightings consecutive to the year of trapping and captured as adult breeders in the Netherlands.* The black areas correspond to the smallest area, where the probability of sighting a neckband, given that it is sighted at this date, is equal to 0.5. The dark grey areas correspond to the smallest area, where this probability is equal to 0.7. The light grey areas correspond to the smallest area, where this probability is equal to 0.9.

Sightings from birds breeding in Norway presented a clear dichotomy between winter and summer sightings, with high sightings densities in Spain and the Netherlands during winter, and no dense patches in Norway, while high sighting densities were observed in Norway during summer.

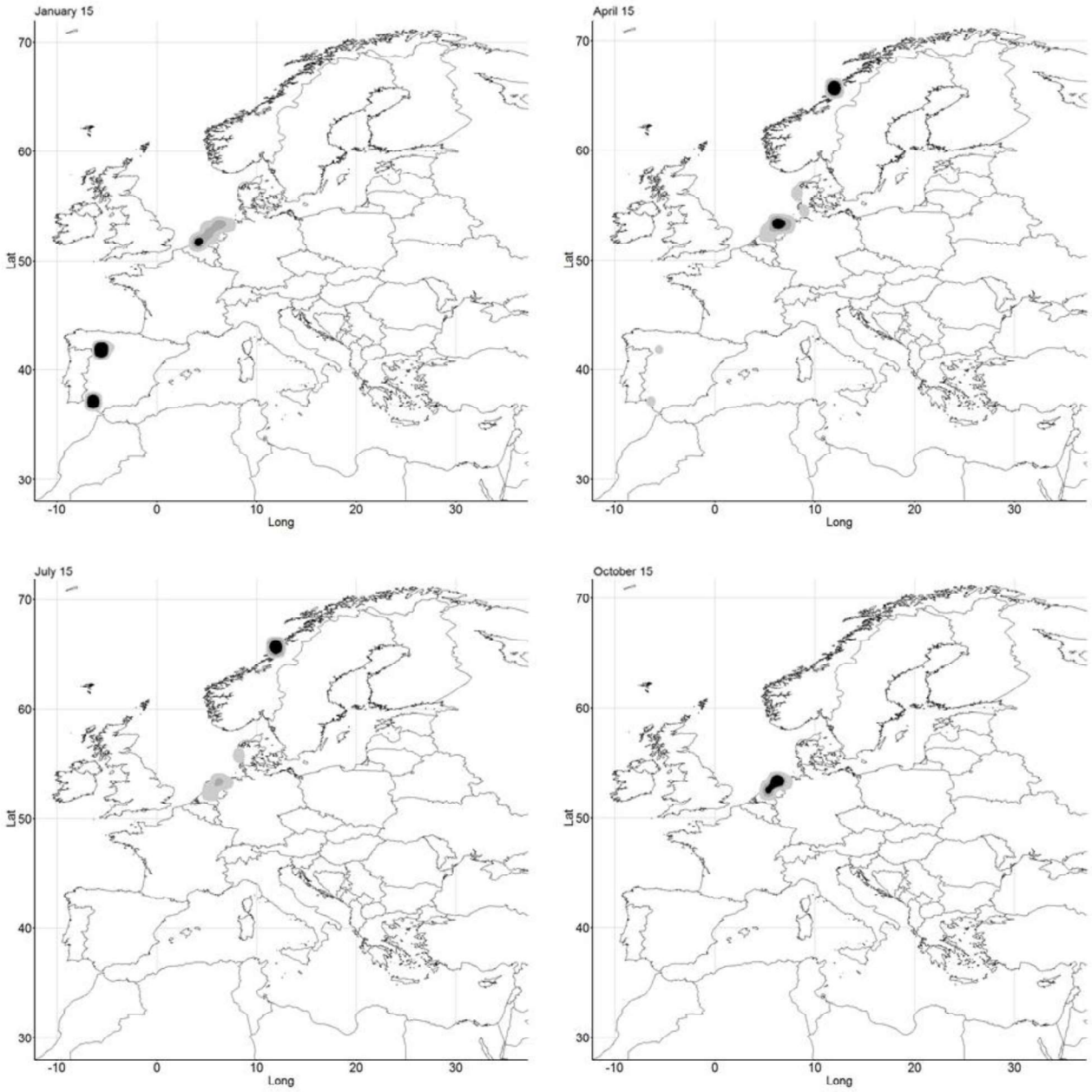


Figure 10. *Spatio-temporal kernel picture on 15 January, April, July and October for Greylag Goose neckband sightings consecutive to the year of trapping and captured as adult breeders in Norway.* The black areas correspond to the smallest area, where the probability of sighting a neckband, given that it is sighted at this date, is equal to 0.5. The dark grey areas correspond to the smallest area, where this probability is equal to 0.7. The light grey areas correspond to the smallest area, where this probability is equal to 0.9.

Birds from Sweden presented an intermediate state, with sightings in southern Sweden throughout the year, supporting the idea of sedentary individuals in the breeding area, as well as a spatio-temporal dynamic of the sightings with winter sighting densities observed in the Netherlands, France and Spain.

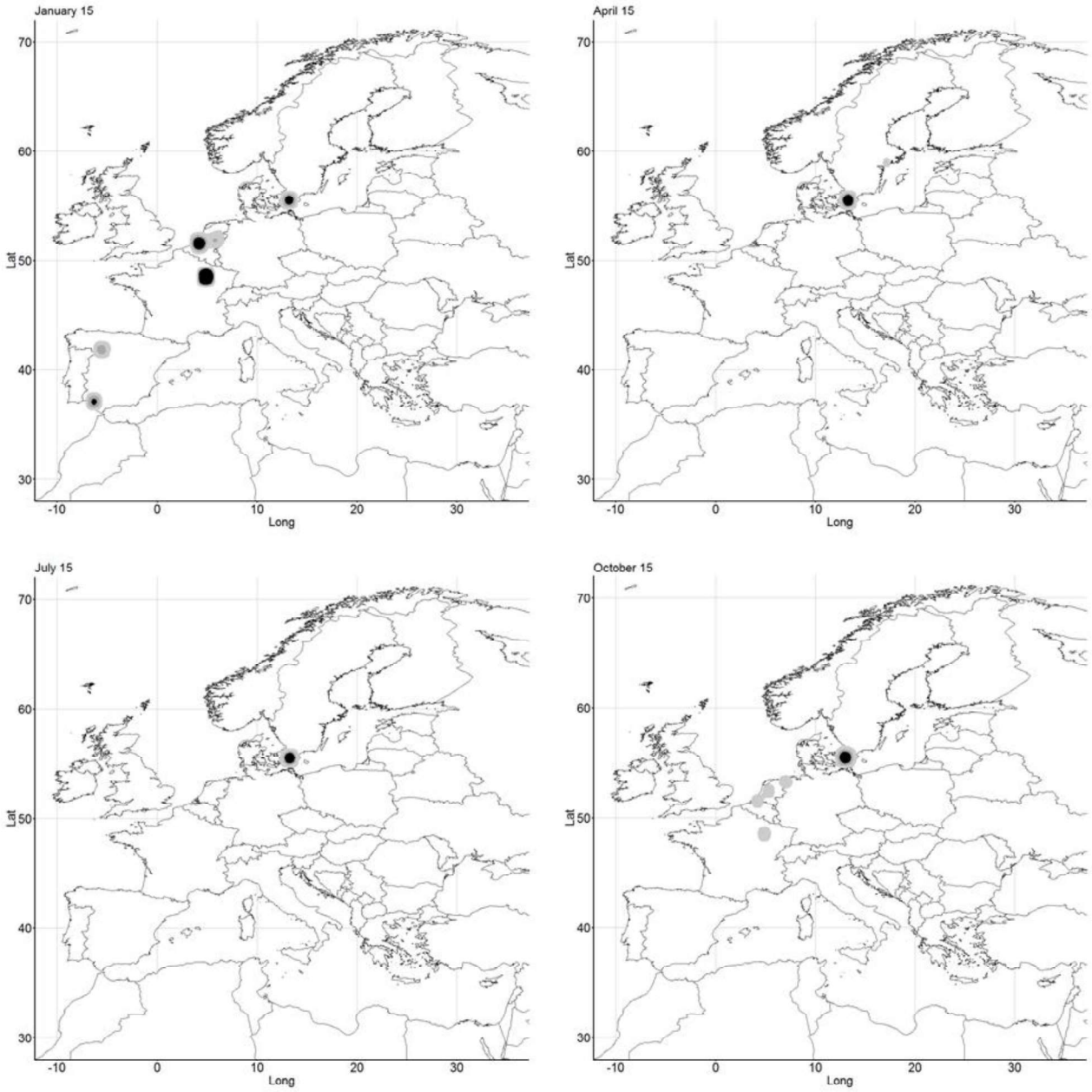


Figure 11. *Spatio-temporal kernel picture on 15 January, April, July and October for Greylag Goose neckband sightings consecutive to the year of trapping and captured as adult breeders in Sweden.* The black areas correspond to the smallest area, where the probability of sighting a neckband, given that it is sighted at this date, is equal to 0.5. The dark grey areas correspond to the smallest area, where this probability is equal to 0.7. The light grey areas correspond to the smallest area, where this probability is equal to 0.9.

Interestingly, birds ringed in Norway were not sighted in Sweden during the following years, and vice-versa (Figure 12), supporting the idea of a philopatric behaviour of adults to their breeding site. Additionally, Netherlands, Germany and Belgium presented high proportions of sightings from bird captured in Sweden, Norway and Netherlands, while France and Spain presented high proportions of sightings of birds from Norway and Sweden. Data exploration also supported previous results that highlighted different patterns of migration phenology at the flyway scale for birds breeding in Norway and Sweden (Andersson et al. 2001).

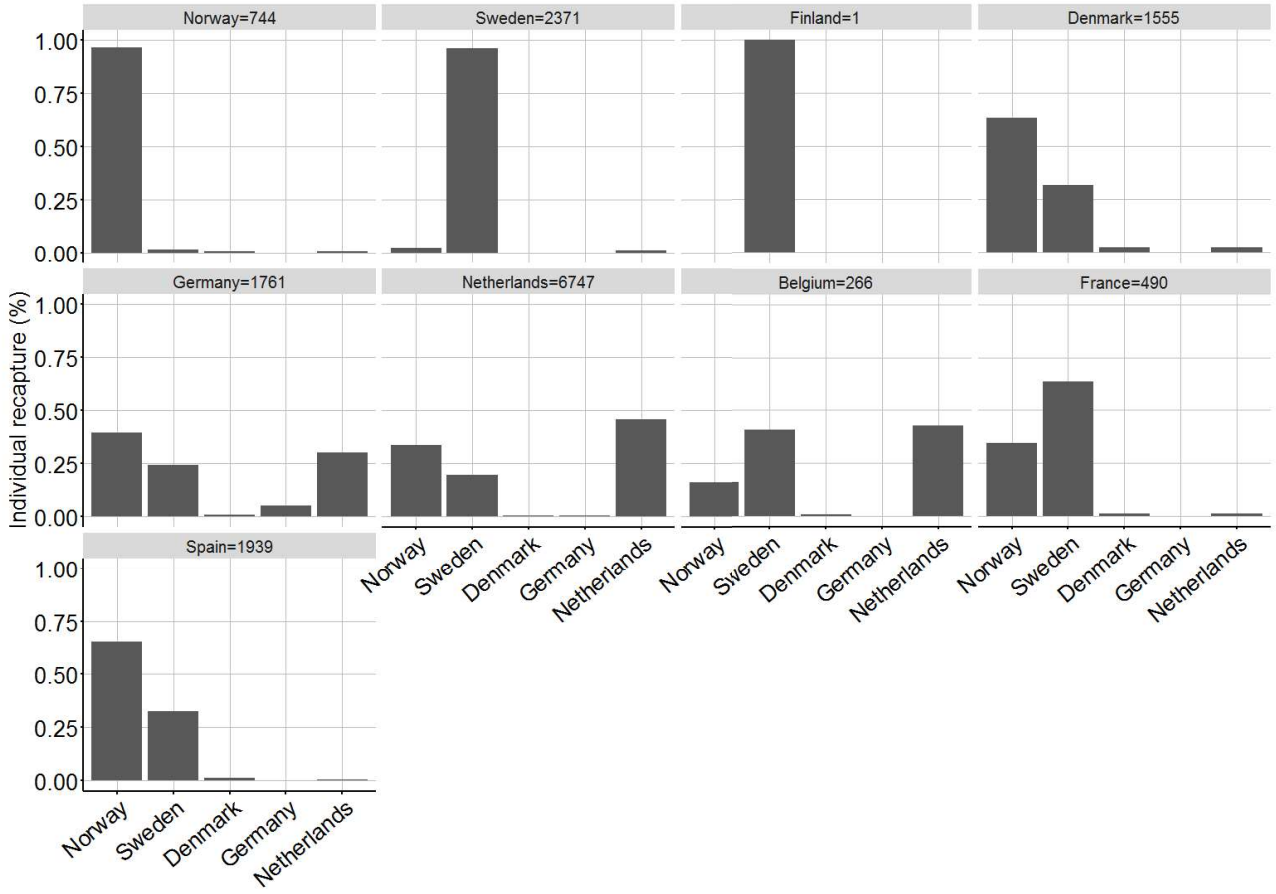


Figure 12. *Sightings probabilities, consecutive to the year of trapping for individuals captured as adult breeders, in each country of the flyway in function of the country of trapping.*

Based on those results and previous knowledge, a preliminary management unit scheme was presented at the *2nd AEWA International Species Management Planning Workshop for the Barnacle Goose and Greylag Goose in June 2018, in Leeuwarden, the Netherlands* (Figure 13). Because of the low connectivity between Norway and Sweden, and the differences in migratory phenology, breeding populations from Norway and Sweden could be delineated as two distinct MUs (MU1 and MU2). Individuals from these two MUs can be subsequently observed in the Netherlands and neighbouring countries, being used as wintering areas and staging areas during pre/post-nuptial migration from/to more southern wintering sites (France/Spain, Andersson et al. 2001). Because of the lack of data on Greylag Goose in Finland, we could not delineate a specific MU for Finnish birds, but it was decided as a first step to integrate these into the Swedish MU. A third Management Unit (MU3) would then encompass the Netherlands, Belgium and Germany as birds breeding in the Netherlands are generally observed in those countries only, and because sighting densities of birds breeding in the Netherlands and Germany (not shown) appear to be static in space and time (sedentary individuals). Within the flyway, Denmark is positioned as a staging and moulting area for birds from Norway and Sweden (Andersson et al. 2001, Nilsson et al. 2001). Because of its positioning at the crossroad of MU1 and MU2 and of the low sighting proportion from individuals breeding in the Netherlands (Figure 12), no settlement within the scheme was currently decided for Denmark.

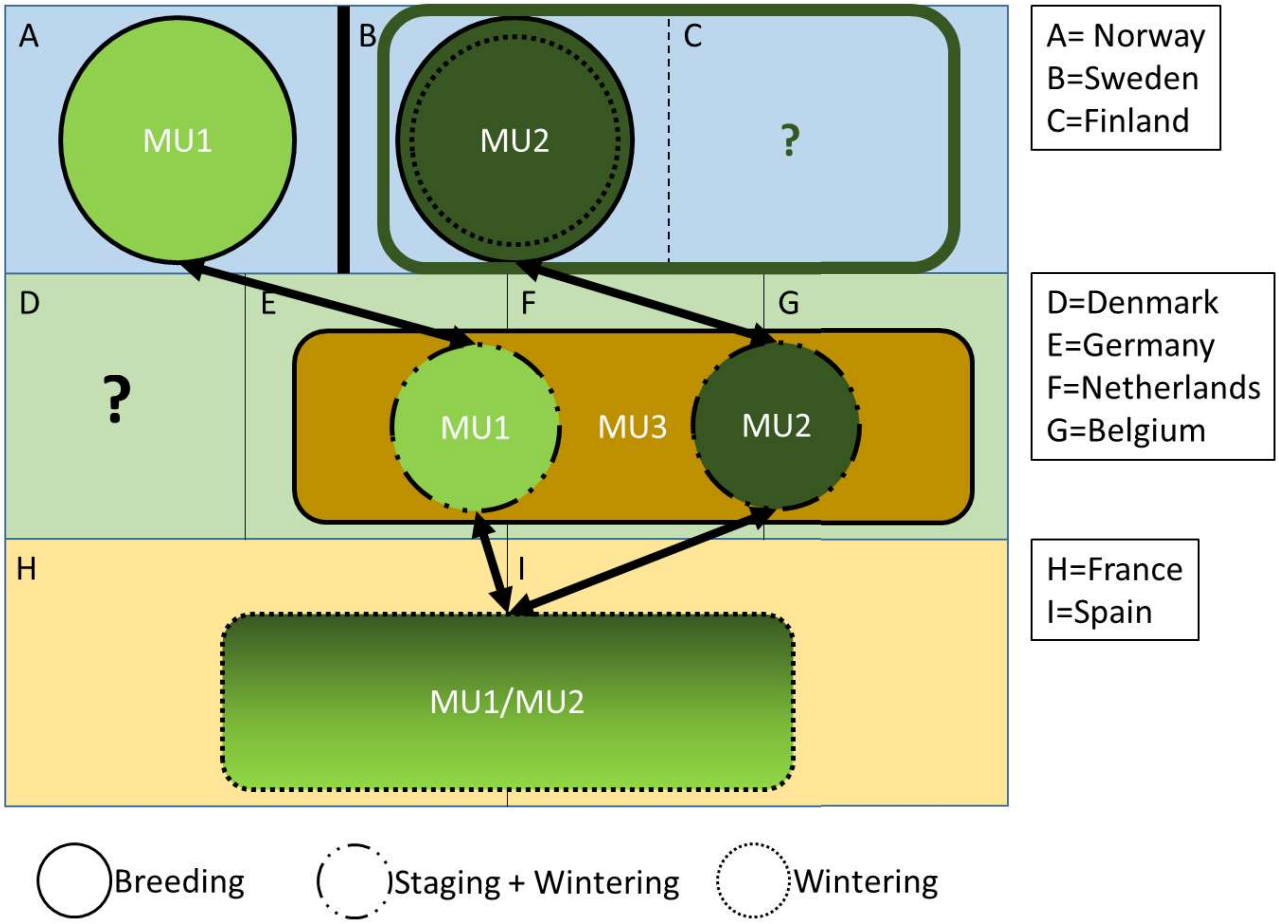


Figure 13. *MUs scheme for the NW/SW European Greylag Goose population. Arrows present migratory transition of individuals from the different management units.* Circles represent characteristic of individuals from MUs in each country.

We highlight the fact that the present MU delineations are not set in stone. They have to be considered in an adaptive process that will be improved/refined with time and learning. The use of cluster analysis to present flyway dynamics at a broad scale has its limits. (1) It does not consider the heterogeneity in sighting probabilities over time and space, nor the temporal trends of demographic parameters and migratory behaviour (Fouquet et al. 2009, Pistorius et al. 2006b, Ramo et al. 2015). (2) As it is conducted at the continental scale, it may be arduous to take into account local specificities of migratory behaviour (Voslamber et al. 2010). As the ambition was to delineate MUs at a transboundary scale, local specificities may not be of prime priority. However, effective management policies for the flyway will require the combination of local and broad scale interventions (Boyd et al. 2008). To cover these points, further analyses at the individual level are currently conducted (Multi-state models with addition of ring recovery data, Lebreton & Pradel 2002, Gauthier & Lebreton 2008). They will give us the opportunity to quantify the transition probabilities between breeding sites and wintering sites for every MUs, as well as to assess potential temporal trends in survival and wintering strategies.

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