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AEWA EUROPEAN GOOSE MANAGEMENT PLATFORM

7th MEETING OF THE AEWA EUROPEAN GOOSE MANAGEMENT INTERNATIONAL WORKING GROUP

21-23 June 2022, Helsinki, Finland

REPORT AND RECOMMENDATIONS OF THE GREYLAG GOOSE TASK FORCE AND DRAFT WORKPLAN FOR 2022/2023

Prepared by Iben Hove Sørensen, Coordinator of the Greylag Goose Task Force,

with contributions from the members of the Greylag Goose Task Force and the Modelling Consortium

Summary:

This document provides an overview of the status and key activities that the Greylag Goose Task Force has undertaken since June 2021 until May 2022. In addition, a proposed list of recommendations is included as well as the proposed annual workplan for 2022/2023.

Action requested from the EGM IWG:

Take note of the task force report and recommendations and adopt the annual workplan

The 7th Meeting of the AEWA European Goose Management International Working Group is being hosted by the Finnish Ministry of the Environment and the Finnish Ministry of Agriculture and Forestry.

Introduction

As outlined in Rule 29 in the Modus Operandi adopted for the AEWA European Goose Management International Working Group (EGM IWG), the IWG may establish species Task Forces as necessary to deal with the preparation and coordination of decision papers and background documents for the EGM IWG as well as to deal with other specific tasks as requested by the IWG.

At the 5th Meeting of the EGM IWG in June 2020, the Range States agreed on the establishment of an EGMP Task Force for the NW/SW European Population of the Greylag Goose (GG TF) and adopted its proposed Terms of Reference (Doc. AEWA/EGMIWG/5.15) as well as the first draft of the AFMP (pending several updates and sections).

At the 6th Meeting of the EGM IWG (EGM IWG6) in June 2021, held remotely in an online conference format, the GG TF presented on the work progress since the establishment of the Task Force and presented recommendations to the EGM IWG, referring to document AEWA/EGMIWG/6.11. In its recommendations, the TF urged the Range States to improve the population counts and provide data on offtake and population size as well as to explore options for summer counts and deployment of GPS-tags to obtain a better understanding of population size and movements of the two Management Units. The Range States adopted the report and agreed on an info-gap analysis approach as a temporary solution allowing the launch of management in the absence of accurate data.

The overall role of the GG TF is to assist the IWG in catalysing and coordinating the implementation of the AFMP workplan and monitoring activities related to the implementation of the AEWA International Single Species Management Plan for the Greylag Goose (NW/SW European Population). This document provides an overview of the work that has taken place since the EGM IWG6 and the Task Force's recommendations and draft workplan for 2022/2023.

1. Status of the Task Force Membership

Presently, the GG TF has 23 members. Members represent seven Range States, five Observer Organisations, the Data Centre and the AEWA Secretariat. Ms. Iben Hove Sørensen is coordinating the GG TF. Two Range States are still to nominate official representatives in the GG TF but have agreed to provide the data necessary for the AFMP process.

Details of the current membership of the GG TF are indicated in Annex 1 to this document. In line with the Terms of Reference, the nomination of additional members to the Task Force is at the discretion of the National Government Representative of each Range State, observer organisations and the Coordinator of the Task Force.

2. Meetings

Since no funding has been specifically allocated for the work of the GG TF, communication and information exchange is mainly conducted via email and online meetings.

The Task Force has held two meetings since EGM IWG6 in June 2021. These online meetings took place on 30 September 2021 and 1 April 2022. A 3rd meeting, this time face-to-face, is planned on 20 June 2022, just before EGM IWG7.

3. Report of key activities and outcomes

Main activities of the GG TF have been the online meetings described above. The GG TF Coordinator has been invited to participate in the meetings of the Fennoscandian Greylag Goose Initiative and the Modelling Consortium (see Doc. AEWA/EGMIWG/7.10), and the GG TF has received regular updates on the work in these groups. The GG TF has also received regular updates from the Data Centre and discussed and commented on issues related to data availability, monitoring activities and ongoing modelling projects.

During the meetings, TF Members have agreed on continued support for national counts and other monitoring programmes, and the TF also supported a modelling proposal from the Data Centre, led by Fred Johnson (see Annex 2). Several GG TF Members have participated in the EGMP webinars, and a briefing note on the AFMP related to Greylag Goose has been produced by the Secretariat and members of the GG TF.

Finally, the GG TF has contributed to the review of the following documents submitted to EGM IWG7:

- Draft EGMP Population Status and Assessment Report 2022
- Briefing note on the Adaptive Harvest Management Programme (AFMP) for Greylag Goose
- Annex 2 to this report

4. Recommendations

Based on meetings and discussions in the GG TF, the Task Force has identified the following issues and activities of essential priority and recommends that:

- All Range States strive to provide the necessary data (including present and historical offtake as well as population size) to switch from the current info-gap analysis to a dynamic model-based assessment in 2023.
- More specifically, the GG TF recommends that Range States follow the general and specific recommendations brought forward in the EGMP Population Status and Assessment Report (Doc. AEWA/EGMIWG/7.10) by:
    - Submitting data to IWC in a timely manner and before March 1 in the year after the count took place.
    - Collecting and submitting hunting bag data to the EGMP Data Centre on an annual basis and at MU level, thus split between April-July and August-March.
    - Providing derogation data to EU or the EGMP Data Centre at MU level, thus split between April-July and August-March.
    - Submitting summer counts as well as the common breeding bird index to the EGMP Data Centre on an annual basis. MU1 range states are encouraged to submit summer counts as soon as these become available.
- The EGM IWG strives to define utility (i.e., stakeholder satisfaction) as a function of population size in the two Management Units relative to their targets as described by Fred Johnson in Annex 2 to this report.
- The GG TF continues to exchange general information and experiences with other species-specific Task Forces and liaises with the Agriculture Task Force, thus strengthening the relations between EGMP Task Forces and benefitting from the work already carried out on other species. More specifically, TFs seek to collaborate on reducing crippling rates of goose species.
- TF Members actively promote available material such as the recorded EGMP webinars and briefing notes.
- Finally, the GG TF will keep the online workplan active and updated between meetings.

5. Draft Workplan 2022/2023

Table 1. Greylag Goose Task Force Draft Workplan for 2022/2023

Actions from the ISSMP	**Priority**	**Timescale**	**Greylag Goose Task Force**
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	High	Short / Rolling	Sharing experience / Coordination with other TFs; included in webinars planned for 2022.
3.2 Establish an internationally coordinated programme to assess agricultural damage including monitoring and assessment protocols	High	Short	Exchange information with the Agri TF; partly included in webinars planned for 2022. Collaborate with the Modelling Consortium.
3.3 Liaise with farmers affected by goose damages to reduce agricultural conflicts	High	Short / Rolling	Cross-cutting TFs, share information. Farmers' representatives will be invited to webinars in 2022, and pdf-files of the presentations will be distributed widely. Upcoming webinars, with open access for all, will also include topics of relevance to farmers.
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	Have a discussion, recommendation for EGM IWG6/7
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	Review reports produced by DC, as appropriate
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	Exchange information and experience through webinar. Collate and summarise results (possibly workshop, if time and resources allow - cross-cutting with PFG and Agri TF)
4.4 Promote best practices of goose hunting including timing to minimize damage and significant disturbance to other species	Medium	Medium / Rolling	Follow up on the information and experience shared during webinar on crippling and promote available material (e.g. recording of webinar). Collate and summarise results (possibly workshop, if time and resources allow – cross-cutting with PFG and Agri TF).
4.5 Maintain low crippling rates	High	Medium / Rolling	Exchange information and experience with PFG TF. Investigate GG crippling rates. Continue raising awareness on the issue and how to minimize crippling.

4.6 Develop hunting techniques to further reduce crippling	Medium	Long / Rolling	Exchange information and experience. Collate, summarise results (possibly workshop, if time and resources allow - cross-cutting with PFG and Agri TF)
A.1 Produce and update periodically spatially explicit population size estimates based on agreed international monitoring	Essential	Short / Rolling	Consultation
A.2 Maintain an annually updated bag statistics database including geese harvested by any means	Essential	Ongoing / Rolling	Consultation
A.3 Maintain a spatially explicit database on goose damage to agriculture, other flora and fauna and risk to air safety	Essential	Medium / Rolling	Liaise with Agri TF. Some Range States already have relevant databases or collated information (France, the Netherlands, Norway).
C.1 Develop and implement a communication strategy and plan	Medium	Short / Rolling	Produce scientific papers - outreach to wider community - then member states can use the info to reach national stakeholders - improve and use the EGMP website news section, publish results, content, scientific results, outputs, not only announce meeting. Continue the outreach activities already taking place in several Range States.

Annex 1. Members of the Greylag Goose Task Force as of 19 May 2022

Country	Representative	Affiliation
Belgium	Mr Floris Verhaeghe	Nature and Forest Agency
	Mr Koen Devos	Research institute for Nature & Forest (INBO) Flemish government
Denmark	Mr Søren Egelund Rasmussen	Danish Environmental Protection Agency
Denmark/CIC - International Council for Game and Wildlife Conservation	Ms Iben Hove Sørensen (TF Coordinator)	Danish Hunters' Association
Finland	Mr Antti Piironen	University of Turku
	Mr Mikko Alhainen	Finnish Wildlife Agency
France	Mr Léo Bacon	Direction de la Recherche et de l'Appui Scientifique Office Français de la Biodiversité
	Mr Charles-Henri de Barsac	Ministère de la Transition Ecologique
	Mr Matthieu Guillemain	Direction de la Recherche et de l'Appui Scientifique Office Français de la Biodiversité
Netherlands	Mr. Nick Warmelink	Ministry of Agriculture, Nature and Food Quality
	Mr. Gerben Mensink	Policymaker Ecology, Province of Friesland
	Mr Kees Koffijberg	Sovon Vogelonderzoek Nederland
Norway	Ms Ingunn Tombre	NINA
Sweden	Mr Per Risberg	Swedish Environmental Protection Agency
FACE	Mr Cy Griffin	Senior Conservation Manager
Nordic Hunters' Alliance	Mr Olav Greivstad	Consultant

OMPO	Mr Thibaut Powolny	Project Manager
Wetlands International	Mr Szabolcs Nagy	Senior Advisor
Wildlife Management Unit Noord-Holland (Netherlands)	Ms Nikkie van Grinsven	Ecologist
	Ms Sofia Kolkman	Project Manager
EGMP Data Centre	Ms. Gitte Høj Jensen	Aarhus University
	Mr. Fred Johnson	Aarhus University
UNEP/AEWA Secretariat	Ms Eva Meyers	EGMP Coordinator

Annex 2. Reports on Monitoring and Modelling Activities related to the TF Workplan

Summary on the state of Greylag Goose monitoring in Finland

Prepared by: Andreas Lindén (andreas.linden@luke.fi) and Tuomas Seimola (tuomas.seimola@luke.fi), Natural Resources Institute Finland (Luke)

Project funded by: The Finnish Wildlife Agency and the Finnish Ministry of Agriculture and Forestry

1. Monitoring population abundance

In Finland, the Greylag Goose (GG) population has increased and seems to have shown large fluctuations in recent years. So far, its distribution has been strongly linked to coastal areas, but recently the species has spread also inland.

Changes in the population abundance of GG in Finland have been monitored in terms of relative abundance indices, based on the national archipelago bird monitoring scheme. This monitoring activity is done by voluntary birdwatchers, mainly ringers, counting nests on islands during breeding time. The archipelago bird data are gathered and complied by Metsähallitus (the Finnish state forestry authority) and analysed by Natural Resources Institute Finland (Luke). So far, we have calculated the indices using software RTRIM (Bogaart et al. 2020) in the programming environment R (see results in Fig. 1).

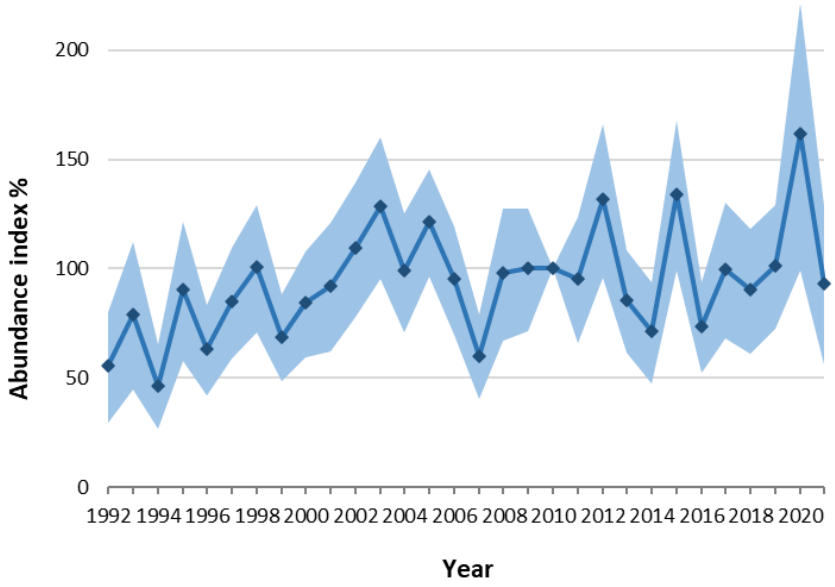

Figure 1. National population abundance indices of Greylag Goose. The shaded areas represent 95% confidence intervals. The time series has been scaled so that 100% is the index in year 2010.

The sites covered by the archipelago bird monitoring scheme are strongly focussed on the outermost archipelago, which is suboptimal habitat for GG that thrive close to the coastline. Moreover, the point of gravity of breeding GG seems to have moved further to the inner archipelago, due to high predation pressure by White-tailed Sea-eagles in the outermost archipelago. Therefore, the current estimated trend is probably underestimated, i.e., the true increase is stronger.

To better cover larger areas in the inner- and middle archipelago in the future, the archipelago bird monitoring is under reformation in a large EU-funded project named LIFE-IP BIODIVERSEA, which involves many national collaborators (including Luke and Metsähallitus). The project started in 2021. A new type of breeding bird survey in the archipelago is done by boat to complement the current nest counts. The boat survey is faster, practically easier to implement (counts of birds, not nests), and better available for average birdwatchers that do not ring. The goal is to be able to calibrate the two methods to each other (for each species) and to analyse the indices and trends in one statistical model (pr species) that is simultaneously accommodating both types of surveys.

This part largely represents monitoring efforts that have been done for long and development that would be done anyway, regardless of the current needs for country-wise estimates of GG population sizes. The following sections present activity specifically related to the new needs in international GG management.

2. Estimation of population size – August survey and GPS-loggers

No major efforts have earlier been made in Finland to estimate the total breeding population size of GG. To fill this knowledge gap and to serve international management needs, Luke has in collaboration with University of Turku (Antti Piironen) started an effort to estimate total population size based on a new GG survey in August and information from GPS-tagged birds. Although estimating of the population size takes several years, this is a one-off type of effort. During 2021 we made a pilot study of the August survey, covering approximately the Southern coast of Finland.

The planned survey is done during one day (or possibly two days) per year, in beginning of August before the field hunting season starts (10. August), at the best-known and most likely gathering sites/areas of GG along the Finnish coast. Surveys will be conducted early in the morning (sunrise to around 9–10 a.m.) from the fields when GG are feeding and before they move to roost at sea or estuaries, where this kind of sampling is far more difficult. Some easy to count roosts will be included. All the flocks are counted, and GPS-tagged birds are spotted. Even if the GPS-tags are not seen, we can often infer from the GPS-data, whether the tagged birds were included in a flock that was seen in the survey, or whether they were present in the survey area.

August 2022 counts will be made 5.–6.8.2022. Hopefully, the survey will cover 70–90 sites from Northern Ostrobothnia to Virolahti in Eastern Gulf of Finland (Fig. 2). We will also try to include Åland mainland to the counts, but unfortunately some parts of SW Archipelago will not be covered due to logistical challenges.

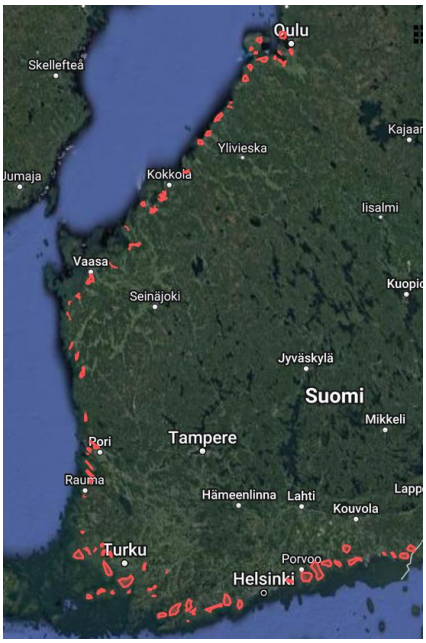

Figure 2. The red shaded polygons are planned sampling sites for the August survey. During the pilot year 2021 the sites around Turku and eastward were covered. Åland main Island is not presented in this map. (Source: Google Maps)

While the actual sampling areas are non-random, we presume that the GPS-tagged birds are randomly distributed among the sample sites and other possible non-sampled areas (see example in Fig. 3). Based on this assumption, we may estimate the proportion of GPS-tagged birds covered by the survey and extrapolate the result to estimate total population size. The survey aims to cover as large part of the population as possible, so that it simultaneously provides a reasonable minimum estimate of the post-breeding population size and covers a large share of the tagged birds, making estimation of the population size more robust.

Currently we have ca 50 GPS-tagged GG, and 10 to 13 further birds will be tagged in 2022. During the pilot survey in 2021 we observed in total 8 595 individuals only along the southern coast of Finland. Out of 17 GPS-tagged birds in Southern Finland, 13 were located inside the sampling plots during the counts and 10 birds were confirmed to be in the counted flocks. This leads to an average post-breeding population size estimate of 16 661 birds (95% CI = 11 482; 26 456) of which the average estimate for the adult population is 14 227 birds (95% CI = 9 799; 22 595).

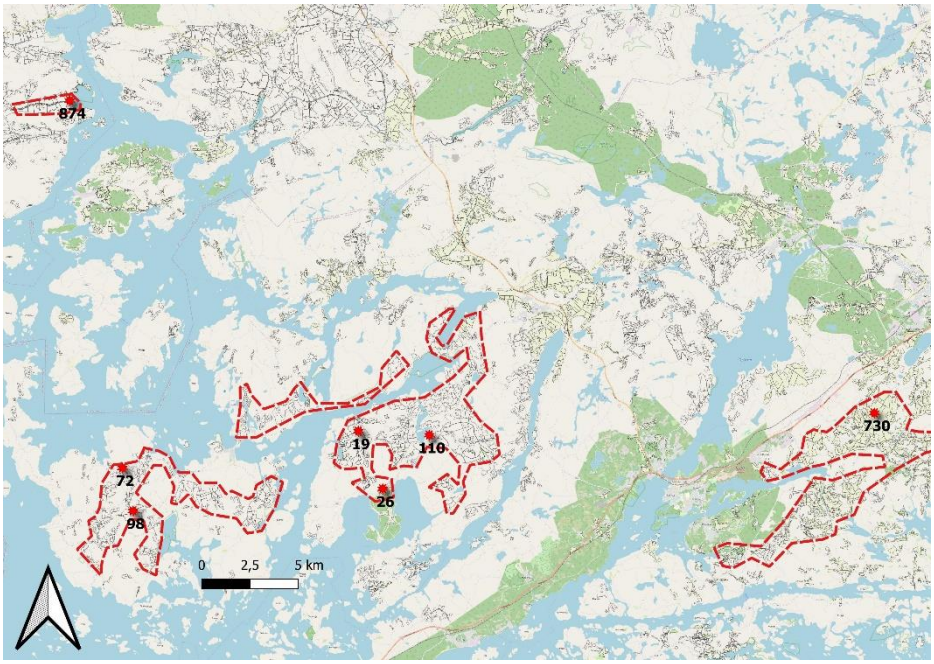

Figure 3. An example of surveyed areas in the pilot count 2021. Dashed lines = surveyed areas; stars = sites with observations and number of Greylag Goose observed.

In our extended future efforts, we hope to get a reasonable estimate of the population size for a given time-period for the whole country. This information may further be used together with population indices (see part 1) to infer time series of total population size. Luke currently has funding from the Finnish ministry of agriculture and forestry to continue the August counts and GPS-tagging in Finland during 2022. We believe we may continue in 2023 as well, but funding is granted on an annual basis.

3. Production of young – Age-ratio sampled in August

Reproductive success of GG has not been systematically monitored in Finland. In the August survey described above (section 2), we sample the age-ratio from the flocks where it is possible to do so, i.e., flocks that are close enough. Form each flock a limited number of individuals are sampled and aged – visually with a spotting scope or using a camera. In small flocks all birds may be sampled, while for larger flocks we recommend sampling 200 individuals, if possible.

In the pilot survey in 2021 in total 1 942 birds were aged. Of these 1 659 were adults and 283 young, indicating that the proportion of young observed was ca 14.6%. The ratio may be underestimated, if families with the young chicks have not yet gathered at these sites. In further efforts we will try at least to account for the between-flock variation in age-ratio and possible predictors of age-ratio (e.g., flock size).

Also, the planned boat surveys (see section 1) may provide complementary information on reproductive success of GG at an early stage of breeding, but also at later stage in July when the chicks are more likely to survive.

As this activity is part of the August survey, we have funding secured for 2022 and will likely also continue after that.

References

Patrick Bogaart, Mark van der Loo and Jeroen Pannekoek (2020). rtrim: Trends and Indices for Monitoring Data. R package version 2.1.1. https://CRAN.R-project.org/package=rtrim

Greylag – summer counts Sweden

Prepared by: Johan Månsson, Swedish University of Agricultural Sciences

Project funded by: The Swedish Environmental Protection Agency

In Sweden it is regarded as a "mission impossible" to achieve accurate estimations of the summer population size, given the expected current resources (100,000-200,000 SEK). The greylag geese are very widespread in Sweden and are breeding in many different habitats (e.g. east and west archipelago, in cities, most small wetlands even in forested areas, large reed beds etc).

Recent studies have shown that the geese arrive to breeding areas in March and leave late September/early October. In Sweden a suit of different ongoing and long-term goose monitoring, e.g. a September count, which at the moment is assumed as the best possibility to get an estimate of the post-breeding population size (after breeding and before migration) as the birds gather at staging sites during this period. When using the September count, it will be important to consider the number of shot geese, as the open hunting season starts in Aug. 11. A time-stamp will therefore be needed for bag reports.

Furthermore, some migration may have started and this needs to be accounted for as well. The available extensive GPS-data (>100 inds.) can provide more detailed information about migration pattern. It´s also known that greylag geese origin in Finland are staging in some eastern parts of Sweden in September. More information is needed about the proportion/number of geese origin in Finland that are staging in Sweden during this period. Moreover, the September count also needs to be extended to more areas than today for an improved coverage.

The summer population of greylag geese in Norway: an estimation of numbers

Prepared by: Nigel Yoccoz, professor UiT, Torkild Tveraa, senior researcher NINA, Ingunn Tombre, senior researcher NINA & Arne Follestad, senior researcher NINA

Project funded by: The Norwegian Environment Agency.

To estimate the number of greylag geese, we will use a combination of multilevel statistical models and poststratification (e.g. Downes et al. 2018, Downes and Carlin 2020). The idea is to combine models based on non-random (i.e. selective) samples predicting the number of geese in different habitat categories and then to extrapolate these models to larger areas, possibly the whole of Norway, using a weighted average across habitat subtypes.

To model the number of geese using non-representative samples, we investigated both classical, parametric models (e.g. generalized linear models) and non-parametric models such as regression trees and random forests. Because non-parametric models (often known as machine learning methods) gave better and more robust predictions, we will use this approach. Moreover, machine learning methods can be implemented in a Bayesian framework (e.g. Chipman et al. 2010), which makes it possible to propagate the uncertainty associated with the first step – predicting goose numbers based on habitat types – to the estimates calculated for a wider region.

We defined habitat categories for each 100x100m pixel corresponding to a goose observation based on distance to the sea extracted from a digital elevation model (Norwegian mapping authorities), and proportions of built area, agricultural lands, heath, mountain, deciduous and non-deciduous forests (Johansen 2009; raster map available from Miljødirektoratets data-portal)). These proportions were calculated for different areas surrounding each pixel – distance of 0.5, 1, 5 and 10 km. All habitat variables were used to predict the number of greylag geese using the BART R package (Sparapani et al. 2021).

We tested the first step of the approach (modelling the number of graylag geese) on the data from Vesterålen area, by building a model based on observations obtained in 2016-2020 (see table) and using the 2021 observations as a out-of sample validation data set (while number of geese may vary from year to year, we want to test if habitat types could predict in a stable way where the geese are from year to year). Moreover, 2021 included randomly stratified observations, i.e. a more robust assessment of model validity.

Number of observations by year, Vesterålen region

2016	2017	2018	2019	2020	2021
79	80	133	35	95	224

The predictions for 2021 based on 2016-2020 data were relatively well correlated with the 2021 observations (R=0.49; log-scale). The next steps are 1) to do similar analyses for three other regions (Trøndelag; Vestfold/Østfold; Rogaland), 2) compare the predictive models between regions to assess if they can be used for larger areas, 3) use these models combined with proportions of habitat types for larger areas to derive estimates of greylag population size, and 4) new field registrations will be conducted in 2022 based on stratification based on the new habitat-categories and adjusted based on local knowledge of goose abundances.

The project is funded by the Norwegian Environment Agency.

References

Chipman, H. A., E. I. George, and R. E. McCulloch. 2010. BART: Bayesian additive regression trees. The Annals of Applied Statistics 4:266-298, 233.

Downes, M., and J. Carlin. 2020. Multilevel regression and poststratification for estimating population quantities from large health studies: a simulation study based on US population structure. Journal of Epidemiology and Community Health 74:1060-1068.

Downes, M., L. C. Gurrin, D. R. English, J. Pirkis, D. Currier, M. J. Spittal, and J. B. Carlin. 2018. Multilevel Regression and Poststratification: A Modeling Approach to Estimating Population Quantities From Highly Selected Survey Samples. American Journal of Epidemiology 187:1780-1790.

Johansen, B., et al. (2009). Vegetasjonskart for Norge basert på satellittdata. Tromsø, NORUT IT: 4/2009, 87pp.

Sparapani, R., C. Spanbauer, and R. McCulloch. 2021. Nonparametric Machine Learning and Efficient Computation with Bayesian Additive Regression Trees: The BART R Package. Journal of Statistical Software 97:1 - 66.

Summer counts of Greylag Goose in Denmark

Prepared by: Gitte Høj Jensen, EGMP Data Centre, Aarhus University

Project funded by: The Danish Environmental Protection Agency

Project website: https://projects.au.dk/can/projects/greylag-geese-count

Monitoring population abundance in Denmark in 2022

Currently Greylag Geese are counted in Denmark in start-August:

a. every 2. year as a partial count in protected areas designated for species whose occurrence peaks in August.

b. every 6. year during the NOVANA census (last time in 2018 with a total count of 111,337). This total count is a combination of counts from a plane (total counts in some areas and transect counts in other areas) as well landbased counts. Furthermore, the counts also including data/information from DOFbasen.

However, the two mentioned counts are not in itself sufficient to form the basis for a national population census, as it is carried out, especially in the years without nationwide census, only in selected bird protection areas designated for species whose occurrence peaks in August (eg spoonbills and splinters). In contrast to these species, the Greylag Geese are found everywhere in Denmark. In order for the NOVANA census to function as a method for estimating a national summer population of Greylag Geese, the census will have to be assisted with additional censuses at selected locations outside the bird protection areas.

During this project we will select additional location using a stratified random sampling method, and make the first total count of Greylag Geese during the first week of August 2022, thus no results are currently available.

Population Model for the NW/SW European Population of Greylag Geese

Prepared by: Fred A. Johnson, EGMP Data Centre, Aarhus University, Denmark

Project funded by: Danish Hunters' Nature Fund (Jægernes Naturfond)

We herein report on progress in building a flyway-level population model for assessing the implications of varying levels of sport harvest and derogation shooting for meeting population targets of greylag geese in western Europe.

There are two breeding management units for this population: MU1, which is centered in Scandinavia and is migratory, and MU2, which is centered in the Netherlands and neighboring countries and is largely sedentary. Birds from the two breeding units mix during the wintering season and we defined two wintering areas: one in the North, centered on the Netherlands, that harbors birds from MU1 and MU2, and one in the South, centered on France and Spain, that harbors mostly MU1 birds.

We constructed a post-breeding matrix model that recognizes three age classes (young, juveniles, and adults), that accounts for the spatial and temporal distribution of birds from the two management units, and that allows for offtake during both the breeding and wintering periods. The model was parameterized using basic life history information, although parameters can be updated as reliable monitoring data become available. We used the number of breeding pairs in each management unit that were reported in the International Single Species Management Plan (ISSMP) as a basis for initializing population sizes.

Once the model structure is deemed acceptable by the relevant range states, research will focus on investigating various strategies for coordinating offtake, with value assigned to strategies based on their ability to maintain target populations in the two management units and the costs of doing so.

A critical aspect of future work will be to define utility (i.e., stakeholder satisfaction) as a function of population size in the two management units relative to their targets. This will involve defining utilities for both management units individually and in the aggregate (e.g., the overall utility if one unit is near its target, but the other is not).

Funding for this study is graciously being provided by the Hunters' Nature Fund (Jægernes Naturfond; https://www.jaegernes-naturfond.dk).

Greylag goose modelling work progress report

Prepared by: Sander Moonen, Wageningen University, and Lisenka de Vries, NIOO, The Netherlands

Projects funded by: The Dutch Ministry of Agriculture, Nature & Food Quality

1. Estimating harvest rates for the greylag goose by combining methods

Proper implementation of adaptive management of populations subject to hunting or derogation shooting is only possible when reliable estimates are available for both the population size and offtake (Johnson & Koffijberg, 2021).

The greylag goose is huntable across large parts of the European Union, but the species is protected in the Netherlands and Belgium. However, this species may be killed for derogation, as long as the condition of the Birds Directive are met. As such, greylag geese belonging to the Northwest/Southwest European population are subjected to hunting or derogation throughout their flyway. Although the number of shot greylag geese in the EU should be reported yearly to the European Commission, reliable long-term estimates are currently not available for all range states (Powolny et al., 2018). In addition, based on the incompatibility between the currently available estimates for abundance and offtake, it can be assumed that either the reported abundance is biased low, the reported offtake is biased high, or both (Johnson & Koffijberg, 2021).

Because reliable offtake estimates are lacking, it is currently not possible to distinguish between natural mortality and additional mortality caused by harvest or derogation in the Integrated Population models that are being developed as part of the Adaptive Management Program for the Northwest/Southwest European population of the greylag goose.

In North-America, the Lincoln estimator is an often-used method to estimate population sizes and harvest rates of harvested species like ducks or geese (Eq. 1). In this method, harvest rates are estimated based on information of shot, marked birds, i.e. the number of newly banded birds that are shot during the following hunting season (Eq. 3) (Alisauskas et al., 2014; Lincoln, 1930). Because it is known that not all hunters will report bands from shot birds, this direct recovery rate is corrected with a reporting rate, i.e. the probability that a band from a bird shot or found dead will be reported (Eq. 2) (Henny & Burnham, 1976).

(Eq. 1)

$$N = \frac{H}{h}$$

N: Estimated population size.

H: Number of birds harvested from a population

h: Harvest rate. The proportion of the population that this harvest represents (Alisauskas et al., 2014).

(Eq. 2)

$$h = \frac{f}{r}$$

f: Direct recovery rate. The probability that a newly banded bird will be shot and its band reported during the next hunting season (Brownie et al., 1985).

r: reporting probability. The probability that a band from a bird shot or found dead during the hunting season is reported (Henny et al., 1976).

(Eq. 3)

$$f = \frac{R}{B}$$

R: Number of newly banded birds (B) that are shot during the first hunting season following banding, and then retrieved and reported.

B: Number of newly banded birds.

In North-America, the reporting rate is estimated using reward bands, which are not in use in Europe.

However, survival models based on mark-recapture data on recoveries of dead ringed individuals, such as the Seber dead recovery model or the Burnham joint live encounter/dead recovery model, give an estimation of the reporting rate, although here it is generally called the recovery probability (Burnham, 1993; Seber, 1970). This recovery or reporting probability is the probability that dead marked individuals are recovered and reported during each period between releases, and where death is not necessarily related to harvest.

Using a reporting rate estimated in a survival model to calculate harvest rates could potentially reduce the reporting bias in the harvest rate, especially the possible overestimation. Additionally, it is possible to estimate Management Unit specific reporting rates in survival models and as such Management Unit specific harvest rates can also be calculated.

Starting in 2023, Management Unit specific reporting rates will be estimated for the Northwest/Southwest European greylag goose flyway population using Seber dead recovery models (Seber, 1970). The mark-recapture data used for these survival models originates from the databank of the coordinating organisation for European bird ringing schemes, Euring, as well as the website geese.org, which facilitates the reporting of colour-ringed geese in Europe. This mark-recapture data will also be used to estimate the direct recovery rate, which can then be used, in combination with the reporting rate estimate in the survival model, to calculate a Management Unit specific harvest rate.

The calculated harvest rates can subsequently be used in the population models that are being developed for the Northwest/Southwest European flyway population.

2. Crippling rate

Geese can be shot by hunters without directly dying from the impact of the pellets, which is called crippling of the bird. The risk of crippling geese increases when shooting distances are over 25 meters, when inadequate gunshot is used or when hunters are inexperienced. Research towards the proportion of geese that are carrying gun pellets but are still alive (crippling rates), is part of the AFMP and strongly related to the 'wise-use' principle that hunters and AEWA endorse. It has a strong ethical component, and is therefore important for broader societal support for any given management scenario. In addition, data on crippling rates can be used to investigate crippling ratio which is the number of geese that are crippled for each successfully bagged (Clausen et al., 2017). Previous research has shown that crippling rates in barnacle geese from the Russian/Baltic population can be high on average 13% of adult birds (Holm & Madsen, 2013), especially for a species that is not listed in Annex II of the Birds Directive and that can only be hunted with a special derogation (e.g. in case of damage to crops).

During the breeding season of 2021 captured greylag geese were x-rayed in both the Netherlands and Sweden. For the assessment of crippling rates we determined whether an individual geese had one or more pellets embedded in it tissue (Figure X). When a pellet was clearly visible within the gastrointestinal tract we did not take it into account, as geese might swallow some metals during foraging.

Crippling rate was then calculated according to the following formula:

$$Crippling\ rate = \frac{Number\ of\ geese\ with\ imbeded\ shotgun\ pellets}{Number\ of\ geese\ x-rayed}\ x\ 100$$

Around 20% of X-rayed greylag geese where carrying shotgun pellets (Table X). During the coming years we will continue our crippling rate study and will collect samples at more locations within the Netherland and Sweden. We also plan to collect crippling rate data in other countries, including Germany.

Table 1: Crippling rates in the Netherlands and Sweden from moulting greylag that were caught during the breeding season.

Country	Catches	Total caught	X-rayed individuals	Crippling rate
Netherlands	6	118	26	22.03
Sweden	6	139	31	22.30

In addition to expanding our sample size and spatial coverage, we aim to investigate the influence of shotgun pellets on condition and survival of graylag geese. We do this by comparing the body conditions at capture of crippled geese with geese that where not carrying pellets in their tissue. Also, by catching at the same sites for multiple years we may be able to recapture crippled geese. This allow us to examine whether the number of pellets they are carrying has increased, and how their body condition may be affected over time as compared to uncrippled individuals. Ultimately it would be our goal to, together with hunting organizations, decrease the number of crippled geese.

Figure 1: Greylag goose carrying 15 shotgun pellets. The Netherlands 14-10-2019

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