Knowledge-update KEC5 density maps seabirds

Author: Susanne van Donk

Wageningen University &
Research report: C044/24

Knowledge-update KEC5 density maps seabirds

Author: Susanne van Donk

Wageningen Marine Research
Waardenburg Ecology

Wageningen Marine Research
IJmuiden, July 2024

Wageningen Marine Research rapport C044/24

Keywords: offshore windfarm assessment, seabirds

Client Rijkswaterstaat Water, Verkeer en Leefomgeving
Attn.: K. Portegies
Lange Kleiweg 34
2288 GK Rijswijk

This report can be downloaded for free from https://doi.org/10.18174/661977
Wageningen Marine Research provides no printed copies of reports

Wageningen Marine Research is ISO 9001:2015 certified.

Wageningen Marine Research, an institute within the legal entity Stichting Wageningen Research (a foundation under Dutch private law) represented by Drs.ir. M.T. van Manen, Director Operations

KvK nr. 09098104,
WMR BTW nr. NL 8113.83.696.B16.
Code BIC/SWIFT address: RABONL2U
IBAN code: NL 73 RABO 0373599285

A_4_3_2 V33 (2023)

Contents

1 Knowledge-update

This memo contains a knowledge update of the seabird maps that are used in the KEC5 project for further calculations on habitat loss and collision risk due to windmill parks. This includes a description of already existing maps that were used and a description of methods for the maps that were generated for this project; which datasets have been used and why, what data selection has been done, and a motivation for the choice of methods used.

The document starts with naming the different types of maps that were used and a motivation of the methodologies that were used. Then we explain which species are considered for KEC5 and why, followed by some more details on the different methods used.

2 Methods

2.1 Map types

2.1.1 Type of maps and their names

The maps for KEC5 are a combination of already existing maps generated by WMR (van Donk et al 2024), maps that were previously published in a scientific journal (Waggitt et al., 2020) and maps that were specifically generated for KEC5. The motivation for the use of the methodology for each of the maps will be given later on in this document. First, we clarify which types of maps were used and which names we use for them.

Separate maps were made of the Dutch part of the North Sea (national maps) and the international part of the North Sea (Southern and Central North Sea) (***Figure** 2-1*). Of the national area, we made maps using the method described by van Donk et al. (2024) and we generated maps using a method that is called 'Inverse Distance Weighting' (IDW) (Leopold et al., 2014). Respectively, these maps will be referred to as 'van Donk maps' and 'IDW national' throughout the document (***Figure** 2-1*). Of the international area, we generated maps using IDW and we used maps from the publication of Waggitt et al. (2020) (***Figure** 2-1*). Respectively, these maps will be referred to as 'IDW international' and 'Waggitt maps' throughout the document. For the Waggitt maps, the explanation of methods and datasets that were used can be found in the publication (Waggitt et al., 2020). The sections below are focused on the explanation of methods of the other three types of maps.

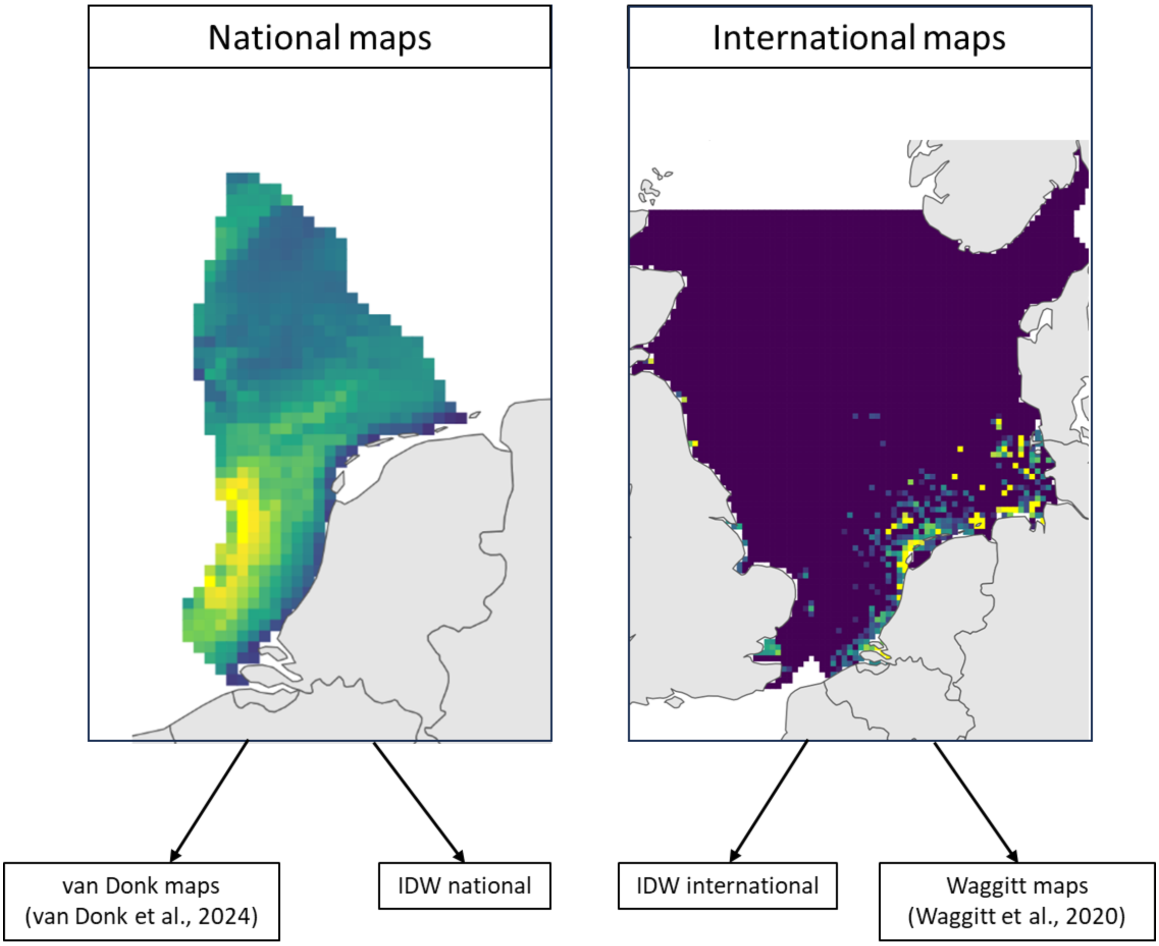

***Figure 2-1** Maps have been created of the Dutch part (National maps) and of the international part of the North Sea (Southern and Central North Sea). For the national area we created maps based on the methodology described by van Donk et al.* (van Donk et al., 2024) *and we generated maps using Inverse Distance weighting (IDW). For the international area we also generated maps using IDW and we used maps previously published by Waggitt et al. (2020).*

2.1.2 Motivation of the methodologies

2.1.2.1 National versus international

Maps based on different methodologies and datasets were created for the national and international areas because more detailed data is available for the national part of the sea. We did this, such that we could create maps based on recent data for the Dutch part of the sea and give a better representation of potential recent developments, in numbers or spatial distributions of the birds. This choice is explained in more detail under the heading ‘Datasets’ (section 2.3).

2.1.2.2 National modelling approach (van Donk maps) versus Inverse Distance Weighting (IDW national)

The van Donk maps are based on habitat suitability models. The method was developed with the aim to improve the maps used for KEC4 (Soudijn et al., 2022). In KEC4, ‘Inverse Distance Weighted’ interpolation (IDW) was used, which is a deterministic method that results directly from raw (averaged) counts (Leopold et al., 2014). A shortcoming of this method is that rare observations with high numbers of birds get a relatively large influence on the density at a certain location. This may occur when gulls are following a fishing vessel or when birds are attracted to an area with a large amount of prey, for instance during a ‘feeding frenzy’. Furthermore, ecological covariates that might explain the distribution of birds are not taken into account. The van Donk maps are an improvement on these issues and besides provide information on robustness and statistical uncertainty that cannot be provided with the IDW method.

For some species, there were not enough observations larger than zero (Great Skua) or there was not enough time to develop a habitat suitability model (Little gull, ‘comic tern’ (Arctic & Common Tern) and Arctic Skua). For these species, we used Inverse Distance Weighting (IDW national) (**Table 2-1**). More details on the methods and data selection of these type of maps can be found under the heading ‘Method national maps’ (section 2.4).

2.1.2.3 International modelling approach (Waggitt maps) versus Inverse Distance Weighting (IDW international)

The international maps were not developed using habitat suitability models. This decision was made because of the unbalanced data of the ESAS data (see for reasoning under the heading ‘Datasets’ (section 2.3) and Soudijn et al., 2022b, Figure 3-1. for an example of an effort map). However, international maps have recently been published that were based on the ESAS data and some other sources, based on a similar but slightly different modelling approach (Waggitt et al., 2020). These maps are comparable to the van Donk maps in terms of the methods used and were therefore considered an improvement compared to the IDW maps used in KEC4.

For some species, the Waggitt maps were not available. For these species, we used IDW (IDW international) (**Table 2-1**). More details on the methods and data selection of these types of maps can be found under the heading ‘Method international maps’ (section 2.5).

2.1.3 Similarities different map types

All maps that were created for KEC5 are on a 10 by 10 km grid, unlike the KEC4 maps which were projected on a 5 by 5 grid. The 10 by 10 grid was found to best fit the modelling approach (van Donk et al., 2024) and in addition, the Waggitt maps were also generated on a 10 by 10 grid.

2.2 Species selection – all maps

For KEC5, the following species were taken into account: Northern Gannet *(Morus bassanus)*, Herring Gull *(Larus argentatus)*, Lesser Black-backed Gull *(Larus fuscus)*, Great Black-backed Gull *(Larus marinus)*, Black-legged Kittiwake *(Rissa tridactyla)*, Little Gull *(Hydrocoloeus minutus)*, Sandwich Tern *(Thalasseus sandvicensis)*, Great Skua *(Stercorarius skua)*, Arctic Skua *(Stercorarius parasiticus)*, Razorbill *(Alca torda)* and Common Guillemot *(Uria aalge)*. Furthermore, a map has been provided for two species combined, the Arctic Tern *(Sterna paradisaea)* and the Common Tern *(Sterna hirundo)*, because these species cannot be distinguished individually during counts (**Table 2-1**).

Given the timetable, there was time to develop a map for one extra species; a choice had to be made between the Sandwich Tern and the Red-throated Diver *(Gavia stellata)*, Puffin *(Fratercula arctica)* and Northern Fulmar *(Fulmarus glacialis)*. In consultation with the commissioner, we developed maps for the Sandwich Tern and not for the Red-throated Diver, Puffin and Northern Fulmar. We chose the Sandwich Tern because the species is a breeding bird of the Netherlands that is mostly bound to coastal areas, but might have occasionally some non-breeding individuals foraging further at sea and is classified as sensitive to wind farms. A large part of the EU-population is breeding in the Netherlands (28%), and therefore, there is also a large international importance in protecting this species in the Netherlands (Natura 2000, 2008). The Red-Throated Diver is mainly seen along the coast not far at sea and is therefore expected to not be very prone to effects of at least the (planned) Dutch windfarms. Although, in international waters this species are expected to have a relatively high amount of casualties (Soudijn et al., 2022). The Puffin is a relatively rare species in the Dutch part of the sea. The Northern Fulmar is a common bird in the Dutch waters, but not a breeding bird of the Netherlands and therefore preference was given to the Sandwich Tern for KEC5 calculations. New national maps for the species Red-Throated Diver, Puffin and Northern Fulmar (van Donk or IDW national) will be developed later in 2024.

2.3 Datasets

2.3.1 Seabird datasets: ESAS & MWTL dataset

Two datasets were used for the density maps that we created (van Donk, IDW national and IDW international). The European Seabirds At Sea (ESAS) database includes mostly ship-based counts of seabirds in the greater North Sea. This dataset is managed and updated by the Brussels 'Instituut voor Natuur- en Bosonderzoek' (INBO). The 'Monitoring Waterstaatskundige Toestand des Lands' (MWTL) dataset holds aerial surveys covering the Dutch section of the North Sea. This dataset was requested from Waardenburg Ecology. For more in depth information on how data is gathered for the ESAS and MWTL datasets we refer to previous studies (Camphuysen et al., 2004; Fijn et al., 2020; van Roomen et al., 2013).

The ESAS database is collated from surveys with a wide variety of objectives (See European Seabirds At Sea (ESAS). ICES, Copenhagen, Denmark. https://esas.ices.dk). In most (standard) surveys, all species encountered were counted. However, some surveys targeted specific species or groups of species. The MWTL dataset is more consistent, as surveys have been conducted in six months over the course of the year in a standardized way. This standardized method and the survey design have been adjusted in 2014. After this change, the lower flying height allowed identification to species level of almost all groups, including Common Guillemot and Razorbill. In addition, the more extensive survey transects design resulted in a more even spread of survey effort across the Dutch continental shelf compared to the survey design before 2014.

After the exploratory analysis in van Donk et al (2024), we decided to only include MWTL data in the analysis for the national van Donk maps and the IDW national maps. This decision was made because of the unbalanced nature of the ESAS data; there is almost no data for the last 10-15 years outside the Dutch part of the North Sea, (see Soudijn et al., 2022b, Figure 3-1. for an example of an effort map). Furthermore, the differences in observation method within the ESAS dataset bring along problems with analysis (ship versus airplane, incidental versus consistent). For instance, some birds are attracted to ships (gull species), while this is not the case with aerial surveys. As said, the ESAS database is collated from surveys with all kinds of different objectives while the MWTL dataset is more consistent as counts have been conducted in six months over the course of the year in a standardized way. Finally, there was also the wish to include a time period in the model for later use in KEC5, to be able to give a better representation of potential recent developments, in numbers or spatial distributions of the birds. This is only possible with the consistent MWTL dataset, as the ESAS dataset has too many gaps/almost no data in especially the latest 10-20 years. Using only the MWTL data, we were able to make national maps (van Donk & IDW national) that are based on more recent and consistently gathered data, while we used more historical data for the IDW international maps to ensure enough coverage in international waters. The data selection for the different maps are further explained below.

2.3.2 Preparation of dataset

From the databases, we selected counts with a valid geographical position (latitude and longitude) and a non-zero sampled surface area. Each count was assigned to a bimonthly period: December-January, February-March, April-May, June-July, August-September and October-November.

Preparation of the dataset for the van Donk, IDW national and IDW international maps has been done as described in van Donk et al. (2024). Preparation included a distance sampling analysis, which is a statistical technique that accounts for the lower detection of birds that are at greater distance from the observer or, in the case of ship-based and aerial surveys of seabirds at sea, the transect line (Buckland et al. 2004, 2015). For each species, only survey campaigns were included where the species was included in the target taxa (species were occasionally excluded for various other reasons for instance when counting from an active fishing vessel, which attracts large numbers or gulls). For some species, identification is not always straightforward and when not identified to species level, they were registered as a species group. For example, Razorbill and Common Guillemot are morphologically similar and are often registered as being one of the two species. The same applies to large gulls. The percentage of individuals not identified to species level can be substantial in these surveys. Excluding unidentified birds would therefore lead to an underestimation of the focal species. Therefore, unidentified birds were divided over the relevant species according to their relative abundance among identified individuals of that species group recorded on that same date in the same survey.

Transects were divided in more even segments. This step is mostly relevant for the IDW international maps as for these maps the ESAS database as a whole is used. The correction of segment length was done to correct for large difference in sampling method. This can cause problems in the analysis, when some surveys use for instance monitoring-segments of every minute compared to segments of every 10 minutes. The first campaign creates more datapoints and could therefore have a bigger weight in the analysis. Dividing the transects differed between survey campaigns and methods. Ship-based surveys with intervals shorter than 5 minutes were resampled to 5-minute intervals. Aerial surveys with short intervals were resampled to 1-minute intervals. The effectively surveyed area per transect segment was calculated as the segment length multiplied by the effective strip width multiplied by the number of sides of the ship or airplane where was counted.

All analyses were performed using R (R Core Team, 2024).

2.4 Method national maps (van Donk and IDW national)

For the national maps (van Donk and IDW national), only data of MWTL was used (section 2.1.2). The van Donk maps were developed for eight species using a statistical model (van Donk et al., 2024) (***Table 2-1***). This model can be used to distinguish between time periods of 5 years, in order to take into account changes in numbers or distribution over time. For Northern Gannet, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Black-legged Kittiwake and Sandwich Tern the same maps were used as described by van Donk et al. (2024) for the time period 2016-2020. For the Razorbill and Common Guillemot, the models described by van Donk et al. (2024) were adjusted from a one year to a five year period and maps were generated for the time period from 2016 to 2020 (***Table 2-1***). Originally, we chose for a one year period because we wanted to study possible changes in densities over time and there was only reliable data within the MWTL database available from 2014 onwards for these species due to a change in counting method. To have similar maps for every species in KEC5, a model with a time period of 5 years was generated for the Razorbill and Common Guillemot in the current project, with the same covariates as described in van Donk et al. (2024).

IDW national maps were generated for the species "comic tern" (combination of Arctic & Common Tern), Little Gull, Arctic Skua and Great Skua (***Table 2-1***). Initially, a van Donk map would be generated for the Great Skua as well, but there were not enough observations available (values greater than zero) to run a model (***Table 2-1***)(van Donk et al., 2024). No van Donk maps have been developed for the other species, because of a lack of time. IDW national maps have been developed using inverse distance weight per 5-year time period on a 10 by 10 km grid (Soudijn et al., 2022; van Donk et al., 2024). IDW was performed with the R package gstat (Gräler et al., 2016; Pebesma, 2004). The following settings were used: the inverse distance weighting power (idp) was set to a value of 2. The minimum number of observations (nmin) for predicting density was set to 5 and the maximum number of observations (nmax) to 15; to predict density, 5-15 observations were used at a specific location. These settings correspond to the settings used for the maps created for KEC 4 (Soudijn et al., 2022). However, the data were not averaged per year and bimonthly period. The time period for the IDW national maps is the same as for the most recent van Donk maps (time period from 2016-2020) to make the maps as representative as possible given potential changes in species distributions in recent years.

Table 2-1 Species within KEC5 and the type of map used for international and national scenarios

Species	Type map national/ Bron	Time period	Type map international/ Bron	Time period
Northern Gannet	van Donk maps (van Donk et al., 2024)	2016-2020	*Waggit maps (Waggitt et al. 2020)*	*1980-2018*
Herring Gull	van Donk maps (van Donk et al., 2024)	2016-2020	*Waggit maps (Waggitt et al. 2020)*	*1980-2018*
Lesser Black-backed Gull	van Donk maps (van Donk et al., 2024)	2016-2020	*Waggit maps (Waggitt et al. 2020)*	*1980-2018*
Great Black-backed Gull	van Donk maps (van Donk et al., 2024)	2016-2020	IDW international	1990-2020
Black-legged Kittiwake	van Donk maps (van Donk et al., 2024)	2016-2020	*Waggit maps (Waggitt et al. 2020)*	*1980-2018*
Little Gull	IDW national	2016-2020	IDW international	1990-2020
Sandwich Tern	van Donk maps (van Donk et al., 2024)	2016-2020	IDW international	1990-2020
"comic tern" Arctic & Common Tern	IDW national	2016-2020	IDW international	1990-2020
Arctic Skua	IDW national	2016-2020	IDW international	1990-2020
Great Skua	IDW national (van Donk et al. 2024)	2016-2020	*Waggit maps (Waggitt et al. 2020)*	*1980-2018*
Razorbill	van Donk maps (van Donk et al., 2024)+ adjustment	2016-2020	*Waggit maps (Waggitt et al. 2020)*	*1980-2018*
Common Guillemot	van Donk maps (van Donk et al., 2024)+ adjustment	2016-2020	*Waggit maps (Waggitt et al. 2020)*	*1980-2018*
Northern Fulmar	Not in KEC 5			
Puffin	Not in KEC 5			
Red-throated Diver	Not in KEC 5			

2.5 Method international maps (Waggitt and IDW international)

For the international scenarios, the Waggitt maps were used where possible Waggitt et al. (2020) (**Table 2-1**). The publication by Waggit et al. (2020) contains density maps based on observational data between 1980 and 2018. These maps cover a long period of data. During this period seabird populations have changed considerably. Possible spatial shifts in the use of the sea may therefore be underexposed in these maps.

The publication by Waggitt et al. (2020) does not provide international maps for the Great Black-backed Gull, the Little Gull, the combination of Arctic/Common Tern, the Sandwich Tern and the Arctic Skua (**Table 2-1**). For these species, we developed IDW international maps based on the ESAS and MWTL data. We selected data from 1991 onwards – this selection includes relatively old data, but older data is needed to ensure enough data for the international part of the North Sea. Maps were then developed with IDW on a 10 by 10 km grid. IDW was performed in the same way as for the IDW national maps (section 2.4). For some species, calculated local densities tend to be too high due to clumping behavior behind fishing vessels (Leopold et al., 2014). To correct slightly for these patterns, peak observations of larger than 10 birds/km^2 were corrected (for details, see Soudijn et al., 2022); peak densities were spread over 5*5 grid cells around the peak observation which coincides with a surface of 50*50km. This was only done for the Great Black-backed Gull as the other species with IDW international maps do not show considerable clumping behavior behind vessels.

2.6 Uncertainty analysis

The van Donk maps were provided with a margin of uncertainty regarding the model results. This can at least indicate spatially whether bird density in certain places are quite reliable or less reliable. A standard deviation and a 'coefficient of variation' have been added to the maps per grid cell. The standard deviation is a statistic that measures the dispersion of a data set relative to the mean. It can be used to compare the variation (dispersion) of one data set. When we want to compare two or more data sets with each other, for example when a comparison in distribution is made between different bimonthly periods within one species or between species, the coefficient of variation is used. The coefficient of variation is calculated as the ratio of the standard deviation to the mean. Both measures can be used, for example, to calculate a lower and upper limit of densities.

3 Updating maps in future

National maps (van Donk or IDW national) will soon be developed within the Wozep program using the model approach (van Donk maps) for the species Northern Fulmar, Puffin and Red-throated Diver. This will create more unity within KEC between the maps used for the Dutch part of the sea.

All maps developed by WMR (van Donk, IDW national, IDW international) can be updated when new MWTL data or ESAS data is available using the developed scripts. New models can also be developed when new or better covariates become available (such as fishing intensity or prey density, or the relationship between different seabird species, see discussion by Donk et al. 2024). It will then also be possible to reassess whether the choice of model used and model selection is still appropriate or whether new scientific insights have been developed within the scientific community. One possibility, for example, is to run two or more models with different model techniques and then take an average of the results of these models for the density per grid cell (Oppel et al., 2012; Woodman et al., 2019).

The maps of the international part of the sea remain a point of attention. The biggest problem is still that there is little recent data available.

Making maps using a model provides the opportunity to study the relationship between seabird density and a range of covariates. However, a full evaluation of the model results was beyond the scope of previous projects. Future studies could therefore focus on understanding and testing the outputs of the models to inform studies on more specific relationships of seabird densities with their environment. Improved or higher quality covariates could help. Studying the links between environment and seabird density is important for our understanding of the predictability and variation in seabird distributions in the North Sea, which can influence decisions around protecting seabird populations.

4 Quality Assurance

Wageningen Marine Research utilises an ISO 9001:2015 certified quality management system. The organisation has been certified since 27 February 2001. The certification was issued by DNV.

References

Camphuysen, C.J., Fox, A.D., Leopold, M.F., Krag Petersen, I., 2004. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K. Environmental Research Institute, COWRIE – BAM- 02-2002.

Fijn, R.., van Bemmelen, R.S.A., de Jong, J.W., Arts, F.A., Beuker, D., Bravo Rebolledo, E.L., Engels, B.W.R., Hoekstein, M., Jonkvorst, R.-J., Lilipaly, S., Sluijter, M., Van Straalen, K.D., Wolf, P.A., 2020. Verspreiding en abundantie van zeevogels en zeezoogdieren op het Nederlands Continentaal Plat in 2019-2020, RWS-Centrale Informatievoorziening BM 20.22. Bureau Waardenburg Rapportnr. 20-324. Bureau Waardenburg & Deltamilieu Projecten, Culemborg.

Leopold, M.F., Boonman, M., Collier, M.P., Davaasuren, N., Fijn, R.C., Gyimesi, A., Jong, J. de, Jongbloed, R.H., Poerink, B.J., Kleyheeg-Hartman, J.C., Krijgsveld, K.L., Lagerveld, S., Lensink, R., Poot, M.J.M., Wal, J.T. van der, Scholl, M., 2014. A first approach to deal with cumulative effects on birds and bats of offshore wind farms and other human activities in the Southern North Sea, IMARES Report C166/14.

Natura 2000, 2008. Profielschets grote stern (Sterna sandvicensis) A191 [WWW Document]. https://www.natura2000.nl/sites/default/files/profielen/Profielen_Vogels_Actueel/Profiel_vogel_A191.pdf.

Oppel, S., Meirinho, A., Ramírez, I., Gardner, B., O'Connell, A.F., Miller, P.I., Louzao, M., 2012. Comparison of five modelling techniques to predict the spatial distribution and abundance of seabirds. Biol. Conserv. 156, 94–104. https://doi.org/10.1016/j.biocon.2011.11.013

R Core Team, 2024. A Language and Environment for Statistical Computing_. R Foundation for Statistical Computing, Vienna, Austria [WWW Document]. https://www.R-project.org/.

Soudijn, F.H., van Donk, S., Leopold, M.F., van der Wal, J.T., Hin, V., 2022. Cumulative population-level effects of habitat loss on seabirds 'Kader Ecologie en Cumulatie 4.0.' Wageningen Mar. Res. Rep. C007/22.

van Donk, S., van Bemmelen, R., Chen, C., Tulp, I., Melis, E., 2024. Seabird maps of the North Sea. Wageningen Univ. Res. Rep. C024/24.

van Roomen, M., Stahl, J., Schekkerman, H., van Turnhout, C., Vogel, R., 2013. Advies ten behoeve van het opstellen van een monitoringplan voor vogels in het Nederlandse Noordzeegebied, Sovon-rapport 2013/22.

Waggitt, J.J., Evans, P.G.H., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J., Felce, T., Fijn, R.C., Garcia-Baron, I., Garthe, S., Geelhoed, S.C.V., Gilles, A., Goodall, M., Haelters, J., Hamilton, S., Hartny-Mills, L., Hodgins, N., James, K., Jessopp, M., Kavanagh, A.S., Leopold, M., Lohrengel, K., Louzao, M., Markones, N., Martínez-Cedeira, J., Ó Cadhla, O., Perry, S.L., Pierce, G.J., Ridoux, V., Robinson, K.P., Santos, M.B., Saavedra, C., Skov, H., Stienen, E.W.M., Sveegaard, S., Thompson, P., Vanermen, N., Wall, D., Webb, A., Wilson, J., Wanless, S., Hiddink, J.G., 2020. Distribution maps of cetacean and seabird populations in the North-East Atlantic. J. Appl. Ecol. 57, 253–269. https://doi.org/10.1111/1365-2664.13525

Woodman, S.M., Forney, K.A., Becker, E.A., DeAngelis, M.L., Hazen, E.L., Palacios, D.M., Redfern, J. V., 2019. esdm: A tool for creating and exploring ensembles of predictions from species distribution and abundance models. Methods Ecol. Evol. 10, 1923–1933. https://doi.org/10.1111/2041-210X.13283

Justification

Report: C044/24
Project Number: 4315100223

The scientific quality of this report has been peer reviewed by a colleague scientist and a member of the Management Team of Wageningen Marine Research

Approved: Floor Soudijn
Researcher

Signature: DocuSigned by:
Floor Soudijn
A5970146C9B44A8...

Date: 9 July 2024

Approved: Dr. A.M. Mouissie
Business Manager Projects

Signature: DocuSigned by:
291E7A4CA7DB419...

Date: 9 July 2024

Wageningen Marine Research
T +31 (0)317 48 09 00
E imares@wur.nl
www.wur.nl/marine-research

Visitors'adress
- Ankerpark 27 1781 AG Den Helder
- Korringaweg 7, 4401 NT Yerseke
- Haringkade 1, 1976 CP IJmuiden

With knowledge, independent scientific research and advice, **Wageningen Marine Research** substantially contributes to more sustainable and more careful management, use and protection of natural riches in marine, coastal and freshwater areas.

The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 7,600 employees (6,700 fte) and 13,100 students and over 150,000 participants to WUR's Life Long Learning, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.