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GREYLAG GOOSE NORTHWEST/SOUTHWEST EUROPEAN POPULATION STATUS REPORT 2016-2019

Report prepared by the AEWA European Goose Management Platform (EGMP) Data Centre

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The 5th Meeting of the AEWA European Goose Management International Working Group is taking place remotely in an online conference mode.

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Data Contribution

Midwinter counts

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Common Bird Monitoring

Norway: John Atle Kålås, Norwegian Institute for Nature Research (NINA) and Ingar Jostein Øien, BirdLife Norway, Sweden: Åke Lindström, Lund University, Finland: Aleksi Lehikoinen, The Helsinki Lab of Ornithology, Denmark: Thomas Vikstrøm, DOF-Birdlife Denmark, The Netherlands: Chris van Turnhout, SOVON and Wallonia, Belgium: Antoine Derouaux, Natagora.

Hunting Bag and Derogation Killing

Norway: Ingunn Tombre, Norwegian Institute for Nature Research (NINA), Sweden: Per Risberg, Swedish Environmental Protection Agency, Finland: Janne Pitkänen, Ministry of Agriculture and Forestry, Denmark: Thomas Kjær Christensen, Aarhus University and Anders Jensen, Environmental Protection Agency. Belgium: Floris Verhaeghe, Agency of Nature and Forest, Spain: Guillermo Ceballos, Instituto Andaluz de Caza y Pesca continental.

Notice that there is a large number of people involved in the data contribution in each country and the above-mentioned people may be the ones who have delivered the data to the EGMP but not being the ones responsible for the actual data collation in the range states.

Summary

The NW/SW European population of Greylag Goose became part of the European Goose Management Platform in 2018 and is now managed under the AEWA International Single Species Management Plan for this population. This is the first status report to compile annual monitoring data from the range states; which consist of midwinter counts in January (EGMP national totals and IWC imputed values), the Common Bird Monitoring Breeding Bird Index, and national reporting of hunting bag statistics and derogation killing. The data is used to assess the population development and provide input for a decision model (info-gap analysis).

From the latest midwinter count in January 2019, EGMP national totals are only available from Sweden, Denmark and Donana (Andalusia, Spain), and is lacking from the most important range states - Germany and The Netherlands. It is therefore not yet possible to give an up to date estimate of the total size of the NW/SW European population of Greylag Goose.

IWC count totals, used to calculate IWC imputed estimates, are not available for 2019 for most range states, and for the period 2016-2018 counts are missing from Germany and Spain. With these limitations, however, a total population size has been estimated for the Greylag Goose during the period 2016-2018. Based on the IWC imputed estimates, the total population size was estimated at 709,000 in 2016, 775,000 in 2017 and 751,000 in 2018. These data provide the best available knowledge at the moment, but also likely underestimate the total flyway population size.

Growth rate estimates for the Greylag Goose have historically shown a strong increase, but has in recent years stabilised. Hence, extrapolating data in this recent period comes with high uncertainty.

Recent offtake data is lacking from some of the most important countries (Germany and The Netherlands). Latest hunting bag estimate from Germany is from 2015, and derogation data from both countries are either

lacking or too uncertain to be used. Furthermore, hunting bag statistics are only collected every c. 12 year in France, with the latest estimates from 2013. For countries for which hunting bags are reported, harvest increased during the last decades but seem to have stabilised in recent years.

Due to these data deficiencies, it is currently not possible to model an optimal harvest strategy for the NW/SW European population of Greylag Goose, which will require reliable harvest and population counts reported annually, and with less delays.

1. Aim

The AEWA European Goose Management International Working Group (EGM IWG) has agreed to continue the process of implementing the Greylag Goose International Single Species Management Plan (ISSMP) (AEWA EGMP, 2019b). The ISSMP provides a mandate for developing a population-specific Adaptive Flyway Management Programme (AFMP), which among other addresses the establishment of an internationally coordinated population management programme encompassing monitoring, assessment and decision-making protocols (AEWA EGMP, 2019a).

The aim of this report is to compile monitoring data on the SW/NW European population of Greylag Goose. This data will be used to assess the population development and provide input for a decision model (info-gap analysis) that will allow decision makers to make more informed decisions about the magnitude of offtake (Johnson, 2020). A second aim is to highlight the main limitations in the data, which currently prevents the development of an optimal harvest strategy.

2. Population Monitoring

The range states for the NW/SW European population of Greylag Goose include Norway (NO), Sweden (SE), Finland (FI), Denmark (DK), Germany (DE), Netherlands (NL), Belgium (BE), France (FR), and Spain (ES) (Figure 1). Geese from this population also occur regularly in Poland (PL), Czech Republic (CZ) and Portugal (PT), but as the numbers are below 1% of the population, they are not included as principal range states (Powolny et al., 2018). While all the birds in PT are from NW/SW European population, the Greylag Geese breeding in PL and CZ mostly belong to the Central European population, hence only the data from Portugal is presented in this report.

Based on the recognition of regional differences in migratory behaviour and the human-wildlife conflicts involved within this population, it has been agreed to define two Management Units (MU) for the NW/SW European population of the Greylag Goose (AEWA EGMP 2019b).

MU1 includes the breeding populations from Norway, Sweden, Finland and Denmark that is subsequently mainly staging and wintering in areas of The Netherlands, Germany and Belgium and migrating to the southernmost wintering sites in France and Spain but also with some birds staying further north. MU2 is the mainly sedentary populations of The Netherlands, Belgium and Germany, and inclusive a small French population of c. 200 breeding pairs (Bacon et al., 2019; Nagy et al., 2020).

3. Midwinter Counts in January

- Each year in January, the Greylag Geese are counted in all range states. The counts are collated by national coordinators and reported to Wetlands International which coordinates the International Waterbird Counts (IWC) survey (van Roomen et al., 2018). In order to examine the best way to treat these data, they are presented in three different ways; EGMP national totals, IWC count totals and IWC imputed values. EGMP national totals are presented on a national level, while IWC count totals and IWC imputed values are presented on the flyway level.
- IWC count totals: The data reported to Wetlands International consist of counts mainly at fixed wetland sites in each range state.
- IWC imputed totals: Wetlands International calculates population trends based on imputed totals from a subset of IWC sites. The imputing ensures that missing counts are estimated. However, sites with only one visit are not included because that would lead to gross overestimations of the population size.
- EGMP national totals (collated by the EGMP): While the sum of geese from IWC count totals represents the total number in some countries, there is an additional number of geese found at other

sites, for instance foraging in the agricultural land. EGMP national totals include IWC count totals as well as counts outside of the sites covered by the IWC counts.

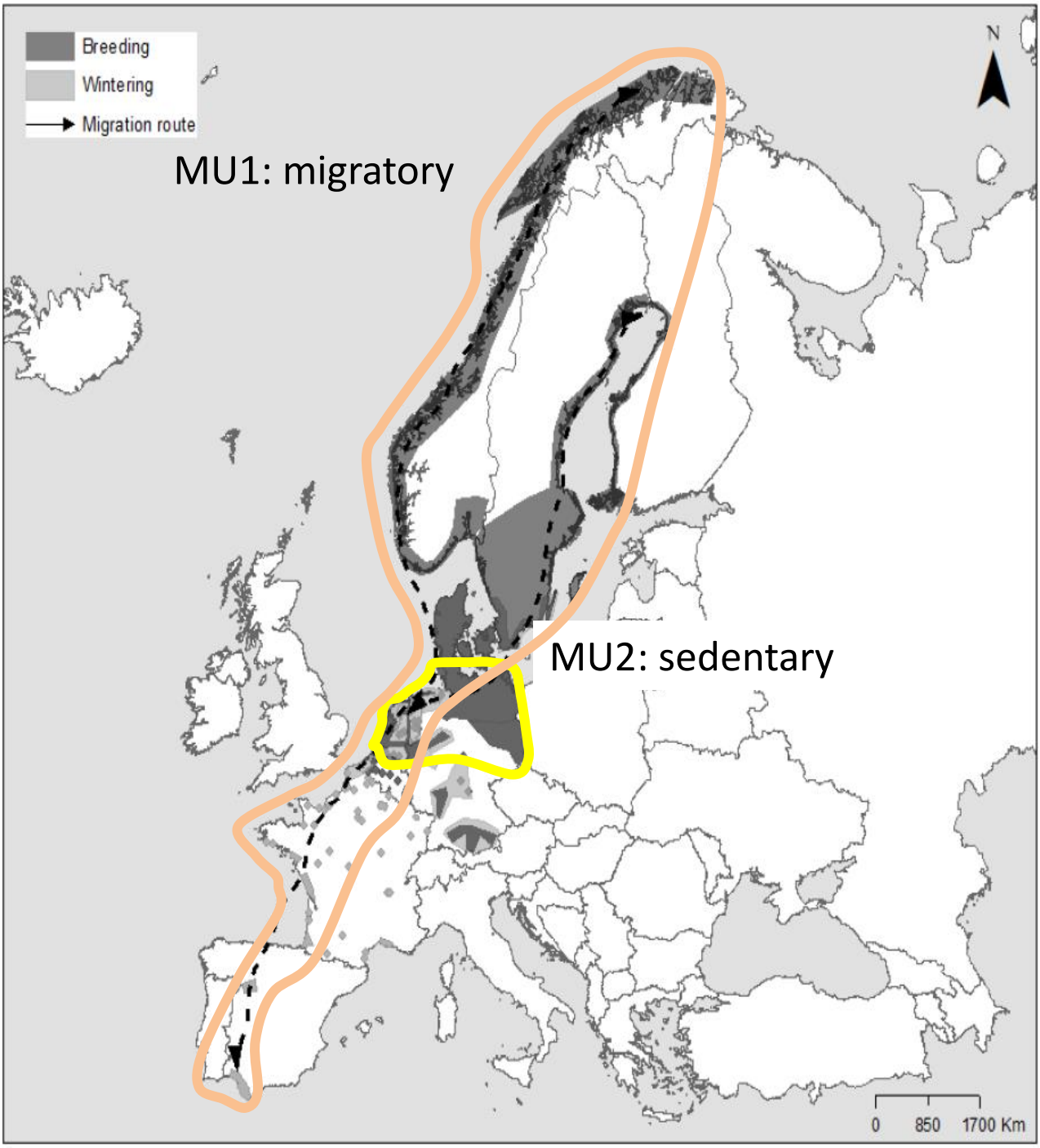

Figure 1. Annual distribution and main migration routes for the NW/SW European population of Greylag Goose including breeding (grey) and wintering (light grey) areas, as well as areas, which are both used during the breeding and wintering period (dark grey) as presented in Powolny et al. (2018). The two management units (MUs) are also shown: MU1 for the migratory population (in orange) and MU2 for the sedentary population (in yellow). Notice that the borders of the MUs are only indicative and may be adapted over time.

The EGMP national totals are shown in Table 1, all annual totals are shown in Table 2 for comparison and presented in Figure 2. The IWC imputed totals and the EGMP national totals were furthermore used to estimate growth rates using a loglinear regression model of counts (Table 3) (for details see Johnson 2020). A stable population has a growth rate equal to 1; increasing populations have values >1 and declining populations <1. The growth rate was estimated for the periods 2004-2012 and 2004-2016. 2004-2012 is the most recent period with EGMP national totals available from all range states. During the 2004-2016 period EGMP national totals are available from all range states (i.e., four additional years) except Spain (however available from Donana) and Germany. Observed growth rates in those two countries during 2004-2012 were used to extrapolate their respective counts through 2016 (Johnson 2020). For the imputed values, it was possible to include the most recent period 2009-2018 and the period covering all years 1980-2018.

It should be noted that during midwinter it is not possible to separate the part of the Nordic breeding birds (MU1) that are wintering in The Netherlands, Belgium and Germany from the sedentary populations in these countries (MU2). Hence, based on the midwinter counts it is only possible to look at the overall trend for the NW/SW European population of Greylag Goose.

Results

EGMP national totals from January 2019 are only available from Sweden (55,710), Denmark (86,553), The Netherlands (448,300) and Donana, Andalusia, Spain (40,080) (Table 1), hence national totals are lacking from the most important range states; Germany and the Netherlands. It is therefore not possible to give an up to date estimate of the total size of the NW/SW European population of Greylag Goose based on EGMP national totals.

The latest estimates from the other countries are:

- Germany 2012 (106,083)
- Spain (outside Andalusia) 2017 (90,339). However, the latest verified number from Spain is from 2012 (57,532)
- France 2016 (17,756)
- Belgium 2018 (17,862)

Looking at individual countries, The Netherlands have reported by far the largest number of wintering Greylag Geese (based on newest estimates from 2018; 417,937 individuals). The Dutch wintering population has increased since the start of the 1980s, but now seems to have stabilized. The importance of the Netherlands for wintering Greylag Geese is furthermore illustrated by the findings that 92% of neck-banded Dutch breeding Greylag Geese are also found in the Netherlands during winter, and that 47% of Norwegian breeding birds and 26% of the Swedish breeding birds are also found here (Bacon et al., 2019).

Estimated mean growth rate for the total population during 2004-2012 is 1.063 (1.048-1.079), and during 2004-2016, using imputed values for Germany and Spain between 2012-2016, the growth rate has declined to 1.038 (1.026-1.051) (Table 3) (Johnson 2020).

IWC count totals

The IWC count totals, just like uncorrected national count totals, cannot be interpreted as fully representing the population size and trends in a country, as coverage may vary in different years or some data may not have been submitted to national coordinators in recent years. As the IWC count totals are used to calculate IWC imputed values, they are however presented in this report to give a full picture of the data used but only at a flyway level.

IWC count totals are available from Belgium and France in 2019 (Table 2). Based on data from only two out of seven range states, it is however not possible to calculate a reliable estimate of the total population size.

During 2018 only data from Germany and Spain is missing, therefore, IWC count totals from 2018 are used calculate imputed IWC values to give a more recent estimate of the total population size.

IWC imputed values

Greylag Goose observations were reported from 4,035 sites in total during the period of 1980 – 2018 (Table 2) and 3,753 of these were used for trend analyses at the flyway level (Table 3). The trend analysis uses data only from sites that had at least two visits in this period. Trends were analysed first separately for each country. Hereafter, the national trends were combined into a flyway trend. rTRIM 2.0.6 (Boogart et al., 2018) was used for the calculations of imputed values and trends. TRIM (Van Strien et al., 2001) takes the observed values whenever it is available and impute the missing values for sites without count in the given year using a General Estimation Equation that takes year and site effects into account.

Denmark was not included into the analysis because the country reports counts only from a reduced index site list since 2000 (Holm et al., 2018; Pihl, 2000) and the results would not be representative for the status of the species in the country. In case of Spain and Portugal, no IWC data is available before the start of the national IWC scheme in 1990 and 1989, respectively. Major data gaps also exist in Spain after 2010 because the government stopped supporting the national coordination of IWC at SEO/BirdLife Spain and also several autonomous regions have stopped the counts due to austerity measures. Data is missing also from large parts of Germany after 2012 because of data flow issues at national level. Finally, it should be noted that for The Netherlands, which holds a large proportion of the population in January, the imputed IWC totals are only calculated for the IWC monitoring areas, and do not include the so-called other areas.

The imputed population size estimates produced by TRIM (Van Strien et al., 2001)should be used with some caution because of two reasons. First, it uses only a subset of sites. In this case that was high (93%). Second, the estimation of missing counts using the year effect can lead to severe overestimations and large fluctuations in case of highly congregatory species such as Greylag Goose. This problem can be especially severe when the number of sites with actual counts is low compared to all sites included in the analysis and this might be the case particularly in Spain and Germany (Table 2).

The imputed IWC totals for the NW/SW European population of Greylag Goose were 751,000 in 2018, 775,000 in 2017 and 709,000 in 2016 (Figure 2). However, these reported estimate of the Greylag Goose population size at the flyway level are likely biased low, and we are currently not able to quantify the bias.

Estimated mean growth rate from IWC data during the entire time series (1980-2018) is 1.088 (1.077-1.099), indicating a strong increase in the population growth (Table 3). The increase seems to slow down over time; during 2004-2012 the growth rate was 1.050 (1.026-1.075), during 2004-2016 it declined to 1.024 (1.007-1.041), and finally during 2009-2018 the growth seems to have stabilised (0.993 (0.976-1.010)). Growth rates derived from EGMP data for 2004-2012 and 2004-2016 are in the same order of magnitude (Table 3).

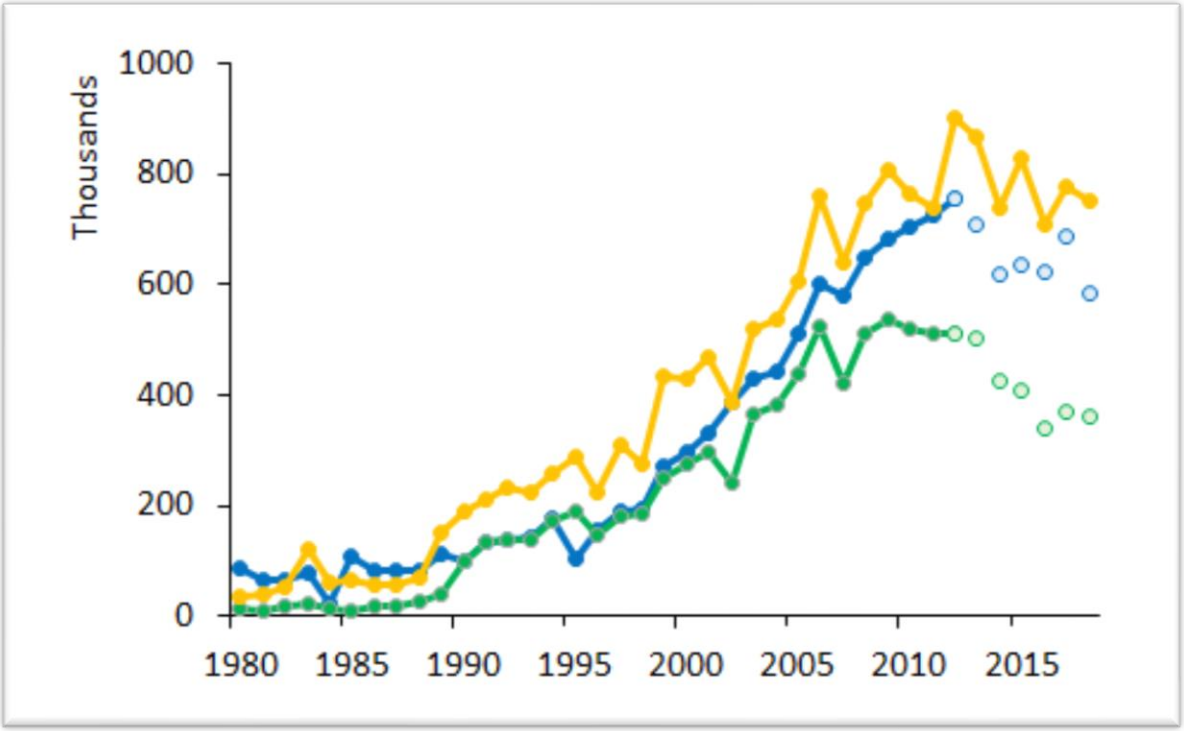

Figure 2. Total January population size of the NW/SW European population of Greylag Goose, 1980-2018, based on EGMP national totals including non-verified numbers from Spain between 2013-2017 (blue), IWC count totals (green) and imputed IWC totals (yellow). Solid circles and lines indicate years with good coverage, years with missing data is shown in open circles.

Table 1. Annual EGMP national totals in January of the NW/SW European population of Greylag Goose reported to the EGMP.

Year	SW	DK	DE	NL	BE	FR	ES[1]	Andalusia, ES[2]	PT
1980	50	NA	NA	15,501	NA	NA	69,747	NA	NA
1981	18	41	NA	10,797	NA	NA	55,636	NA	NA
1982	0	30	NA	20,270	NA	1,575	42,560	NA	226
1983	30	499	NA	13,902	NA	1,193	63,616	NA	NA
1984	46	NA	NA	21,887	NA	700	NA	NA	NA
1985	31	NA	NA	31,120	NA	2,207	74,311	NA	NA
1986	10	NA	NA	17,525	NA	908	63,686	NA	468
1987	14	5	NA	20,849	NA	1,730	60,220	NA	841
1988	73	136	NA	25,063	NA	1,645	52,704	NA	700
1989	123	334	NA	27,740	NA	1,358	81,942	NA	867
1990	69	252	7,337	32,994	NA	1,749	55,155	NA	950
1991	325	613	5,609	57,403	NA	1,722	67,856	NA	1,731
1992	139	580	9,331	50,243	1,080	2,048	75,528	NA	986
1993	470	1,754	11,983	51,776	1,656	3,826	70,682	NA	1,242
1994	434	1,808	14,790	75,004	4,394	3,483	75,100	NA	1,704
1995	657	2,956	20,797	71,503	1,534	4,648	NA	NA	1,228
1996	96	978	11,103	73,908	6,778	7,951	52,360	NA	3,321
1997	466	561	12,516	96,608	7,215	6,462	64,207	NA	2.652
1998	1,457	4,533	24,896	89,888	2,978	5,850	61,874	NA	3,120
1999	736	4,545	25,897	116,649	9,100	6,493	101,909	NA	4,602
2000	3,455	17,386	36,105	135,704	6,996	8,716	86,074	NA	3,084
2001	6,138	15,374	32,937	177,432	8,763	12,461	79,565	NA	123
2002	3,567	13,295	34,101	198,688	14,173	9,532	110,895	NA	2,261
2003	1,297	28,634	36,069	229,689	16,270	14,610	101,284	NA	3,490
2004	6,989	31,934	51,137	226,502	12,981	13,987	96,458	30,488	1,828
2005	23,380	40,096	68,704	227,401	9,472	14,313	125,632	60,115	2,332
2006	5,847	51,669	82,390	295,162	15,746	15,730	132,190	43,718	2,840
2007	39,300	75,092	63,846	254,874	10,649	13,879	119,456	50,849	2,734
2008	49,592	75,671	86,800	276,832	10,578	14,356	130,786	81,726	2,391
2009	35,631	91,057	81,451	325,987	11,950	15,558	119,000	72,156	2,673
2010	30,260	71,974	61,597	393,662	10,130	20,173	114,642	50,376	2,322
2011	12,510	61,353	65,040	448,419	13,893	28,284	93,775	50,548	3,163
2012	40,033	133,453	106,083	381,774	12,941	19,612	57,532	22,204	2,576
2013	19,849	91,185	NA	437,290	14,031	20,081	121,575	64,101	5,128
2014	31,382	87,095	NA	407,525	14,530	15,898	57,995	30,560	2,959
2015	37,907	81,268	NA	414,557	13,863	18,755	66,428	46,195	2,439
2016	29,749	106,295	NA	401,236	13,100	17,756	52,702	36,449	1,597
2017	33,717	96,887	NA	446,299	17,828	NA	90,339	73,630	2.600
2018	46,151	78,357	NA	417,937	17,862	NA	NA	22,190	NA
2019	55,710	86,553	NA	448.300	NA	NA	NA	40,080	NA

[1] The Spanish data from 2013-2017 are not verified.

[2] Donana (data from 2018-2019) is located in Andalusia (data from 2004-2017) and the majority of the birds is from this site.

Table 2. Annual January totals of the NW/SW European population of Greylag Goose; three values: EGMP national totals, IWC count totals and IWC imputed estimates (Data provided by Wetlands International for the two latter) and comments on missing or partly missing national IWC count totals.

Year	EGMP	IWC count	IWC imputed	Missing or partly missing IWC counts
counts				
1980	85,298	12,984	33,031	BE: 1980-81, FR: 1980-1986, ES: 1980-1987 PT: 1980-1986
1981	66,492	8,690	38,781	
1982	64,661	16,663	52,139	
1983	79,240	20,667	119,658	
1984	22,633	13,922	61,960	
1985	107,669	11,318	65,180	
1986	82,597	17,009	55,505	
1987	83,659	19,249	56,891	
1988	80,321	26,072	68,654	
1989	112,364	39,253	150,174	
1990	98,506	100,245	189,725	
1991	135,259	133,339	212,029	
1992	139,935	139,114	231,504	
1993	143,389	136,808	221,955	
1994	176,717	171,682	259,026	
1995	103,323	189,126	287,885	
1996	156,495	145,054	225,397	
1997	190,687	179,880	308,740	
1998	194,596	183,562	275,687	
1999	269,931	250,651	435,444	
2000	297,520	276,273	429,377	
2001	332,793	296,079	466,293	
2002	386,512	240,085	385,476	
2003	431,343	367,082	519,774	
2004	441,816	382,799	536,469	
2005	511,330	436,387	606,181	
2006	601,574	521,693	758,679	
2007	579,830	421,709	637,763	
2008	647,006	510,231	745,563	
2009	683,307	537,007	808,065	
2010	704,760	519,655	763,912	
2011	726,437	511,482	737,943	
2012	754,004	511,303	899,516	
2013	709,158	500,580	866,056	DE partly: 2013-2015 ES partly: 2013-2017
2014	617,384	425,004	738,679	
2015	635,217	409,224	827,804	
2016	622,435	338,251	708,553	DE: 2016-2018
2017	687,670	371,233	774,969	PT: 2017-2018
2018	582,497	362,612	751,106	ES: 2018

Table 3. Growth rates for EGMP national totals and IWC imputed based on data from Table 1 and 2. p-values of ≤ 0.05 indicate a significant increase or decrease.

Year	Growth rate	95% confidence limit	p-values
IWC imputed			
1980-2018	1.088	1.077-1.099	0.00 (***)
2004-2012	1.050	1.026-1.075	0.04(*)
2004-2016	1.024	1.007-1.041	0.09(ns)
2009-2018	0.993	0.976-1.010	0.68(ns)
EGMP national totals			
2004-2012	1.063	1.048-1.079	0.00(***)
2004-2016	1.038	1.026-1.051	0.00(***)

The statistical significance is marked with asterisks.
Ns P > 0.05
* P ≤ 0.05
** P ≤ 0.01
*** P ≤ 0.001

4. Common Bird Monitoring: Breeding Bird Index

The Breeding bird index is a supplementary method to achieve information on the relative changes and trends in the population. The aim of these schemes is however not to count and estimate the total number of birds, but instead to produce comparable national breeding bird indices from year to year, useful for the production of trends, and thus provide a second source of information regarding population trends.

Similar as in winter, these schemes are all based on fieldwork by a large number of volunteers and include all the common species; hence, Greylag Goose is only one of the species counted. The methodology varies between the countries but all have standardized methodology, a formal design and all are producing annual breeding bird indices (PECBMS, 2019). Information about each of the schemes can be found via www.pecbms.info.

In general, the precision of the indices increases with the number of observers and with the abundance of the species. A national index for the Greylag Goose is included when data on the species makes it possible in the given country. These factors explain the length of the time series, the variation in the indices and explains for instance the higher annual variation seen in the data from Finland compared to the data from The Netherlands and the shorter time series for Norway compared to the longer time series for Sweden and Denmark (Figure 3).

The breeding bird indices are obtained from each of the national schemes. For comparison of the different national indices, the indices have been recalculated so all indices were set to 100 in year 2010.

Usually, the calculations of breeding bird indices include trend analyses. However, in order to make the trends of the different datasets comparable to each other, we instead use the indices to calculate trends in the same way as was done with the data from the other datasets.

Results

The Breeding bird index is presented from Norway, Sweden, Denmark, Finland and The Netherlands. The species is too scarce for the production of a breeding bird index in Wallonia (Belgium) and it has not been possible to obtain information from neither Flanders (Belgium) nor Germany.

Breeding Greylag Geese are dispersed over large areas and notoriously difficult to count, resulting in a variation between years related to the sample sizes in the various countries. The indices will therefore fluctuate and should be treated with some caution. However, the trends based on the indices over a number of years are much more robust and are therefore used in this study.

For especially Denmark and The Netherlands, a large increase is observed, with a growth rate of 1.118 (1.066-1.175) and 1.148 (1.135-1.616) during 2004-2012, respectively (Table 4; Figure 3). This increase has however, slowed down in recent years to, 1.091 (1.063-1.120) and 1.126 (1.114-1.138) during 2004-2016, respectively. For Denmark it is down to 1.039 (1.018--1.062) during 2009-2018 (Table 4). In Finland, the growth rate is fluctuating between c. 0.999-1.029 in all three periods, hence showing a stable breeding index. In Sweden on the contrary, the growth rate is increasing, from 0.993 (0.879-1.120) during 2004-2012 to 1.061 (1.000-1.124) during 2009-2018. In Norway the growth rate is 1.042 (1.014-1.071) for the available period (2010-2018).

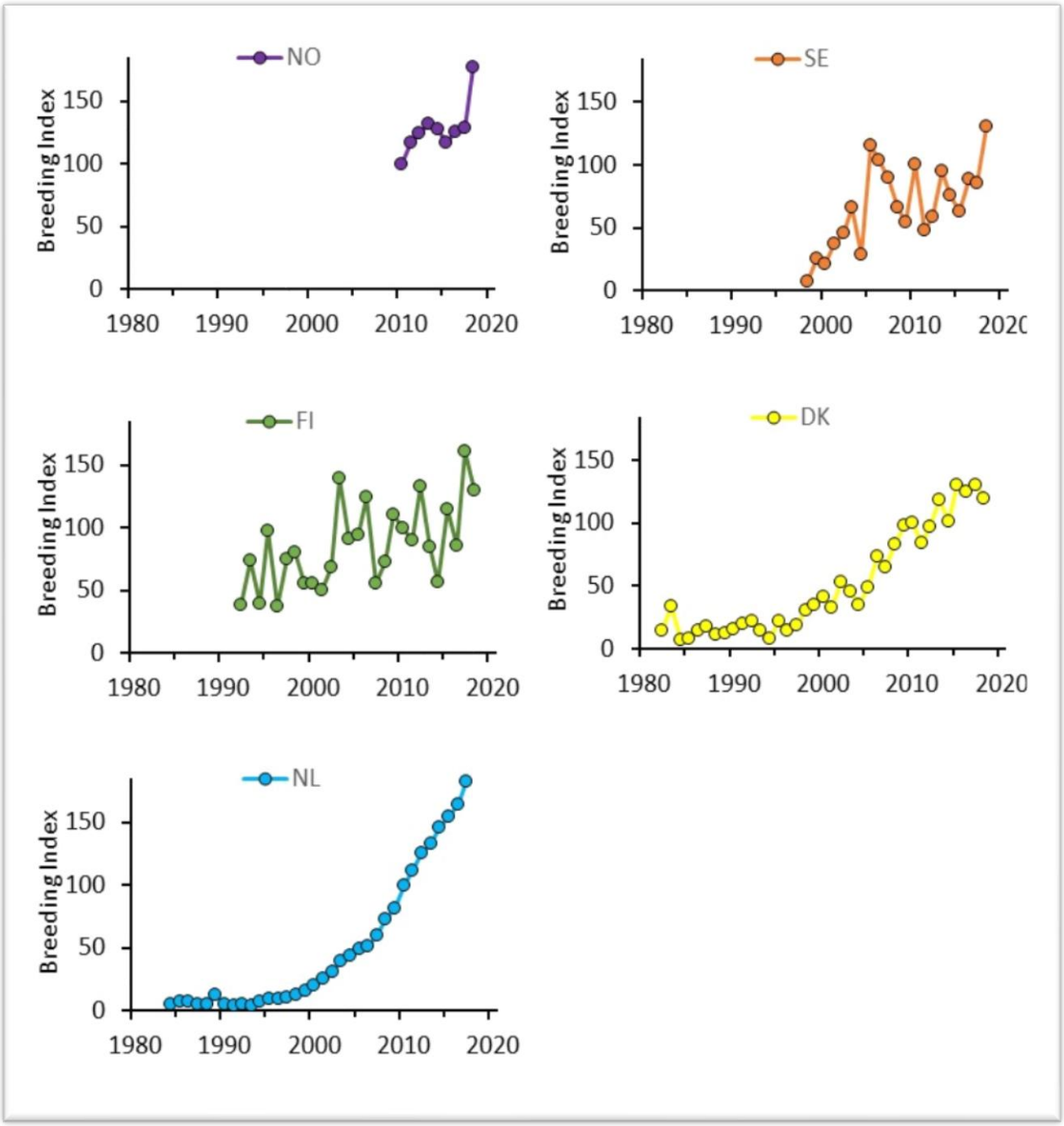

Figure 3. National breeding bird indices for the NW/SW European population of Greylag Goose provided by the different national Common Bird Monitoring programmes: Norway (NO) 2010-2018, Sweden (SE) 1998-2018, Finland (FI)1992-2018, Denmark (DK) 1982-2018 and The Netherlands (NL) 1984-2017. The index is set to 100 in year 2010.

5. Article 12 Reporting

Article 12 requires EU Member States to report about the progress made with the implementation of the Birds Directive. All EU countries are obliged to deliver estimates on the number of birds of every species present in their country winter and summer. This information is delivered every sixth year, most recently in 2019 covering the years 2013-2018 Article 12, Birds Directive (EEA, 2020).

The information reported to the EU comes from all available sources. We include it here to show information from all countries in the same period and in the same framework. Besides, we have included similar data from Norway, the only country among the range states, which is not an EU member state (Table 4). However, such

data are relevant for providing an overview of the populations in the range states but not useful for management of the populations. Note also that winter populations not necessarily refer to January so may be different from other data presented in this report.

Results

Based on the Article 12 reporting the estimated winter population size ranged from 863,382 to 990,669 between 2013-2018, whereas the estimated breeding population size ranged from 181,472 to 276,491 pairs, including Norway (Table 4). It is important to note that these wintering population size estimates are not necessarily based on January counts only but include also other months, since maximum abundances during the winter are used here. Therefore, adding them up most likely overestimate the population size.

Table 4. Overview of the national breeding and winter populations plus population growth in the relevant countries for the NW/SW European population of Greylag Goose. Note that winter populations not necessarily refer to January so may be different from other data presented in this report. The population sizes are obtained from 'Annex B - Bird species' status and trends report format (Article 12) for the period 2013 – 2018' (EEA, 2020). For Norway data is obtained from the online data-portal www,artsobservasjoner,no and Powolny et al. (2018). Growth rates are based on the Common Bird Monitoring, obtained from the national schemes: Breeding bird index, from 2004-2012, 2004-2016, and 2009-2018, respectively, and showing 95% confidence limits.

Country	**Estimated wintering population size** (birds; min-max or best estimate)	**Estimated breeding population size** (pairs; min-max or best estimate)	**Estimated mean population growth Breeding bird index**;
Periods	**2013-2018**	**2013-2018**	**2004-2012** **2004-2016** **2009-2018**
Norway	500	20,000-25,500	1.042 (1.014-1.071)[1]
Sweden	20,000-46,000	32,000-51,000	0.993 (0.879-1.120) 1.012 (0.955-1.072) 1.061 (1.000-1.124)
Finland		3,550-10,064	1.029 (0.959-1.104) 0.999 (0.960-1.041) 1.023 (0.958-1.092)
Denmark	96,887	14,703	1.118 (1.066-1.175) 1.091 (1.063-1.120) 1.039 (1.018-1.062)
Germany	160,000	42,000-59,000	[2]
Netherlands	492,651-547,022	67,000-111,000	1.148 (1.135-1.161) 1.126 (1.114-1.138) No data for 2018
Belgium	13,000-27,000	2,000-5,000	[2,3]
France	14,211-19,159	219-224	[3]
Spain	210,133-238,101	0	[3]
Population	863,382-990,669	181,472-276,491	

6. Harvest Monitoring

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. At present, it is protected in The Netherlands (since 2000) and in the Walloon Region of Belgium (see more details in Powolny et al, 2018). Furthermore, it is subject to derogation killing. Hence, the total harvest consists of legal and reported hunting as well as derogation killing, The Greylag Goose is huntable in Norway.

Hunting bag and derogation killing is registered in all countries; however, it is not always possible to get an estimate of the respective data, as it is not always clear whether the national derogation data are additional to or included in the reported hunting data in countries where both hunting and derogation occurs. France only records harvest at approximately 12-year intervals.

[1] Data only available for the period 2010-2018.

[2] No breeding bird index available.

[3] Few or no breeding birds.

Furthermore, there is an absence of harmonisation among the different hunting bag collecting schemes in Europe as well as lack of information on how calculations are made with the local/regional data to produce the national hunting bag statistics (Aubry et al, submitted).

EU Member States are obliged to report all derogations to the European Commission in annual derogation reports (according to Article 9 in the Birds Directive; EU 2020), however, for a number of Member States the data are only available after several years. Furthermore, in some countries this reporting involved several administrative levels and with some uncertainty to the true number of killed birds.

Results

There is no total hunting bag estimates available from 2019, and in 2018 estimates are only available from part of the range states and regions; Norway, Sweden, Denmark, Finland and Donana (Andalusia, Spain), giving a total of 108,411 from these range states and regions (Table 5).

The primary limitations in the hunting bag data arise from:

- No reporting from Germany since 2015, however at that time 53,957 was reported shot.
- National hunting bag surveys in France are only carried out approximately every 12 years, with the latest one being in 2013 with 10,614 reported shot.
- Hunting bag statistics are only available from Andalusia (including Donana) in Spain with the latest one being from 2017, with 7,151 reported shot (and 2018, with 5,698 reported shot, only in Donana).
- No reporting from Belgium since 2017, however at that time only 2,235 was reported shot.

Derogation information is only available from part of the range states in 2019; in France and Spain no Greylag Goose were killed under derogation in 2019 (or any other year) and in Denmark, Norway and Belgium, a total of 5,549 was reported (Table 5). From Finland and Sweden information, data exist from 2018, with 445 being killed. The primary limitations in the derogation data arise from:

- No recent available and/or reliable information from Germany and The Netherlands. However, according to the Article 9 reporting in the Birds Directive (in 2016), the number of birds killed is much higher in The Netherlands than in any other range state (including those with an open season), with most recent reported numbers of c. 163,000 individuals, c. 56,000 eggs and c. 29,000 nests (Table 6). In countries with both legal hunting and derogation, the level of the latter is much lower (the numbers are 1-16% of the hunting bag numbers in 2018).

Hence, it is therefore not possible to give an up to date estimate neither of the hunting bag size nor for the derogation killing at population level.

Table 4. National (regional) annual bag statistics for the NW/SW European population of Greylag Goose reported to the EGMP. Note that in The Netherlands, Greylag Goose became a protected species in 2000 and offtake after that is listed under derogations in Table 5.

Year	NO	SE	FI	DK	DE[2]	NL	BE	FR	Andalusia ES[41]
1981	NA	NA	NA	NA	NA	3,770	NA	NA	NA
1980	NA	NA	NA	NA	NA	4,748	NA	NA	NA
1982	NA	NA	NA	NA	NA	3,694	NA	NA	NA
1983	NA	NA	NA	NA	NA	3,858	NA	NA	NA
1984	NA	NA	NA	NA	NA	3,518	NA	NA	NA
1985	NA	NA	NA	NA	200	6,437	NA	NA	NA
1986	NA	NA	NA	NA	200	3,129	NA	NA	NA
1987	NA	NA	NA	NA	200	2,653	NA	NA	NA
1988	NA	NA	NA	NA	200	6,705	NA	NA	NA
1989	NA	NA	NA	NA	200	5,813	NA	NA	NA
1990	NA	NA	NA	NA	200	10,037	NA	NA	NA
1991	10,810	NA	NA	NA	250	6,347	NA	NA	NA
1992	6,290	NA	NA	NA	250	7,407	NA	NA	NA
1993	9,480	NA	NA	NA	300	10,177	NA	NA	NA
1994	9,470	NA	NA	NA	800	10,747	NA	NA	NA
1995	10,480	NA	NA	NA	700	20,572	NA	NA	NA
1996	7,960	NA	3,400	NA	1,000	20,752	NA	NA	NA
1997	8,370	NA	2,800	NA	950	31,451	0	NA	NA
1998	8,080	NA	2,300	NA	850	19,901	193	20,850	NA
1999	7,800	NA	3,600	NA	1,100	6,668	628	NA	NA
2000	7,700	4,315	3,100	NA	1,050	0	204	NA	NA
2001	10,800	6,600	3,900	NA	1,350	0	370	NA	NA
2002	9,493	6,584	3,400	NA	1,150	0	432	NA	NA
2003	10,499	9,553	7,200	NA	1,350	0	NA	NA	NA
2004	10,200	10,229	4,800	NA	1,950	0	778	NA	NA
2005	10,571	12,240	4,100	NA	2,350	0	NA	NA	5,485
2006	10,132	8,271	5,000	NA	2,400	0	1,375	NA	2,296
2007	11,589	13,862	7,000	17,900	2,700	0	1,278	NA	2,815
2008	12,865	11,233	3,200	27,000	29,376	0	1,499	NA	1,609
2009	12,800	17,483	9,700	42,500	34,576	0	2,040	NA	7,878
2010	14,630	22,394	8,900	38,700	36,100	0	2,170	NA	9,502
2011	13,320	23,782	5,500	35,200	38,643	0	2,316	NA	9,834
2012	13,710	23,139	7,700	52,300	41,960	0	2,531	NA	8,364
2013	15,690	24,085	4,900	47,400	43,160	0	2,590	10,614	1,991
2014	16,140	24,379	7,900	56,500	44,934	0	2,544	NA	7,453
2015	19,020	31,537	3,000	65,833	53,957	0	2,183	NA	4,624
2016	14,720	22,192	6,500	60,525	NA	0	2,220	NA	7,529
2017	15,470	22,069	8,700	55,346	NA	0	2,235	NA	7,151
2018	15,640	23,314	6,300	57,459[3]	NA	0	NA	NA	5,698
2019	NA	NA	NA	NA	NA	0	NA	NA	NA

[1] The figure in 2018 is from Donana only.

[2] Germany: The sum of information from the following Federal states: Lower Saxony, Mecklenburg-Vorpommern, North Rhine Westphalia, Schleswig-Holstein, Bavaria, Rhineland-Pfalz and Brandenburg.

[3] Preliminary data.

Table 5. National annual derogation of Greylag Goose reported to the EGMP.

Year	NO	SE	FI	DK	DE	NL	BE	FR	ES
2009	NA	NA	NA	NA	NA	108,792	37	0	0
2010	NA	NA	177	NA	NA	58,121	88	0	0
2011	NA	NA	69	NA	NA	NA	181	0	0
2012	NA	NA	78	NA	NA	NA	127	0	0
2013	NA	NA	110	NA	NA	NA	310	0	0
2014	NA	NA	125	2269	NA	NA	608	0	0
2015	NA	NA	79	1964	NA	NA	379	0	0
2016	NA	227	89	2359	NA	163,354	211	0	0
2017	NA	300	104	3092	NA	NA	229	0	0
2018	NA	300	145	1886	NA	NA	221	0	0
2019	2500	NA	NA	2921	NA	NA	128	0	0

Table 6. Overview of the latest annual national level of derogation of Greylag Goose reported to the EU (EU 2020).

Derogation numbers	**Reported to the EU-Article 9 (derogations)**			
Range state	**Adults**	**Eggs**	**Nests**	**Year**
Finland	0	0	0	2018
Belgium	1,957	40	8	2018
Denmark	145	0	0	2018
France	-	-	-	NA 2015-18
Germany	1,582	8,919	1,843	2016
The Netherlands	163,354	55,652	29,009	2016
Spain	0	0	0	2016
Sweden	300	0	0	2018

7. Discussion

This report compiles annual monitoring data and annual offtake data from the range states of the NW/SW European population of Greylag Goose covering the period from 2016-2019.

We present counts of Greylag Geese in mid-winter and indices of breeding birds. The mid-winter counts are an important source, as simultaneous counts are performed across the range of the population, however towards the end of the hunting season, hence affected by the size of the offtake during the hunting season from late summer to the midwinter period.

The use of the data is, however, complicated by the lack of data from some key range states, like Germany and Spain in most recent years. To compensate for the lack of data we used imputed values where data was missing. This is assumed to provide the best possible solution at present but a combination of EGMP national totals and IWC totals may be the best solution in the future. In most countries, the imputed values are higher than the EGMP national total counts. However, imputing has some uncertainty and, in some countries (The Netherlands and Denmark), the IWC data only cover so-called monitoring sites, resulting in EGMP national total counts being higher than the imputed estimates in countries. Hence, our estimates from IWC data are incomplete and annual counts and up-to-date data from all countries would be preferable. Furthermore, there is a need for the

range states to agree on how monitoring and data handling should be performed to improve the outputs that are made available for population modelling and subsequently the management of the population.

The mid-winter results show a slowing down and a recent stabilisation in the population growth rate. This could result from a saturation of the main areas we study but also from less immigration to MU2 from the Nordic countries. We need to study the regional differentiation more in detail to understand the spatial variation. There is a tendency for a decline in the South, however due to incomplete of data, from Spain in particular, it is still highly uncertain.

In contrast, there is an indication that the national breeding bird populations continue to increase in The Netherlands. To some extent, this is also evident in the Nordic countries, but only when including the most recent years since these increases follow a period of mainly stable indices. Nevertheless, at a slower pace in recent years for The Netherlands and Denmark, and highly fluctuating in Finland.

For the moment it is not possible to assess the reasons for the discrepancy between mid-winter and breeding growth rates; however, it is hypothesized that derogation and harvest mortality, which take place during the summer and autumn/winter period explains at least some of it. Moreover, breeding bird counts are also complicated by a large number of non-breeding birds. The ratio of non-breeders to breeding birds are most probably varying with the density of breeding birds and therefore also between regions.

With the aim of improving the data for monitoring and adaptively managing the population at management unit level in the years to come, there are several variables, which need to be included and adjusted. The decision to manage the population divided into a migratory MU1 and a sedentary MU2 (AEWA EGMP 2019a) implies the need to understand the exchange rates between MUs throughout the year. The analysis based on neck-banding data by Bacon et al. (2019) will have to be updated because of the rapid changes in wintering strategies of the population and because Finland and the eastern parts of Germany were not included in the analysis. This will require a continuous and systematic Capture-Mark-Resighting (CMR) or tracking program in the breeding range states.

There is a need to know the size of the breeding populations in both MUs but at present annual monitoring takes place only during winter when the MUs are mixed. The accuracy of the breeding population estimates reported to the EU under Article 12 of the Birds Directive is too low to be used in the context of harvest management: the maximum population estimate is 50% more than the minimum estimate. Surveys of summering populations (July) are carried out in Belgium, The Netherlands, North Rhine Westphalia and Lower Saxony in Germany; however, this needs to be extended to other German federal states to provide an overview of the size of MU2 and establish the relationship between breeding population estimates and summering population sizes. Optimally, similar counts in MU1 should be initiated as well but whether this is practically and economically doable must be considered first. Besides, the July numbers should be quantified across the breeding range because targets and breeding Favourable Reference Populations are expressed in pairs to be consistent with the EU Birds Directive Article 12 reporting.

For a better understanding of the annual production of juveniles and the variation in this it would be necessary with a coordinated monitoring after the breeding season and before any harvest of the population, preferably also before the migration starts, so that variation in the production between range states could be studied as well. It is possible to age the full-grown Greylag Goose in summer and early autumn. Age ratio data is available from The Netherlands where the mean ratio of first year birds was 15.4% in 2012-2016 (Hornmann et al. 2020) and from North Rhine Westphalia in Germany (collected during the count in July) where it was on average 15.7% in 2011-2017(Koffijberg & Kowallik, 2018). Similar data from other parts of the range would provide us with an estimate of the annual addition of birds to the population, and collection of such data could be combined with a count of summer populations.

Another important demographic variable is the annual adult survival rate, which may be derived from CMR programs coordinated among the breeding range states (L. Bacon in prep.).

The results on harvest and derogation show that (1) there are time lags in the national analysis and reporting of data, ranging from 1 to 4 years, (2) from France, the harvest is only reported at 12 year intervals and, (3) from Spain outside Andalusia, harvest has not been reported. Furthermore, it is suggested that there are serious biases in some of the datasets provided (Johnson 2020).

For countries, which have reported hunting bags, harvest increased during the last decades but seem to have stabilised in recent years. The level and trend in derogation cannot be unravelled due to lack in data from key countries like The Netherlands. In consequence, the total offtake in recent years cannot be estimated.

8. Conclusions

It has not been possible to neither compile up to date information on the total population size nor the total offtake. The primarily reason is that data is either not collected in some range states and/or reported with one or more years delay. Due to lack of up-to-date and reliable monitoring data, it is currently not possible to model an optimal harvest strategy, which ultimately will be needed to reliably manage Greylag Goose abundance in accordance with population targets set for the two management units.

This report also illustrates what data is missing for the development of population models that can guide the management of this population in the future. It becomes clear that there is a gap between the political-administrative interest of producing sound population models right away and the present datasets and quality of the schemes that should deliver the necessary data input. It is not possible to make such requested assessments before better monitoring data is available.

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References

AEWA EGMP. (2019a). *Process for the development of the Adaptive Flyway management programme for the Northwest/Southwest European population of the Greylag Goose*. (AEWA/EGMIWG/4.12/Rev.1, 2019).

AEWA EGMP. (2019b). *Report of the 4th meeting of the AEWA European Goose Management Working Group*.

Aubry, P., Guillemain, M., Jensen, G. H., Sorrenti, M., & Scallan, D. (n.d.). Moving from intentions to actions for collecting hunting bag statistics at the European scale: some methodological insights. In *European Journal of Wildlife Research*.

Bacon, L., Madsen, J., Jensen, G. H., de Vries, L., Follestad, A., Koffijberg, K., Kruckenberg, H., Loonen, M. J. J. E., Månsson, J., Nilsson, L., Voslamber, B., & Guillemain, M. (2019). Spatio–temporal distribution of greylag goose Anser anser resightings on the north-west/south-west European flyway: guidance for the delineation of transboundary management units. *Wildlife Biology*, *1*, 1–10. https://doi.org/10.2981/wlb.00533

Boogart, P., van der Loo, M., & Pannekoek, J. (2018). *Package 'rtrim'. Trends and Indices for Monitoring Data (Version 2.0.6).*

EEA. (2020). *Annex B - Bird species' status and trends report format (Article 12) for the period 2013 - 2018.* Annex B - Bird Species' Status and Trends Report Format (Article 12) for the Period 2013 - 2018.

EU. (2020). *Composite European Commission Report on Derogations according to article 9 of Directive 2009/147/EC on the Conservation of Wild Birds*. Article 9 Reporting (Derogations).

Holm, T. E., Clausen, P., Nielsen, R. D., Bregnballe, T., Petersen, I. K., Mikkelsen, P., & Bladt, J. (2018). *Fugle 2016. NOVANA.*

Johnson, F. A. (2020). *Management of the NW/SW European population of Greylag Geese: Decision making under deep uncertainty*.

Koffijberg, K., & Kowallik, C. (2018). Sommerbestände von Gänsen in Nordrhein-Westfalen 2011-2017. *Charadrius*, *54*, 151–166.

Nagy, S., Dereliev, S., Heldbjerg, H., Jensen, G. H., Johnson, F. A., Madsen, J. & Meyers E. (2020). *Adaptive Flyway Management Programme for the Greylag Goose Anser anser, NW Europe/SW Europe population. (*AEWA/EGMIWG/5.14, 2020).

PECBMS. (2019). *Trends of common birds in Europe, 2019 update.* https://pecbms.info/trends-of-common-birds-in-europe-2019-update/

Pihl, S. (2000). Vinterklimaets indflydelse på bestandsudviklingen for overvintrende kystnære vandfugle i Danmark 1987-1996. *Dansk Ornitologisk Forenings Tidsskrift*, *94*, 73–89.

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

van Roomen, M., Nagy, S., Citegetse, G., & Schekkerman, H. (2018). *East Atlantic Flyway Assessment*

2017: the status of coastal waterbird populations and their sites,.

Van Strien, A. J., Pannekoek, J., & Gibbons, D. W. (2001). Indexing european bird population trends using results of national monitoring schemes: A trial of a new method. *Bird Study*, *48*(2), 200–213. https://doi.org/10.1080/00063650109461219