Hornsea Project Four

Revised Ornithology Baseline (tracked)

Deadline: 5a, Date: 04 July 2022
Document Reference: G5.9
Revision: 02

Prepared	APEM Ltd, June 2022
Checked	Faye McGinn, Orsted, July 2022
Accepted	Hannah Towner-Roethe, Ortsed, July 2022
Approved	Julian Carolan, Orsted, July 2022

G5.9
Ver. no. A

Revision Summary

Rev	*Date*	*Prepared by*	*Checked by*	*Approved by*
01	08/06/2022	APEM Ltd	Faye McGinn, Orsted, June 2022	Julian Carolan, Orsted, June 2022
02	28/06/2022	APEM Ltd	Faye McGinn, Orsted, July 2022	Julian Carolan, Orsted, July 2022

Revision Change Log

Rev	*Page*	*Section*	*Description*
02	Page 14	Table 1	Amendment to Table 1 and additional information added at the request of Natural England

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Glossary

Term	Definition
Auto-correlation	Data containing systemic variation; for example, spatial variation and is seen by sites close to each other having more similar values.
Bootstrapping	Tests that use random sampling with replacement to assign measures of accuracy to sample estimates.
Bio-season	Bird behaviour and abundance is recognised to differ across a calendar year, with particular months recognised as being part of different seasons. The biologically defined minimum population scales (BDMPS) bio-seasons used in this report are based on those in Furness (2015), hereafter referred to as bio-seasons.
Coefficient of Variation	A statistical measure of the distribution of data points around the mean.
Confidence intervals	Range of values that with a specified certainty contains the true mean of the population that a sample was taken from. For example, 95% confidence intervals states a range of values with a 95% certainty those values contain the population mean.
Design-based Abundance Estimates	An estimated total abundance of identified targets (in the case of this report gannets) within a given area ("design- based" because the approach relies on the survey design providing representative sampling and assuming transects can be considered independent samples from a uniform distribution) based on the raw observations recorded within a survey.
Displacement	The potential for birds and other animals to avoid an area due to the presence of the wind turbines or from vessel activity.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
MRSea	Statistical package to model spatial count data and predict spatial abundances; developed by the Centre for Research into Ecological and Environmental Modelling (CREEM) specifically for dealing with data collected for offshore wind farm projects.

Acronyms

Term	Definition
1D	One-dimensional
2D	Two-dimensional
AFL	Agreement for Lease
ANOVA	Analysis of Variance
BDMPS	Biologically Defined Minimum Population Scale
CREEM	Centre for Research into Ecological and Environmental Modelling
CI	Confidence Interval
CV	Coefficient of Variation
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ETG	Expert Topic Group
ExA	Examining Authority
FFC	Flamborough and Filey Coast
GLM	Generalised Linear Model
JNCC	Joint Nature Conservation Committee
MRSea	Marine Renewables Strategic environmental assessment
RIAA	Report to Inform Appropriate Assessment
SPA	Special Protection Area

1 Introduction

1.1.1.1 Following Natural England's submissions for Deadline 3 and 4, the Examining Authority (ExA) issued a Rule 17 letter to the Applicant **(PD-010)**. The letter was submitted in relation to Natural England's opinion that the original MRSea v1 model-based estimates are not fit for purpose and cannot be reliably used to inform the assessment of impacts within the Environmental Impact Assessment (EIA) or the Report to Inform Appropriate Assessment (RIAA), potential compensation requirements or future cumulative or in-combination assessments **(REP4-055)**. This is despite the Applicant presenting a revised MRSea_V2 baseline and assessments for gannet that resulted in a difference of less than two birds per annum at the EIA level and significantly less than one breeding adult for impacts apportioned to the FFC SPA, as detailed within **G4.13 Comparative Gannet Assessment (REP4-047)**.

1.1.1.2 Furthermore, the MRSea v2 that was undertaken and presented by the Applicant followed Natural England's advice in relation to MRSea reanalysis, which was to consult and follow the recommendations from the Centre for Research into Ecological and Environmental Modelling (CREEM), as detailed within **G2.10 MRSea Baseline Sensitivity Report (Gannet) (REP3-029)**. Following the MRSea v2 Natural England raised further concerns in relation to the 'best fit' model producing 12 months of data not 24 months as commonly used for assessments **(REP4-055)**, though the Applicant has since consulted on this with Natural England in a meeting on 25th May and developed a working method to complete a revised baseline and set of assessments.

1.1.1.3 Natural England suggested that the Applicant should consider the following options for satisfying their concerns in relation to baseline characterisation:

1. The Applicant should provide design-based estimates for all species where model based analyses have been used in the current assessment. We note that this should not require any significant additional resource from the Applicant. This is to i) allow comparison with model-based outputs, and ii) to provide a fallback option where modelling is not possible due to time constraints."

2. For gannet, revise the modelling to include 'survey' or 'year/month' as the only possible temporal variables. This would provide individual survey estimates that can be used in both displacement and collision risk assessments. Alternatively, if this is not possible in time to provide updated assessments at Deadline 5, we would recommend the use of the MRSea_v2 estimates for the collision risk assessment and design-based estimates for displacement."

3. In order of priority, for kittiwake, common guillemot (Uria aalge) and razorbill (Alca torda), provide updated model-based estimates using the revised approach set out in 2. Alternatively, if this is not possible in time to provide updated assessments at Deadline 5, we would recommend the use of design-based estimates for the collision risk and displacement assessments respectively."

4. For completeness, use design-based estimates for all other species where the MRSea_v1 model-based estimates have been used."

1.1.1.4 In order to fully align with Natural England's request, the Applicant has undertaken revised MRSea v2 modelling for **Kittiwake**, **Guillemot** and **Razorbill**, of which the 'best fit' modelling results are presented within this report. A separate request from Natural England was to

present design-based abundance estimates for all seven species (**Fulmar**, **Gannet**, **Great black-backed gull**, **Kittiwake**, **Guillemot**, **Razorbill** and **Puffin**) previously assessed using MRSea_V1, which are also presented within this report in full.

2 Methodology

2.1 Methodology for Revised MRSea Modelling

2.1.1.1 In line with the approach agreed with Natural England, during a consultation meeting on the 25th May 2022, MRSea v2 analysis was performed for the remaining key species where possible (kittiwake, guillemot and razorbill) following the best practice guidance in Scott-Hayward et al. (2017). The initial stages of the re-building and testing process for the revised MRSea v2 modelling also accounts for the comments provided in the CREEM Statistical Review of Hornsea Project Four: Environmental Statement for Natural England (presented within the **MRSea Baseline Sensitivity Report (Gannet) (REP3-029)**).

2.1.1.2 The source of the site-specific offshore ornithology data for use in the MRSea v2 modelling was the aerial digital video surveys conducted by HiDef over 24 months from April 2016 to March 2018 across the Hornsea Four AfL area plus 4 km buffer. The full Hornsea Four AfL plus 4 km buffer data were used to extract locations and counts of birds recorded, with the use of the wider full survey data ensuring the models were as accurate as possible, as utilisation of the maximum amount of data available across the largest area available ensured that any relationships between environmental variables and gannet density had the greatest opportunity to be recognised and integrated as possible. Shapefiles of observations and transect lines from each survey were supplied by HiDef. The footprint of each survey was estimated from the transect line shapefile by assuming a 125m image half-width, as specified by HiDef, and generated using the MMQGIS Create Buffer tool within QGIS (QGIS Version 3.10.5; MMQGIS version 2020.1.16). Observation and transect shapefiles were clipped to the Hornsea Four Agreement for Lease (AfL) area plus 4 km buffer.

2.1.1.3 A regular grid of 1x1km squares covering the Hornsea Four AfL plus 4 km buffer was generated using the "Create grid" tool within QGIS. The transect footprints were intersected with this grid to produce a shapefile of transect segments for each survey.

2.1.1.4 The three environmental variables considered for modelling were; distance to coast, distance to the Flamborough and Filey Coast Special Protection Area (FFC SPA) and water (sea) depth. These environmental variables were selected on the basis of having a biologically plausible relationship with the spatial distribution of focal species and were agreed as suitable in ETG#13. For each transect segment, distance to coast, distance to FFC SPA, and depth were calculated within R (R Core Team, 2020) as follows. The distance to coast was measured in kilometres from the centroid of each transect segment to the nearest point on the coast based on a publicly available shapefile of coastlines and using the st_nearest_points function in the sf package (Pebesma, 2018). The distance to FFC SPA was measured in kilometres from the centroid of each transect segment to the centroid of FFC SPA, based on the SPA shapefile available from JNCC (2021). The depth of each transect segment was calculated as the area-weighted mean depth in metres within each transect segment using the OceanWise Bathymetry raster. The coordinates of the centroid of each

transect segment in UTM zone 31N (EPSG:32631) were added as variables named "x.pos" and "y.pos".

2.1.1.5 The same approach was taken to assign a distance to coast, distance to FFC SPA, depth, x.pos and y.pos to each grid cell of the 1x1km grid, to be used as the prediction grid.

2.1.1.6 Observations of birds were assigned to each transect segment using a spatial join with the join term set to "nearest". This accommodates minor discrepancies between the observation shapefile and the transect footprints. The number of birds per transect segment was then extracted and added to the transect shapefile. The survey month was extracted from the date field present within the transect line shapefile, and a field for bio-seasons was created based on the survey month and the definitions of bio-seasons for each species presented in **A2.5 Environmental Statement Volume A2 Chapter 5 Offshore and Intertidal Ornithology (APP-017)**. The transect shapefile was then converted into a data frame for use as input to the subsequent modelling.

2.1.1.7 All subsequent modelling was carried out in R (R Core Team, 2020) using MRSea version 1.3.

2.1.1.8 Details of the modelling undertaken are presented in **Appendix A**, **Appendix B** and **Appendix C**. This includes full details of the final best model, along with other candidate models considered and justification for the model choice.

2.2 Methodology for Revised Design-based Abundance Estimation

2.2.1.1 Design-based abundance estimates were also calculated for the seven species where MRSea_V1 was previously used for baseline characterisation (fulmar, gannet, kittiwake, great black-backed gull, guillemot, razorbill and puffin). The methodology followed for design-based abundance estimation, including derivation of and apportionment of unidentified species groups and the correction factor for availability bias (for auk species) is described in **Section 3.4 of A2.5 Environmental Statement Volume A2 Chapter 5 Offshore and Intertidal Ornithology (APP-017)**.

2.3 Age Classification

2.3.1.1 Knowledge of the different ages of each species of bird present within the proposed area for an offshore wind farm can contribute to the assessment of the significance of potential impacts. This can include consideration of whether any potential impact(s) might occur to an adult bird that is part of the breeding population of a specific colony or designated site (an SPA) or if it might occur to an immature bird that is not associated with the breeding population of a particular colony or SPA

2.3.1.2 A detailed breakdown of seabird age classification for key seabirds (gannet, kittiwake, guillemot and razorbill) recorded in the site-specific aerial digital video surveys for the Hornsea Four AfL plus 4 km buffer is presented in **Table 34**, providing the largest dataset available for characterising age classification. The approximate age of seabirds has been categorised as follows: adult, immature and juvenile. It should be noted however, that the number of birds recorded as adult is likely to be overinflated, due to adult and immature plumage being indistinguishable for certain age groups for some species, as detailed in **G4.7 Ornithological Assessment Sensitivity Report (REP4-041)**.

3 MRSea Abundance Results

3.1 Gannet

Table 1: Gannet MRSea_V2 abundance estimates for the DCO array area including apportionment of unidentified species groups.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including	Final Density (birds/km2)
Jan	11.75	2.71	62.84	10.49	0.00	11.75	0.03	11.7529.53	2.7112.94	62.8471.04	0.00	11.75	0.03	0.0014.76	0.006.47	0.0035.52	0.00	-	-
Feb	15.78	5.01	64.99	0.62	0.00	15.78	0.03	15.7844.83	5.0110.15	64.99288.93	0.00	15.78	0.03	0.0076.86	0.0017.40	0.00495.31	0.00	-	-
Mar	163.02	78.07	352.44	0.27	0.00	163.02	0.35	84.14212.10	40.29119.71	181.91375.92	0.00	84.14	0.18	78.88308.51	37.77174.12	170.54546.79	0.00	78.88	0.17
Apr	44.29	19.41	106.56	0.34	0.00	44.29	0.09	29.53209.58	12.94114.56	71.04390.35	0.00	29.53	0.06	14.7695.26	6.4752.07	35.52177.43	0.00	14.76	0.03
May	121.69	27.55	784.24	1.22	0.00	121.69	0.26	44.83184.32	10.15104.71	288.93332.19	0.00	44.83	0.10	76.8641.47	17.4023.56	495.3174.74	0.00	76.86	0.16
Jun	520.61	293.82	922.70	0.17	0.00	520.61	1.11	212.1072.97	119.7139.25	375.92141.75	0.00	212.10	0.45	308.5187.56	174.1247.10	546.79170.09	0.00	308.51	0.66
Jul	304.84	166.63	567.78	0.18	0.00	304.84	0.65	209.5878.33	114.5639.37	390.35168.51	0.00	209.58	0.45	95.26255.87	52.07128.62	177.43550.48	0.00	95.26	0.20
Aug	225.80	128.26	406.94	0.16	0.00	225.80	0.48	184.32301.12	104.71163.01	332.19546.92	0.00	184.32	0.39	41.47257.32	23.56139.30	74.74467.37	0.00	41.47	0.09
Sept	160.52	86.34	311.84	0.20	0.00	160.52	0.34	72.9772.71	39.2530.11	141.75191.40	0.00	72.97	0.16	87.56106.93	47.1044.28	170.09281.47	0.00	87.56	0.19
Oct	334.20	167.99	718.99	0.19	10.00	344.20	0.74	78.3311.75	39.372.71	168.5162.84	0.00	78.33	0.17	255.870.00	128.620.00	550.480.00	10.00	265.87	0.57
Nov	558.44	302.31	1014.28	0.18	0.00	558.44	1.19	301.1215.78	163.015.01	546.9264.99	0.00	301.12	0.64	257.320.00	139.300.00	467.370.00	0.00	257.32	0.55
Dec	179.64	74.40	472.87	0.32	0.00	179.64	0.38	72.7184.14	30.1140.29	191.40181.91	0.00	72.71	0.16	106.9378.88	44.2837.77	281.47170.54	0.00	106.93	0.23

Table 2: Gannet MRSea_V2 abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)
Jan	27.02	6.28	140.08	14.52	0.00	27.02	0.04	27.02	6.28	140.08	0.00	27.02	0.04	0.00	0.00	0.00	0.00	0.00	0
Feb	28.22	9.92	99.76	0.62	0.00	28.22	0.04	28.22	9.92	99.76	0.00	28.22	0.04	0.00	0.00	0.00	0.00	0.00	0
Mar	219.35	105.31	473.77	0.28	0.00	219.35	0.33	99.70	47.87	215.35	0.00	99.70	0.15	119.64	57.44	258.42	0.00	119.64	0.18
Apr	62.71	28.00	147.91	0.33	0.00	62.71	0.09	43.89	19.60	103.54	0.00	43.89	0.07	18.81	8.40	44.37	0.00	18.81	0.03
May	195.05	44.77	1222.80	1.42	0.00	195.05	0.29	67.97	15.60	426.13	0.00	67.97	0.10	127.08	29.17	796.67	0.00	127.08	0.19
Jun	730.57	411.23	1304.05	0.17	0.00	730.57	1.10	305.60	172.02	545.49	0.00	305.60	0.46	424.97	239.21	758.57	0.00	424.97	0.64
Jul	468.70	252.79	889.31	0.18	0.00	468.70	0.71	319.57	172.35	606.35	0.00	319.57	0.48	149.13	80.43	282.96	0.00	149.13	0.22
Aug	357.68	205.75	637.59	0.16	0.00	357.68	0.54	293.10	168.60	522.47	0.00	293.10	0.44	64.58	37.15	115.12	0.00	64.58	0.10
Sept	245.54	133.09	473.29	0.19	0.00	245.54	0.37	118.05	63.99	227.54	0.00	118.05	0.18	127.49	69.11	245.75	0.00	127.49	0.19
Oct	494.19	251.45	1056.80	0.18	10.00	504.19	0.76	107.23	54.56	229.31	0.00	107.23	0.16	386.96	196.89	827.50	10.00	396.96	0.60
Nov	750.99	409.21	1364.20	0.19	0.00	750.99	1.13	402.53	219.34	731.21	0.00	402.53	0.61	348.46	189.88	632.99	0.00	348.46	0.52
Dec	282.03	118.11	742.10	0.30	0.00	282.03	0.42	117.81	49.34	309.99	0.00	117.81	0.18	164.22	68.77	432.11	0.00	164.22	0.25

Table 3: Gannet MRSea_V2 abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)
Jan	52.37	12.27	267.38	18.52	0.00	52.37	0.06	52.37	12.27	267.38	0.00	52.37	0.06	0.00	0.00	0.00	0.00	0.00	0
Feb	43.22	15.96	140.10	0.71	0.00	43.22	0.05	37.04	13.68	120.08	0.00	37.04	0.04	6.17	2.28	20.01	0.00	6.17	0.01
Mar	276.19	132.06	598.74	0.27	0.00	276.19	0.31	106.60	50.97	231.09	0.00	106.60	0.12	169.59	81.09	367.65	0.00	169.59	0.19
Apr	84.86	38.84	195.47	0.32	0.00	84.86	0.10	53.04	24.28	122.17	0.00	53.04	0.06	31.82	14.57	73.30	0.00	31.82	0.04
May	281.72	65.08	1712.61	1.80	0.00	281.72	0.32	104.46	24.13	635.01	0.00	104.46	0.12	177.26	40.95	1077.60	0.00	177.26	0.20
Jun	949.07	533.42	1702.97	0.16	0.00	949.07	1.07	421.24	236.76	755.86	0.00	421.24	0.48	527.82	296.66	947.10	0.00	527.82	0.60
Jul	673.37	357.35	1302.05	0.19	0.00	673.37	0.76	456.33	242.17	882.38	0.00	456.33	0.52	217.04	115.18	419.67	0.00	217.04	0.25
Aug	519.59	302.05	916.61	0.16	0.00	519.59	0.59	389.69	226.54	687.46	0.00	389.69	0.44	129.90	75.51	229.15	0.00	129.90	0.15
Sept	353.04	191.92	678.40	0.18	0.00	353.04	0.40	176.52	95.96	339.20	0.00	176.52	0.20	176.52	95.96	339.20	0.00	176.52	0.20
Oct	688.20	353.30	1467.81	0.18	10.00	698.20	0.79	158.10	81.16	337.20	0.00	158.10	0.18	530.10	272.13	1130.61	10.00	540.10	0.61
Nov	952.14	519.78	1735.76	0.19	0.00	952.14	1.08	510.79	278.84	931.16	0.00	510.79	0.58	441.36	240.94	804.60	0.00	441.36	0.50
Dec	395.68	168.41	1030.10	0.29	0.00	395.68	0.45	168.94	71.91	439.82	0.00	168.94	0.19	226.74	96.51	590.28	0.00	226.74	0.26

3.2 Kittiwake

Table 4: Kittiwake MRSea_V2 abundance estimates for the DCO array area including apportionment of unidentified species groups.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)
Jan	196.55	92.25	423.48	0.23	1.09	197.65	0.42	135.55	63.62	292.05	1.09	136.65	0.29	61.00	28.63	131.42	-	61.00	0.13
Feb	163.20	75.26	364.08	0.28	12.21	175.42	0.37	135.06	62.28	301.31	8.79	143.86	0.31	28.14	12.98	62.77	3.42	31.56	0.07
Mar	273.66	152.75	504.49	0.17	10.38	284.03	0.61	175.55	97.99	323.63	-	175.55	0.38	98.10	54.76	180.85	10.38	108.48	0.23
Apr	571.81	228.78	1721.05	0.61	1.21	573.03	1.22	439.86	175.98	1323.89	-	439.86	0.94	131.96	52.79	397.17	1.21	133.17	0.28
May	968.68	386.64	2465.50	0.32	15.53	984.22	2.10	766.48	305.93	1950.85	-	766.48	1.64	202.20	80.71	514.64	15.53	217.73	0.47
Jun	1109.26	637.39	1882.63	0.16	34.81	1144.07	2.44	778.55	447.36	1321.35	4.71	783.26	1.67	330.71	190.03	561.28	30.10	360.81	0.77
Jul	670.60	346.96	1316.63	0.18	14.90	685.50	1.46	360.76	186.65	708.31	-	360.76	0.77	309.83	160.30	608.31	14.90	324.74	0.69
Aug	3312.37	1412.35	7812.77	0.24	9.87	3322.24	7.10	1196.30	510.09	2821.67	-	1,196.30	2.56	2116.07	902.26	4991.10	9.87	2,125.94	4.54
Sept	650.41	111.31	3983.37	0.58	9.92	660.33	1.41	138.21	23.65	846.47	-	138.21	0.30	512.20	87.66	3136.90	9.92	522.12	1.12
Oct	75.83	30.56	197.40	0.24	10.37	86.19	0.18	57.99	23.37	150.95	2.86	60.84	0.13	17.84	7.19	46.45	7.51	25.35	0.05
Nov	240.67	102.19	593.62	0.28	0.10	240.77	0.51	177.34	75.30	437.41	-	177.34	0.38	63.33	26.89	156.22	0.10	63.43	0.14
Dec	718.15	263.45	2220.61	0.37	19.19	737.35	1.58	439.56	161.25	1359.17	7.85	447.41	0.96	278.59	102.20	861.44	11.34	289.94	0.62

Table 5: Kittiwake MRSea_V2 abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)
Jan	285.59	130.59	638.65	0.21	5.44	291.03	0.44	198.16	90.61	443.15	2.94	201.10	0.30	87.42	39.98	195.51	2.50	89.92	0.14
Feb	238.16	108.02	542.06	0.27	12.94	251.09	0.38	202.21	91.71	460.24	9.12	211.33	0.32	35.95	16.30	81.82	3.82	39.77	0.06
Mar	427.35	238.11	783.50	0.16	36.84	464.19	0.70	313.06	174.43	573.96	4.50	317.56	0.48	114.29	63.68	209.54	32.34	146.63	0.22
Apr	966.92	401.34	2,802.96	0.55	6.16	973.08	1.47	744.48	309.02	2158.15	-	744.48	1.12	222.44	92.33	644.81	6.16	228.60	0.34
May	1,508.45	587.23	3,970.39	0.32	41.46	1,549.91	2.33	1063.21	413.90	2798.47	4.96	1,068.17	1.61	445.24	173.33	1171.92	36.50	481.74	0.73
Jun	1,733.58	982.05	2,998.66	0.15	52.47	1,786.05	2.69	1196.98	678.08	2070.51	4.80	1,201.79	1.81	536.58	303.97	928.16	47.67	584.26	0.88
Jul	1,017.90	525.91	2,007.62	0.17	14.62	1,032.52	1.56	624.85	322.83	1232.40	-	624.85	0.94	393.05	203.07	775.22	14.62	407.67	0.61
Aug	5,465.61	2,264.91	13,530.04	0.23	19.55	5,485.16	8.26	2108.52	873.75	5219.61	4.80	2,113.32	3.18	3357.09	1391.15	8310.43	14.75	3,371.84	5.08
Sept	1,130.65	216.76	6,395.75	0.52	15.53	1,146.18	1.73	195.15	37.41	1103.92	-	195.15	0.29	935.50	179.35	5291.82	15.53	951.02	1.43
Oct	103.85	40.80	278.27	0.24	8.23	112.09	0.17	77.89	30.60	208.70	2.22	80.11	0.12	25.96	10.20	69.57	6.01	31.97	0.05
Nov	336.21	139.44	848.00	0.26	2.59	338.80	0.51	245.04	101.63	618.03	-	245.04	0.37	91.18	37.81	229.97	2.59	93.77	0.14
Dec	1,136.31	404.71	3,660.24	0.37	37.80	1,174.11	1.77	630.62	224.60	2031.33	12.16	642.78	0.97	505.69	180.11	1628.90	25.64	531.33	0.80

Table 6: Kittiwake MRSea_V2 abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km^2)
Jan	381.86	169.96	889.97	0.20	8.65	390.51	0.44	226.10	100.64	526.95	3.10	229.20	0.26	155.76	69.33	363.01	5.55	161.31	0.18
Feb	314.72	141.36	726.67	0.25	13.86	328.59	0.37	243.19	109.23	561.51	8.92	252.11	0.29	71.53	32.13	165.15	4.95	76.47	0.09
Mar	605.39	336.96	1,110.39	0.15	56.80	662.19	0.75	398.90	222.03	731.65	11.79	410.69	0.46	206.49	114.93	378.74	45.01	251.50	0.28
Apr	1,476.18	609.98	4,270.68	0.49	7.73	1,483.91	1.68	1,113.03	459.92	3220.06	-	1,113.03	1.26	363.15	150.06	1050.61	7.73	370.88	0.42
May	2,140.72	815.47	5,832.67	0.31	75.33	2,216.05	2.51	1,474.80	561.78	4018.29	4.92	1,479.72	1.67	665.92	253.67	1814.38	70.41	736.33	0.83
Jun	2,449.84	1,380.64	4,296.76	0.15	66.15	2,515.99	2.85	1,728.13	973.91	3030.96	9.62	1,737.75	1.97	721.71	406.73	1265.80	56.53	778.24	0.88
Jul	1,396.73	717.71	2,798.82	0.17	40.57	1,437.30	1.63	878.84	451.59	1761.06	-	878.84	0.99	517.89	266.12	1037.76	40.57	558.46	0.63
Aug	8,054.06	3,292.34	20,537.28	0.23	64.22	8,118.28	9.18	2,799.79	1144.50	7139.26	8.15	2,807.94	3.18	5,254.27	2147.84	13398.02	56.07	5,310.34	6.01
Sept	1,907.72	419.53	9,882.30	0.47	28.76	1,936.47	2.19	406.72	89.44	2106.89	13.51	420.23	0.48	1,500.99	330.09	7775.41	15.25	1,516.24	1.72
Oct	132.53	50.65	366.48	0.23	10.84	143.37	0.16	106.02	40.52	293.18	5.13	111.15	0.13	26.51	10.13	73.30	5.71	32.21	0.04
Nov	437.36	175.10	1,151.23	0.24	4.15	441.51	0.50	286.87	114.85	755.10	-	286.87	0.32	150.49	60.25	396.12	4.15	154.64	0.17
Dec	1,587.07	565.01	5,112.21	0.38	53.35	1,640.42	1.86	760.56	270.76	2449.90	12.40	772.96	0.87	826.51	294.24	2662.31	40.95	867.46	0.98

3.3 Guillemot

Table 7: Guillemot MRSea_V2 abundance estimates for the DCO array area including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	1,072.61	560.80	2,073.15	0.84	101.34	1,499.32	3.20	87.31	45.65	168.74	42.00	129.31	0.28	985.30	515.15	1904.41	59.34	1,370.02	2.93
May-16	3,647.72	2,317.16	5,909.14	0.38	291.14	5,105.40	10.91	163.62	103.94	265.05	30.00	193.62	0.41	3,484.10	2213.23	5644.09	261.14	4,911.78	10.50
Jun-16	4,234.88	2,761.59	6,793.51	0.12	369.82	5,913.71	12.64	382.09	249.17	612.95	20.00	402.09	0.86	3,852.78	2512.42	6180.56	349.82	5,511.61	11.78
Jul-16	4,753.11	3,512.31	6,516.84	0.07	226.74	6,487.95	13.86	128.71	95.11	176.47	9.33	138.04	0.29	4,624.40	3417.20	6340.37	217.41	6,349.90	13.57
Aug-16	3,793.08	2,243.28	6,468.33	0.19	149.02	5,169.96	11.05	-	0	0	-	-	-	3,793.08	2243.28	6468.33	149.02	5,169.96	11.05
Sep-16	8,852.30	5,683.60	14,145.06	0.34	453.70	12,204.60	26.08	-	0	0	-	-	-	8,852.30	5683.60	14145.06	453.70	12,204.60	26.08
Oct-16	5,119.91	3,596.72	7,411.21	0.09	561.45	7,429.26	15.87	51.72	36.33	74.86	18.00	69.72	0.15	5,068.20	3560.39	7336.35	543.45	7,359.54	15.73
Nov-16	1,879.56	1,245.30	2,883.77	0.27	11.10	2,475.35	5.29	11.53	7.64	17.69	2.00	13.53	0.03	1,868.03	1237.66	2866.08	9.10	2,461.81	5.26
Dec-16	914.71	658.70	1,267.13	0.22	70.00	1,291.43	2.76	-	0	0	-	-	-	914.71	658.70	1267.13	70.00	1,291.43	2.76
Jan-17	2,039.86	1,569.32	2,697.16	0.21	25.90	2,700.68	5.77	27.32	21.02	36.12	-	27.32	0.06	2,012.54	1548.30	2661.03	25.90	2,673.36	5.71
Feb-17	2,610.16	1,997.80	3,462.43	0.10	138.81	3,548.70	7.58	181.40	138.84	240.63	-	181.40	0.39	2,428.76	1858.95	3221.80	138.81	3,367.30	7.20
Mar-17	4,759.30	2,162.02	10,606.84	0.33	368.70	6,491.27	13.87	704.38	319.98	1569.81	46.84	751.21	1.61	4,054.93	1842.04	9037.03	321.87	5,740.06	12.27
Apr-17	803.13	386.71	1,700.63	0.38	123.28	1,190.70	2.54	63.89	30.76	135.28	14.00	77.89	0.17	739.25	355.95	1565.35	109.28	1,112.82	2.38
May-17	2,999.64	1,847.14	5,135.55	0.26	229.28	4,111.16	8.78	362.59	223.28	620.78	33.85	396.44	0.85	2,637.05	1623.86	4514.77	195.43	3,714.72	7.94
Jun-17	415.64	210.79	822.43	0.30	10.00	543.83	1.16	46.18	23.42	91.38	-	46.18	0.10	369.46	187.37	731.05	10.00	497.65	1.06
Jul-17	2,018.23	1,400.94	2,933.11	0.21	79.02	2,736.41	5.85	45.25	31.41	65.76	-	45.25	0.10	1,972.98	1369.53	2867.34	79.02	2,691.15	5.75
Aug-17	25,105.77	17,697.35	36,148.69	0.12	2,047.35	35,607.25	76.08	10.93	7.70	15.73	-	10.93	0.02	25,094.85	17689.65	36132.96	2,047.35	35,596.33	76.06
Sep-17	2,133.24	942.75	5,250.49	12.00	173.71	2,952.44	6.31	221.22	97.77	544.50	13.33	234.56	0.50	1,912.01	844.98	4705.99	160.38	2,717.89	5.81
Oct-17	750.96	558.64	1,011.24	0.15	57.41	1,016.37	2.17	122.03	90.78	164.33	18.57	140.60	0.30	628.93	467.86	846.92	38.84	875.77	1.87
Nov-17	10,688.13	6,723.36	17,302.91	0.18	571.94	14,661.05	31.33	190.01	119.53	307.61	151.11	341.12	0.73	10,498.12	6603.83	16995.30	420.82	14,319.93	30.60
Dec-17	3,460.04	2,249.37	5,554.30	0.13	123.15	4,672.72	9.98	83.88	54.53	134.65	1.33	85.21	0.18	3,376.16	2194.84	5419.65	121.82	4,587.51	9.80
Jan-18	1,308.24	818.17	2,118.27	0.17	208.88	1,898.64	4.06	284.40	177.86	460.49	7.81	292.21	0.62	1,023.84	640.30	1657.78	201.06	1,606.43	3.43
Feb-18	1,781.27	1,388.72	2,316.15	0.14	60.89	2,338.37	5.00	224.06	174.68	291.34	25.00	249.06	0.53	1,557.21	1214.04	2024.81	35.89	2,089.31	4.46
Mar-18	871.17	632.70	1,182.69	0.18	26.10	1,158.04	2.47	50.07	36.36	67.97	10.00	60.07	0.13	821.10	596.34	1114.72	16.10	1,097.97	2.35

Table 8: Guillemot MRSea_V2 abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km²)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km²)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km²)
Apr-16	1,347.98	700.21	2,658.40	1.21	156.59	1,931.92	2.91	74.37	38.63	146.67	58.18	132.55	0.20	1,273.61	661.57	2511.73	98.40	1,799.37	2.71
May-16	5,846.26	3,637.65	9,680.91	0.41	511.51	8,237.04	12.41	284.32	176.91	470.80	40.00	324.32	0.49	5,561.94	3460.75	9210.11	471.51	7,912.73	11.92
Jun-16	6,691.54	4,372.95	10,695.98	0.14	470.39	9,197.86	13.85	585.51	382.63	935.90	40.00	625.51	0.94	6,106.03	3990.32	9760.08	430.39	8,572.35	12.91
Jul-16	7,420.16	5,550.32	10,075.83	0.07	306.87	10,060.40	15.15	226.16	169.17	307.10	9.55	235.70	0.35	7,194.00	5381.15	9768.73	297.33	9,824.70	14.80
Aug-16	7,872.16	4,814.04	12,840.43	0.23	265.61	10,672.48	16.07	-	0	0	-	-	-	7,872.16	4814.04	12840.43	265.61	10,672.48	16.07
Sep-16	15,568.66	10,369.20	23,973.41	0.34	613.26	21,222.20	31.96	-	0	0	-	-	-	15,568.66	10369.20	23973.41	613.26	21,222.20	31.96
Oct-16	7,885.72	5,528.82	11,390.44	0.09	774.06	11,313.06	17.04	109.78	76.97	158.57	31.58	141.36	0.21	7,775.94	5451.85	11231.87	742.48	11,171.70	16.82
Nov-16	2,627.28	1,703.82	4,143.70	0.25	78.59	3,524.93	5.31	54.06	35.06	85.26	22.22	76.28	0.11	2,573.22	1668.76	4058.44	56.37	3,448.64	5.19
Dec-16	1,314.22	921.04	1,883.89	0.20	68.90	1,813.92	2.73	-	0	0	-	-	-	1,314.22	921.04	1883.89	68.90	1,813.92	2.73
Jan-17	2,732.54	2,096.11	3,619.99	0.20	52.91	3,627.52	5.46	81.98	62.88	108.60	-	81.98	0.12	2,650.56	2033.23	3511.39	52.91	3,545.54	5.34
Feb-17	3,604.44	2,712.14	4,887.39	0.09	167.55	4,880.47	7.35	213.17	160.40	289.04	-	213.17	0.32	3,391.27	2551.75	4598.35	167.55	4,667.31	7.03
Mar-17	6,417.59	2,994.62	13,944.47	0.32	493.56	8,703.11	13.11	1,094.15	510.56	2377.42	63.86	1,158.01	1.74	5,323.45	2484.06	11567.05	429.70	7,545.10	11.36
Apr-17	1,187.08	580.73	2,488.78	0.52	230.97	1,831.08	2.76	79.14	38.72	165.92	12.86	92.00	0.14	1,107.94	542.02	2322.86	218.11	1,739.09	2.62
May-17	4,528.44	2,772.89	7,767.94	0.24	340.86	6,176.45	9.30	639.05	391.31	1096.21	33.62	672.67	1.01	3,889.39	2381.58	6671.73	307.24	5,503.78	8.29
Jun-17	808.36	424.95	1,556.48	0.31	66.72	1,095.20	1.65	168.41	88.53	324.27	-	168.41	0.25	639.95	336.42	1232.21	66.72	926.79	1.40
Jul-17	3,476.31	2,413.69	5,068.25	0.20	128.83	4,709.85	7.09	58.43	40.57	85.18	-	58.43	0.09	3,417.88	2373.12	4983.07	128.83	4,651.42	7.01
Aug-17	37,801.01	26,928.92	53,938.18	0.13	2,391.72	52,708.29	79.38	11.21	7.98	15.99	-	11.21	0.02	37,789.81	26920.93	53922.19	2,391.72	52,697.08	79.36
Sep-17	2,450.85	1,041.73	6,365.31	19.23	310.84	3,551.94	5.35	189.38	80.50	491.86	35.17	224.56	0.34	2,261.46	961.23	5873.44	275.67	3,327.39	5.01
Oct-17	1,045.29	763.30	1,437.92	0.14	71.41	1,382.39	2.08	241.22	176.15	331.83	22.50	263.72	0.40	804.07	587.15	1106.09	48.91	1,118.67	1.68
Nov-17	16,637.18	10,720.49	26,296.70	0.16	731.87	22,610.12	34.05	369.72	238.23	584.37	172.73	542.44	0.82	16,267.46	10482.26	25712.33	559.14	22,067.68	33.23
Dec-17	5,401.38	3,563.62	8,483.47	0.12	222.62	7,334.28	11.05	130.27	85.95	204.61	2.86	133.13	0.20	5,271.11	3477.67	8278.86	219.77	7,201.15	10.85
Jan-18	2,010.60	1,220.73	3,399.24	0.16	293.38	2,879.07	4.34	423.92	257.38	716.71	33.73	457.65	0.69	1,586.68	963.34	2682.54	259.65	2,421.42	3.65
Feb-18	2,569.37	1,986.93	3,354.82	0.13	105.33	3,399.25	5.12	314.40	243.13	410.51	34.12	348.51	0.52	2,254.97	1743.80	2944.32	71.21	3,050.73	4.59
Mar-18	1,284.91	937.26	1,749.95	0.17	52.90	1,728.98	2.60	71.96	52.49	98.00	10.00	81.96	0.12	1,212.96	884.78	1651.95	42.90	1,647.03	2.48

Table 9: Guillemot MRSea_V2 abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km²)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km²)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km²)
Apr-16	1,604.05	814.63	3,289.79	1.69	246.20	2,353.97	2.66	115.85	58.83	237.60	117.23	233.08	0.26	1,488.21	755.80	3052.19	128.97	2,120.89	2.40
May-16	8,625.49	5,217.43	14,770.23	0.43	683.31	12,074.63	13.66	379.04	229.28	649.07	50.00	429.04	0.49	8,246.45	4988.15	14121.17	633.31	11,645.59	13.17
Jun-16	9,767.26	6,319.10	15,779.80	0.16	692.58	13,448.50	15.21	794.66	514.12	1283.84	70.00	864.66	0.98	8,972.60	5804.98	14495.96	622.58	12,583.84	14.24
Jul-16	10,672.39	8,017.05	14,479.75	0.09	542.34	14,593.91	16.51	356.12	267.51	483.16	9.70	365.81	0.41	10,316.28	7749.54	13996.58	532.65	14,228.10	16.10
Aug-16	14,313.18	8,829.57	23,023.38	0.28	424.62	19,328.26	21.86	-	0	0	-	-	-	14,313.18	8829.57	23023.38	424.62	19,328.26	21.86
Sep-16	24,849.57	16,780.58	37,803.76	0.34	801.60	33,637.52	38.05	10.79	7.28	16.41	-	10.79	0.01	24,838.78	16773.29	37787.35	801.60	33,626.73	38.04
Oct-16	11,332.90	7,796.14	16,712.24	0.13	946.74	16,044.28	18.15	167.38	115.15	246.84	25.76	193.14	0.22	11,165.51	7680.99	16465.40	920.98	15,851.14	17.93
Nov-16	3,449.73	2,195.43	5,581.06	0.23	95.54	4,620.11	5.23	64.48	41.04	104.32	30.00	94.48	0.11	3,385.25	2154.39	5476.74	65.54	4,525.63	5.12
Dec-16	1,766.57	1,205.41	2,629.00	0.19	90.96	2,436.10	2.76	-	0	0	-	-	-	1,766.57	1205.41	2629.00	90.96	2,436.10	2.76
Jan-17	3,437.55	2,619.82	4,588.51	0.19	131.81	4,628.72	5.24	149.46	113.91	199.50	18.82	168.28	0.19	3,288.09	2505.91	4389.01	112.99	4,460.43	5.05
Feb-17	4,650.61	3,446.44	6,436.56	0.09	246.93	6,318.69	7.15	334.92	248.20	463.54	-	334.92	0.38	4,315.69	3198.24	5973.03	246.93	5,983.77	6.77
Mar-17	8,064.18	3,821.87	17,305.20	0.31	599.16	10,926.19	12.36	1,306.88	619.37	2804.49	91.49	1,398.37	1.58	6,757.29	3202.50	14500.72	507.67	9,527.82	10.78
Apr-17	1,652.63	805.92	3,484.59	0.77	336.51	2,552.57	2.89	150.24	73.27	316.78	30.00	180.24	0.20	1,502.39	732.65	3167.81	306.51	2,372.33	2.68
May-17	6,352.36	3,837.98	11,012.90	0.23	504.15	8,742.59	9.89	766.86	463.32	1329.49	34.36	801.22	0.91	5,585.50	3374.66	9683.42	469.79	7,941.37	8.98
Jun-17	1,413.78	764.18	2,660.91	0.34	76.22	1,904.13	2.15	160.43	86.72	301.95	-	160.43	0.18	1,253.35	677.47	2358.96	76.22	1,743.70	1.97
Jul-17	5,477.08	3,788.51	8,079.71	0.19	208.06	7,422.48	8.40	107.39	74.28	158.43	-	107.39	0.12	5,369.69	3714.23	7921.28	208.06	7,315.08	8.27
Aug-17	51,709.83	36,738.74	74,107.83	0.13	3,921.27	72,955.96	82.53	9.18	6.53	13.16	-	9.18	0.01	51,700.64	36732.22	74094.66	3,921.27	72,946.77	82.52
Sep-17	2,673.06	1,090.76	7,536.90	24.78	453.53	4,038.93	4.57	164.90	67.29	464.94	32.57	197.47	0.22	2,508.16	1023.48	7071.96	420.96	3,841.47	4.35
Oct-17	1,362.82	973.48	1,928.39	0.14	192.79	1,917.87	2.17	272.56	194.70	385.68	120.00	392.56	0.44	1,090.26	778.79	1542.71	72.79	1,525.30	1.73
Nov-17	23,760.51	15,434.87	37,390.25	0.17	1,049.76	32,338.10	36.58	446.63	290.13	702.82	195.35	641.97	0.73	23,313.88	15144.75	36687.42	854.42	31,696.13	35.86
Dec-17	7,756.60	5,134.89	12,080.37	0.13	331.80	10,550.77	11.94	180.62	119.57	281.30	2.29	182.91	0.21	7,575.98	5015.32	11799.07	329.51	10,367.86	11.73
Jan-18	2,868.63	1,664.73	5,204.37	0.17	373.15	4,076.18	4.61	529.95	307.54	961.45	32.96	562.91	0.64	2,338.68	1357.19	4242.92	340.19	3,513.28	3.97
Feb-18	3,457.04	2,638.51	4,564.20	0.11	221.63	4,672.69	5.29	366.66	279.84	484.08	120.65	487.30	0.55	3,090.38	2358.67	4080.12	100.98	4,185.39	4.73
Mar-18	1,764.56	1,279.65	2,433.26	0.18	63.22	2,365.87	2.68	90.23	65.44	124.43	10.00	100.23	0.11	1,674.33	1214.21	2308.83	53.22	2,265.63	2.56

3.4 Razorbill

Table 10: Razorbill MRSea_V2 abundance estimates for the DCO array area including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Jan	161.14	68.67	395.92	0.30	6.52	202.10	0.43	4.03	5.59	40.57	-	4.03	0.01	157.11	29.34	213.00	6.52	198.07	0.42
Feb	137.42	61.09	325.16	0.36	4.88	163.85	0.35	37.48	12.13	126.11	2.50	39.98	0.09	99.94	56.61	588.52	2.38	123.87	0.26
Mar	198.28	78.55	500.91	0.36	12.22	249.84	0.53	22.03	0	0	1.58	23.61	0.05	176.25	27.56	192.12	10.64	226.22	0.48
Apr	90.78	34.93	253.57	0.30	17.47	126.72	0.27	14.53	1.24	16.56	6.00	20.53	0.04	76.26	7.44	99.383	11.47	106.20	0.23
May	222.46	68.74	714.63	0.36	14.34	277.74	0.59	39.26	0	0	3.08	42.34	0.09	183.20	583.87	3204.24	11.26	235.40	0.50
Jun	70.00	27.56	192.12	0.31	8.19	94.65	0.20	-	11.95	63.20	-	-	-	70.00	380.73	2013.29	8.19	94.65	0.20
Jul	29.73	8.68	115.95	0.66	1.63	37.00	0.08	4.25	27.13	236.44	0.33	4.58	0.01	25.48	37.13	323.55	1.30	32.42	0.07
Aug	1,375.86	583.87	3,204.24	0.36	141.06	1,836.24	3.92	-	13.09	95.35	-	-	-	1,375.86	113.46	826.37	141.06	1,836.24	3.92
Sept	891.87	392.68	2,076.49	0.30	54.81	1,139.55	2.43	27.14	0	0	3.33	30.48	0.07	864.73	0.22	104.50	51.48	1,109.07	2.37
Oct	177.41	64.26	560.00	0.32	28.38	229.83	0.49	74.91	1.72	9.90	16.71	91.62	0.20	102.50	66.95	386.02	11.67	138.21	0.30
Nov	329.62	126.55	921.72	0.39	22.88	416.70	0.89	34.10	16.66	88.68	13.44	47.54	0.10	295.52	44.43	236.48	9.44	369.16	0.79
Dec	2.56	0.22	104.50	0.95	1.13	4.47	0.01	-	8.73	55.66	-	-	-	2.56	69.82	445.25	1.13	4.47	0.01

Table 11: Razorbill MRSea_V2 abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Jan	247.24	105.43	607.95	0.30	8.50	308.42	0.46	5.49	2.34	13.51	-	5.49	0.01	241.75	103.08	594.44	8.50	302.93	0.46
Feb	218.79	94.54	532.62	0.31	7.90	264.31	0.40	45.04	19.47	109.66	2.94	47.99	0.07	173.74	75.08	422.96	4.96	216.32	0.33
Mar	290.65	115.08	740.24	0.33	21.20	367.14	0.55	46.14	18.27	117.50	3.07	49.21	0.07	244.52	96.82	622.74	18.13	317.94	0.48
Apr	132.69	48.76	388.04	0.27	23.78	182.49	0.27	25.68	9.44	75.11	7.21	32.89	0.05	107.01	39.33	312.94	16.57	149.60	0.23
May	354.88	118.22	1,077.48	0.33	17.37	431.27	0.65	88.72	29.56	269.37	3.19	91.91	0.14	266.16	88.67	808.11	14.19	339.36	0.51
Jun	105.86	42.93	283.95	0.27	8.25	138.13	0.21	-	0.00	0.00	-	-	-	105.86	42.93	283.95	8.25	138.13	0.21
Jul	48.05	14.53	176.65	0.49	1.75	58.97	0.09	6.01	1.82	22.08	0.23	6.23	0.01	42.04	12.72	154.56	1.52	52.73	0.08
Aug	2,016.30	868.38	4,681.20	0.31	130.76	2,599.03	3.91	-	0.00	0.00	-	-	-	2,016.30	868.38	4681.20	130.76	2,599.03	3.91
Sept	1,346.17	591.10	3,188.19	0.28	86.13	1,721.53	2.59	45.89	20.15	108.69	12.41	58.31	0.09	1,300.28	570.95	3079.50	73.72	1,663.23	2.50
Oct	313.88	117.20	978.06	0.26	34.66	390.52	0.59	131.17	48.98	408.74	17.96	149.13	0.22	182.71	68.22	569.32	16.70	241.39	0.36
Nov	496.26	193.39	1,350.82	0.33	29.68	622.66	0.94	48.93	19.07	133.18	17.53	66.45	0.10	447.33	174.33	1217.64	12.15	556.21	0.84
Dec	8.12	1.08	176.81	0.74	1.80	12.01	0.02	-	0.00	0.00	-	-	-	8.12	1.08	176.81	1.80	12.01	0.02

Table 12: Razorbill MRSea_V2 abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Jan	357.10	150.68	889.44	0.31	13.28	446.95	0.51	6.05	2.55	15.08	0.59	6.64	0.01	351.04	148.13	874.36	12.70	440.31	0.50
Feb	322.64	135.38	814.75	0.30	24.06	406.64	0.46	48.16	20.21	121.60	13.79	61.94	0.07	274.49	115.17	693.15	10.27	344.70	0.39
Mar	398.68	157.85	1,026.13	0.32	27.23	502.68	0.57	56.95	22.55	146.59	4.26	61.21	0.07	341.72	135.30	879.54	22.98	441.47	0.50
Apr	181.98	63.78	563.13	0.27	32.73	251.09	0.28	32.35	11.34	100.11	9.51	41.86	0.05	149.63	52.44	463.02	23.22	209.23	0.24
May	529.34	190.32	1,515.85	0.30	20.35	639.80	0.72	118.83	42.73	340.29	2.82	121.65	0.14	410.51	147.60	1175.55	17.53	518.15	0.59
Jun	147.96	61.28	389.83	0.23	12.39	194.10	0.22	-	0.00	0.00	-	-	-	147.96	61.28	389.83	12.39	194.10	0.22
Jul	75.17	23.37	265.88	0.42	3.07	93.37	0.11	6.26	1.95	22.16	0.15	6.42	0.01	68.91	21.43	243.72	2.92	86.95	0.10
Aug	2,751.99	1,189.37	6,494.68	0.28	190.77	3,562.24	4.03	-	0.00	0.00	-	-	-	2,751.99	1189.37	6494.68	190.77	3,562.24	4.03
Sept	1,949.49	860.22	4,634.45	0.27	101.48	2,463.89	2.79	75.71	33.41	179.98	13.71	89.42	0.10	1,873.79	826.81	4454.47	87.76	2,374.47	2.69
Oct	523.74	193.71	1,650.48	0.26	76.66	671.53	0.76	208.37	77.07	656.64	54.12	262.49	0.30	315.37	116.64	993.84	22.53	409.04	0.46
Nov	707.02	275.95	1,899.43	0.30	41.61	894.91	1.01	36.39	14.20	97.76	17.33	53.72	0.06	670.63	261.75	1801.66	24.28	841.19	0.95
Dec	22.45	3.87	285.75	0.61	2.05	29.65	0.03	-	0.00	0.00	-	-	-	22.45	3.87	285.75	2.05	29.65	0.03

4 Design-based Abundance Results

4.1 Fulmar

Table 13: Fulmar design-based abundance estimates for the DCO array area including apportionment of unidentified species groups.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	110.00	24.00	221.00	1.00	-	110.00	0.24	70.00	-	28.00	-	70.00	0.15	40.00	-	-	-	40.00	0.09
May-16	319.00	167.00	424.00	0.23	13.33	332.33	0.71	80.00	43.00	185.00	-	80.00	0.17	239.00	62.00	398.00	13.33	252.33	0.54
Jun-16	289.00	63.00	530.00	0.30	33.25	322.25	0.69	10.00	162.00	544.00	0.10	10.10	0.02	279.00	216.00	884.00	33.16	312.16	0.67
Jul-16	10.00	-	28.00	0.24	0.45	10.45	0.02	-	133.00	406.00	-	-	-	10.00	18.00	283.00	0.45	10.45	0.02
Aug-16	-	-	-	0.41	-	-	-	-	10.00	128.00	-	-	-	-	-	61.00	-	-	-
Sep-16	10.00	-	29.00	0.42	0.05	10.05	0.02	-	34.00	159.00	-	-	-	10.00	19.00	322.00	0.05	10.05	0.02
Oct-16	150.00	64.00	239.00	0.51	-	150.00	0.32	30.00	10.00	249.00	-	30.00	0.06	120.00	69.00	775.00	-	120.00	0.26
Nov-16	30.00	-	53.00	0.25	-	30.00	0.06	10.00	117.00	352.00	-	10.00	0.02	20.00	88.00	316.00	-	20.00	0.04
Dec-16	50.00	16.00	101.00	0.57	1.48	51.48	0.11	40.00	40.00	308.00	1.48	41.48	0.09	10.00	-	117.00	-	10.00	0.02
Jan-17	140.00	73.00	175.00	-	-	140.00	0.30	60.00	-	-	-	60.00	0.13	80.00	-	-	-	80.00	0.17
Feb-17	90.00	19.00	206.00	0.67	2.00	92.00	0.20	40.00	-	63.00	-	40.00	0.09	50.00	-	-	2.00	52.00	0.11
Mar-17	150.00	37.00	326.00	0.40	-	150.00	0.32	40.00	56.00	190.00	-	40.00	0.09	110.00	19.00	362.00	-	110.00	0.24
Apr-17	50.00	-	87.00	0.35	-	50.00	0.11	40.00	-	78.00	-	40.00	0.09	10.00	-	40.00	-	10.00	0.02
May-17	40.00	10.00	89.00	0.61	1.33	41.33	0.09	20.00	-	31.00	-	20.00	0.04	20.00	-	149.00	1.33	21.33	0.05
Jun-17	30.00	-	59.00	0.38	10.00	40.00	0.09	10.00	10.00	92.00	-	10.00	0.02	20.00	-	59.00	10.00	30.00	0.06
Jul-17	20.00	-	48.00	0.37	-	20.00	0.04	20.00	60.00	262.00	-	20.00	0.04	-	10.00	168.00	-	-	-
Aug-17	50.00	8.00	89.00	0.45	-	50.00	0.11	30.00	125.00	492.00	-	30.00	0.06	20.00	-	168.00	-	20.00	0.04
Sep-17	120.00	42.00	195.00	0.22	-	120.00	0.26	20.00	34.00	153.00	-	20.00	0.04	100.00	29.00	132.00	-	100.00	0.21
Oct-17	10.00	-	30.00	0.43	5.00	15.00	0.03	-	-	187.00	-	-	-	10.00	17.00	185.00	5.00	15.00	0.03
Nov-17	10.00	-	65.00	0.47	-	10.00	0.02	-	84.00	582.00	-	-	-	10.00	56.00	481.00	-	10.00	0.02
Dec-17	10.00	-	28.00	0.95	-	10.00	0.02	10.00	-	25.00	-	10.00	0.02	-	-	544.00	-	-	-
Jan-18	80.00	21.00	134.00	0.72	-	80.00	0.17	80.00	-	84.00	-	80.00	0.17	-	-	-	-	-	-
Feb-18	100.00	-	225.00	-	8.22	108.22	0.23	60.00	-	-	2.07	62.07	0.13	40.00	-	-	6.15	46.15	0.10
Mar-18	30.00	-	54.00	0.72	-	30.00	0.06	10.00	-	74.00	-	10.00	0.02	20.00	-	-	-	20.00	0.04

Table 14: Fulmar design-based abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	170.00	83.00	309.00	0.72	-	170.00	0.26	110.00	-	68.00	-	110.00	0.17	60.00	-	-	-	60.00	0.09
May-16	540.00	325.00	1,422.00	0.24	21.15	561.15	0.85	120.00	121.00	338.00	-	120.00	0.18	420.00	154.00	1,207.00	21.15	441.15	0.66
Jun-16	400.00	92.00	658.00	0.28	31.98	431.98	0.65	10.00	337.00	802.00	0.07	10.07	0.02	390.00	312.00	1,428.00	31.91	421.91	0.64
Jul-16	20.00	-	81.00	0.24	0.83	20.83	0.03	-	121.00	421.00	-	-	-	20.00	23.00	316.00	0.83	20.83	0.03
Aug-16	30.00	-	105.00	0.29	0.69	30.69	0.05	10.00	79.00	571.00	-	10.00	0.02	20.00	-	102.00	0.69	20.69	0.03
Sep-16	50.00	9.00	87.00	0.43	0.13	50.13	0.08	10.00	29.00	148.00	-	10.00	0.02	40.00	17.00	296.00	0.13	40.13	0.06
Oct-16	200.00	108.00	366.00	0.27	-	200.00	0.30	30.00	78.00	322.00	-	30.00	0.05	170.00	377.00	1,041.00	-	170.00	0.26
Nov-16	40.00	8.00	68.00	0.25	-	40.00	0.06	10.00	142.00	414.00	-	10.00	0.02	30.00	94.00	330.00	-	30.00	0.05
Dec-16	72.00	33.00	103.00	0.48	1.54	73.54	0.11	62.00	71.00	978.00	1.54	63.54	0.10	10.00	-	356.00	-	10.00	0.02
Jan-17	230.00	159.00	340.00	-	-	230.00	0.35	100.00	-	-	-	100.00	0.15	130.00	-	-	-	130.00	0.20
Feb-17	110.00	34.00	224.00	0.53	1.67	111.67	0.17	60.00	-	64.00	-	60.00	0.09	50.00	-	-	1.67	51.67	0.08
Mar-17	571.00	83.00	3,367.00	0.39	26.51	597.51	0.90	380.00	80.00	221.00	-	380.00	0.57	190.00	10.00	346.00	26.51	216.51	0.33
Apr-17	60.00	13.00	128.00	0.27	-	60.00	0.09	50.00	9.00	69.00	-	50.00	0.08	10.00	-	53.00	-	10.00	0.02
May-17	40.00	9.00	72.00	0.47	0.95	40.95	0.06	20.00	-	87.00	-	20.00	0.03	20.00	-	161.00	0.95	20.95	0.03
Jun-17	70.00	20.00	286.00	0.26	18.46	88.46	0.13	10.00	45.00	174.00	-	10.00	0.02	60.00	-	57.00	18.46	78.46	0.12
Jul-17	40.00	8.00	67.00	0.29	-	40.00	0.06	40.00	155.00	429.00	-	40.00	0.06	-	28.00	227.00	-	-	-
Aug-17	60.00	19.00	99.00	0.34	0.20	60.20	0.09	40.00	233.00	610.00	0.20	40.20	0.06	20.00	10.00	205.00	-	20.00	0.03
Sep-17	180.00	60.00	291.00	0.20	-	180.00	0.27	20.00	63.00	203.00	-	20.00	0.03	160.00	36.00	154.00	-	160.00	0.24
Oct-17	10.00	-	30.00	0.34	4.00	14.00	0.02	-	12.00	142.00	-	-	-	10.00	57.00	229.00	4.00	14.00	0.02
Nov-17	50.00	10.00	96.00	0.38	1.07	51.07	0.08	20.00	152.00	640.00	-	20.00	0.03	30.00	148.00	577.00	1.07	31.07	0.05
Dec-17	20.00	-	47.00	0.55	-	20.00	0.03	20.00	9.00	124.00	-	20.00	0.03	-	23.00	878.00	-	-	-
Jan-18	130.00	32.00	226.00	0.50	6.15	136.15	0.21	90.00	10.00	132.00	-	90.00	0.14	40.00	-	-	6.15	46.15	0.07
Feb-18	120.00	15.00	238.00	1.00	6.01	126.01	0.19	80.00	-	84.00	1.57	81.57	0.12	40.00	-	-	4.44	44.44	0.07
Mar-18	60.00	19.00	92.00	0.55	1.76	61.76	0.09	30.00	10.00	91.00	-	30.00	0.05	30.00	-	217.00	1.76	31.76	0.05

Table 15: Fulmar design-based abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	300.00	180.00	472.00	0.57	-	300.00	0.34	220.00	-	129.00	-	220.00	0.25	80.00	-	-	-	80.00	0.09
May-16	679.00	336.00	1,277.00	0.25	37.99	716.99	0.81	140.00	172.00	474.00	-	140.00	0.16	539.00	183.00	831.00	37.99	576.99	0.65
Jun-16	430.00	121.00	731.00	0.25	28.60	458.60	0.52	20.00	472.00	966.00	0.22	20.22	0.02	410.00	426.00	1,595.00	28.38	438.38	0.50
Jul-16	40.00	8.00	135.00	0.22	0.65	40.65	0.05	20.00	223.00	608.00	-	20.00	0.02	20.00	50.00	481.00	0.65	20.65	0.02
Aug-16	50.00	-	120.00	0.30	0.95	50.95	0.06	10.00	124.00	611.00	-	10.00	0.01	40.00	22.00	105.00	0.95	40.95	0.05
Sep-16	50.00	7.00	88.00	0.40	0.13	50.13	0.06	10.00	40.00	188.00	-	10.00	0.01	40.00	23.00	308.00	0.13	40.13	0.05
Oct-16	248.00	138.00	399.00	0.23	-	248.00	0.28	30.00	106.00	498.00	-	30.00	0.03	219.00	501.00	1,203.00	-	219.00	0.25
Nov-16	40.00	8.00	63.00	0.26	2.14	42.14	0.05	10.00	154.00	510.00	-	10.00	0.01	30.00	126.00	399.00	2.14	32.14	0.04
Dec-16	82.00	32.00	113.00	0.45	1.46	83.46	0.09	71.00	105.00	697.00	1.46	72.46	0.08	10.00	-	220.00	-	10.00	0.01
Jan-17	279.00	146.00	387.00	-	2.46	281.46	0.32	119.00	-	-	-	119.00	0.13	159.00	-	-	2.46	161.46	0.18
Feb-17	179.00	102.00	385.00	0.48	4.00	183.00	0.21	100.00	-	82.00	-	100.00	0.11	80.00	-	51.00	4.00	84.00	0.10
Mar-17	608.00	138.00	2,129.00	0.36	21.94	629.94	0.71	399.00	68.00	211.00	-	399.00	0.45	209.00	30.00	465.00	21.94	230.94	0.26
Apr-17	70.00	19.00	117.00	0.41	-	70.00	0.08	50.00	20.00	89.00	-	50.00	0.06	20.00	-	124.00	-	20.00	0.02
May-17	50.00	12.00	77.00	0.41	1.71	51.71	0.06	20.00	-	57.00	-	20.00	0.02	30.00	32.00	256.00	1.71	31.71	0.04
Jun-17	100.00	48.00	228.00	0.25	14.29	114.29	0.13	20.00	71.00	392.00	-	20.00	0.02	80.00	-	124.00	14.29	94.29	0.11
Jul-17	40.00	8.00	62.00	0.24	-	40.00	0.05	40.00	242.00	1,034.00	-	40.00	0.05	-	20.00	222.00	-	-	-
Aug-17	120.00	53.00	345.00	0.26	0.22	120.22	0.14	60.00	332.00	792.00	0.15	60.15	0.07	60.00	40.00	381.00	0.06	60.06	0.07
Sep-17	229.00	99.00	322.00	0.17	-	229.00	0.26	30.00	84.00	270.00	-	30.00	0.03	199.00	62.00	236.00	-	199.00	0.23
Oct-17	9.00	-	29.00	0.25	3.80	12.80	0.01	-	19.00	146.00	-	-	-	9.00	118.00	302.00	3.80	12.80	0.01
Nov-17	70.00	17.00	119.00	0.33	0.78	70.78	0.08	30.00	309.00	1,034.00	-	30.00	0.03	40.00	230.00	1,008.00	0.78	40.78	0.05
Dec-17	30.00	-	51.00	0.49	-	30.00	0.03	30.00	12.00	112.00	-	30.00	0.03	-	68.00	868.00	-	-	-
Jan-18	190.00	67.00	260.00	0.48	9.47	199.47	0.23	130.00	19.00	250.00	-	130.00	0.15	60.00	-	-	9.47	69.47	0.08
Feb-18	179.00	83.00	295.00	0.68	7.50	186.50	0.21	90.00	-	106.00	1.50	91.50	0.10	90.00	-	-	6.00	96.00	0.11
Mar-18	60.00	19.00	89.00	0.45	5.68	65.68	0.07	30.00	17.00	111.00	1.40	31.40	0.04	30.00	-	240.00	4.29	34.29	0.04

4.2 Gannet

Table 16: Gannet design-based abundance estimates for the DCO array area including apportionment of unidentified species groups.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	10.00	-	28.00	1.00	-	10.00	0.02	10.00	-	28.00	-	10.00	0.02	-	-	-	-	-	-
May-16	309.00	162.00	503.00	0.23	-	309.00	0.66	130.00	43.00	185.00	-	130.00	0.28	179.00	62.00	398.00	-	179.00	0.38
Jun-16	1,017.00	430.00	1,378.00	0.30	-	1,017.00	2.17	399.00	162.00	544.00	-	399.00	0.85	618.00	216.00	884.00	-	618.00	1.32
Jul-16	391.00	222.00	553.00	0.24	-	391.00	0.84	270.00	133.00	406.00	-	270.00	0.58	120.00	18.00	283.00	-	120.00	0.26
Aug-16	90.00	22.00	163.00	0.41	-	90.00	0.19	70.00	10.00	128.00	-	70.00	0.15	20.00	-	61.00	-	20.00	0.04
Sep-16	260.00	70.00	474.00	0.42	-	260.00	0.56	100.00	34.00	159.00	-	100.00	0.21	160.00	19.00	322.00	-	160.00	0.34
Oct-16	479.00	82.00	1,012.00	0.51	20.00	499.00	1.07	90.00	10.00	249.00	-	90.00	0.19	389.00	69.00	775.00	20.00	409.00	0.87
Nov-16	450.00	264.00	630.00	0.25	-	450.00	0.96	250.00	117.00	352.00	-	250.00	0.53	200.00	88.00	316.00	-	200.00	0.43
Dec-16	210.00	43.00	427.00	0.57	-	210.00	0.45	160.00	40.00	308.00	-	160.00	0.34	50.00	-	117.00	-	50.00	0.11
Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-17	20.00	-	65.00	0.67	-	20.00	0.04	20.00	-	63.00	-	20.00	0.04	-	-	-	-	-	-
Mar-17	280.00	81.00	501.00	0.40	-	280.00	0.60	130.00	56.00	190.00	-	130.00	0.28	150.00	19.00	362.00	-	150.00	0.32
Apr-17	50.00	15.00	91.00	0.35	-	50.00	0.11	30.00	-	78.00	-	30.00	0.06	20.00	-	40.00	-	20.00	0.04
May-17	70.00	-	168.00	0.61	-	70.00	0.15	10.00	-	31.00	-	10.00	0.02	60.00	-	149.00	-	60.00	0.13
Jun-17	60.00	21.00	109.00	0.38	-	60.00	0.13	40.00	10.00	92.00	-	40.00	0.09	20.00	-	59.00	-	20.00	0.04
Jul-17	250.00	87.00	394.00	0.37	-	250.00	0.53	170.00	60.00	262.00	-	170.00	0.36	80.00	10.00	168.00	-	80.00	0.17
Aug-17	399.00	136.00	632.00	0.45	-	399.00	0.85	329.00	125.00	492.00	-	329.00	0.70	70.00	-	168.00	-	70.00	0.15
Sep-17	180.00	101.00	241.00	0.22	-	180.00	0.38	100.00	34.00	153.00	-	100.00	0.21	80.00	29.00	132.00	-	80.00	0.17
Oct-17	160.00	50.00	298.00	0.43	-	160.00	0.34	60.00	-	187.00	-	60.00	0.13	100.00	17.00	185.00	-	100.00	0.21
Nov-17	569.00	154.00	1,025.00	0.47	-	569.00	1.22	299.00	84.00	582.00	-	299.00	0.64	269.00	56.00	481.00	-	269.00	0.57
Dec-17	210.00	-	514.00	0.95	-	210.00	0.45	10.00	-	25.00	-	10.00	0.02	200.00	-	544.00	-	200.00	0.43
Jan-18	30.00	-	87.00	0.72	-	30.00	0.06	30.00	-	84.00	-	30.00	0.06	-	-	-	-	-	-
Feb-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar-18	30.00	-	72.00	0.72	-	30.00	0.06	30.00	-	74.00	-	30.00	0.06	-	-	-	-	-	-

Table 17: Gannet design-based abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	30.00	-	70.00	0.72	-	30.00	0.05	30.00	-	68.00	-	30.00	0.05	-	-	-	-	-	-
May-16	571.00	328.00	1,451.00	0.24	-	571.00	0.86	210.00	121.00	338.00	-	210.00	0.32	360.00	154.00	1,207.00	-	360.00	0.54
Jun-16	1,431.00	790.00	2,118.00	0.28	-	1,431.00	2.16	561.00	337.00	802.00	-	561.00	0.84	871.00	312.00	1,428.00	-	871.00	1.31
Jul-16	441.00	217.00	611.00	0.24	-	441.00	0.66	300.00	121.00	421.00	-	300.00	0.45	140.00	23.00	316.00	-	140.00	0.21
Aug-16	200.00	101.00	608.00	0.29	-	200.00	0.30	170.00	79.00	571.00	-	170.00	0.26	30.00	-	102.00	-	30.00	0.05
Sep-16	260.00	55.00	426.00	0.43	-	260.00	0.39	100.00	29.00	148.00	-	100.00	0.15	160.00	17.00	296.00	-	160.00	0.24
Oct-16	850.00	510.00	1,269.00	0.27	20.00	870.00	1.31	160.00	78.00	322.00	-	160.00	0.24	690.00	377.00	1,041.00	20.00	710.00	1.07
Nov-16	539.00	254.00	703.00	0.25	-	539.00	0.81	310.00	142.00	414.00	-	310.00	0.47	230.00	94.00	330.00	-	230.00	0.35
Dec-16	381.00	81.00	1,354.00	0.48	-	381.00	0.57	288.00	71.00	978.00	-	288.00	0.43	93.00	-	356.00	-	93.00	0.14
Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-17	30.00	-	66.00	0.53	-	30.00	0.05	30.00	-	64.00	-	30.00	0.05	-	-	-	-	-	-
Mar-17	310.00	111.00	529.00	0.39	-	310.00	0.47	150.00	80.00	221.00	-	150.00	0.23	160.00	10.00	346.00	-	160.00	0.24
Apr-17	70.00	28.00	93.00	0.27	-	70.00	0.11	40.00	9.00	69.00	-	40.00	0.06	30.00	-	53.00	-	30.00	0.05
May-17	90.00	22.00	204.00	0.47	-	90.00	0.14	20.00	-	87.00	-	20.00	0.03	70.00	-	161.00	-	70.00	0.11
Jun-17	100.00	58.00	189.00	0.26	-	100.00	0.15	80.00	45.00	174.00	-	80.00	0.12	20.00	-	57.00	-	20.00	0.03
Jul-17	440.00	203.00	621.00	0.29	-	440.00	0.66	300.00	155.00	429.00	-	300.00	0.45	140.00	28.00	227.00	-	140.00	0.21
Aug-17	521.00	271.00	791.00	0.34	-	521.00	0.78	421.00	233.00	610.00	-	421.00	0.63	100.00	10.00	205.00	-	100.00	0.15
Sep-17	260.00	148.00	312.00	0.20	-	260.00	0.39	150.00	63.00	203.00	-	150.00	0.23	110.00	36.00	154.00	-	110.00	0.17
Oct-17	209.00	91.00	335.00	0.34	-	209.00	0.31	70.00	12.00	142.00	-	70.00	0.11	140.00	57.00	229.00	-	140.00	0.21
Nov-17	710.00	345.00	1,203.00	0.38	-	710.00	1.07	360.00	152.00	640.00	-	360.00	0.54	350.00	148.00	577.00	-	350.00	0.53
Dec-17	421.00	68.00	866.00	0.55	-	421.00	0.63	50.00	9.00	124.00	-	50.00	0.08	371.00	23.00	878.00	-	371.00	0.56
Jan-18	70.00	9.00	135.00	0.50	-	70.00	0.11	70.00	10.00	132.00	-	70.00	0.11	-	-	-	-	-	-
Feb-18	10.00	-	79.00	1.00	-	10.00	0.02	10.00	-	84.00	-	10.00	0.02	-	-	-	-	-	-
Mar-18	130.00	18.00	252.00	0.55	-	130.00	0.20	50.00	10.00	91.00	-	50.00	0.08	80.00	-	217.00	-	80.00	0.12

Table 18: Gannet design-based abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	40.00	-	129.00	0.57	-	40.00	0.05	40.00	-	129.00	-	40.00	0.05	-	-	-	-	-	-
May-16	749.00	407.00	1,348.00	0.25	-	749.00	0.85	309.00	172.00	474.00	-	309.00	0.35	439.00	183.00	831.00	-	439.00	0.50
Jun-16	1,708.00	1,012.00	2,384.00	0.25	-	1,708.00	1.93	709.00	472.00	966.00	-	709.00	0.80	999.00	426.00	1,595.00	-	999.00	1.13
Jul-16	648.00	372.00	936.00	0.22	-	648.00	0.73	399.00	223.00	608.00	-	399.00	0.45	249.00	50.00	481.00	-	249.00	0.28
Aug-16	319.00	164.00	655.00	0.30	-	319.00	0.36	259.00	124.00	611.00	-	259.00	0.29	60.00	22.00	105.00	-	60.00	0.07
Sep-16	310.00	80.00	466.00	0.40	-	310.00	0.35	130.00	40.00	188.00	-	130.00	0.15	180.00	23.00	308.00	-	180.00	0.20
Oct-16	1,153.00	681.00	1,526.00	0.23	20.00	1,173.00	1.33	248.00	106.00	498.00	-	248.00	0.28	904.00	501.00	1,203.00	20.00	924.00	1.05
Nov-16	678.00	293.00	908.00	0.26	-	678.00	0.77	379.00	154.00	510.00	-	379.00	0.43	299.00	126.00	399.00	-	299.00	0.34
Dec-16	418.00	113.00	893.00	0.45	-	418.00	0.47	326.00	105.00	697.00	-	326.00	0.37	92.00	-	220.00	-	92.00	0.10
Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-17	50.00	10.00	99.00	0.48	-	50.00	0.06	40.00	-	82.00	-	40.00	0.05	10.00	-	51.00	-	10.00	0.01
Mar-17	389.00	126.00	646.00	0.36	-	389.00	0.44	150.00	68.00	211.00	-	150.00	0.17	239.00	30.00	465.00	-	239.00	0.27
Apr-17	120.00	39.00	193.00	0.41	-	120.00	0.14	60.00	20.00	89.00	-	60.00	0.07	60.00	-	124.00	-	60.00	0.07
May-17	140.00	44.00	278.00	0.41	-	140.00	0.16	20.00	-	57.00	-	20.00	0.02	120.00	32.00	256.00	-	120.00	0.14
Jun-17	159.00	96.00	426.00	0.25	-	159.00	0.18	120.00	71.00	392.00	-	120.00	0.14	40.00	-	124.00	-	40.00	0.05
Jul-17	559.00	305.00	1,082.00	0.24	-	559.00	0.63	419.00	242.00	1,034.00	-	419.00	0.47	140.00	20.00	222.00	-	140.00	0.16
Aug-17	720.00	457.00	1,054.00	0.26	-	720.00	0.81	520.00	332.00	792.00	-	520.00	0.59	200.00	40.00	381.00	-	200.00	0.23
Sep-17	349.00	230.00	408.00	0.17	-	349.00	0.39	199.00	84.00	270.00	-	199.00	0.23	150.00	62.00	236.00	-	150.00	0.17
Oct-17	296.00	162.00	413.00	0.25	-	296.00	0.33	83.00	19.00	146.00	-	83.00	0.09	213.00	118.00	302.00	-	213.00	0.24
Nov-17	1,238.00	582.00	1,947.00	0.33	-	1,238.00	1.40	649.00	309.00	1,034.00	-	649.00	0.73	589.00	230.00	1,008.00	-	589.00	0.67
Dec-17	480.00	129.00	930.00	0.49	-	480.00	0.54	60.00	12.00	112.00	-	60.00	0.07	420.00	68.00	868.00	-	420.00	0.48
Jan-18	120.00	19.00	261.00	0.48	-	120.00	0.14	120.00	19.00	250.00	-	120.00	0.14	-	-	-	-	-	-
Feb-18	20.00	-	103.00	0.68	-	20.00	0.02	20.00	-	106.00	-	20.00	0.02	-	-	-	-	-	-
Mar-18	180.00	48.00	317.00	0.45	-	180.00	0.20	70.00	17.00	111.00	-	70.00	0.08	110.00	-	240.00	-	110.00	0.12

4.3 Great black-backed gull

Table 19: Great black-backed gull design-based abundance estimates for the DCO array area including apportionment of unidentified species groups.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun-16	10.00	-	30.00	1.00	8.10	18.10	0.04	10.00	-	29.00	8.10	18.10	0.04	-	-	-	-	-	-
Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-16	10.00	-	27.00	1.00	10.11	20.11	0.04	-	-	-	-	-	-	10.00	-	27.00	10.11	20.11	0.04
Oct-16	10.00	-	53.00	1.00	-	10.00	0.02	-	-	-	-	-	-	10.00	-	48.00	-	10.00	0.02
Nov-16	50.00	10.00	126.00	0.46	-	50.00	0.11	30.00	-	76.00	-	30.00	0.06	20.00	-	63.00	-	20.00	0.04
Dec-16	90.00	-	166.00	0.59	8.61	98.61	0.21	30.00	-	66.00	8.61	38.61	0.08	60.00	-	113.00	-	60.00	0.13
Jan-17	179.00	83.00	904.00	0.32	-	179.00	0.38	80.00	32.00	854.00	-	80.00	0.17	100.00	25.00	152.00	-	100.00	0.21
Feb-17	190.00	88.00	323.00	0.38	16.67	206.67	0.44	10.00	-	53.00	-	10.00	0.02	180.00	64.00	304.00	16.67	196.67	0.42
Mar-17	40.00	-	73.00	0.56	-	40.00	0.09	20.00	-	40.00	-	20.00	0.04	20.00	-	42.00	-	20.00	0.04
Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May-17	10.00	-	29.00	1.00	-	10.00	0.02	10.00	-	31.00	-	10.00	0.02	-	-	-	-	-	-
Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct-17	-	-	-	-	10.00	10.00	0.02	-	-	-	10.00	10.00	0.02	-	-	-	-	-	-
Nov-17	140.00	34.00	337.00	0.42	-	140.00	0.30	60.00	20.00	123.00	-	60.00	0.13	80.00	-	247.00	-	80.00	0.17
Dec-17	269.00	63.00	548.00	0.61	3.23	272.23	0.58	60.00	10.00	182.00	-	60.00	0.13	210.00	19.00	471.00	3.23	213.23	0.46
Jan-18	90.00	29.00	165.00	0.37	10.00	100.00	0.21	40.00	-	98.00	-	40.00	0.09	50.00	10.00	98.00	10.00	60.00	0.13
Feb-18	50.00	-	98.00	0.54	6.50	56.50	0.12	10.00	-	34.00	0.34	10.34	0.02	40.00	-	85.00	6.15	46.15	0.10
Mar-18	20.00	-	40.00	0.67	-	20.00	0.04	20.00	-	40.00	-	20.00	0.04	-	-	-	-	-	-

Table 20: Great black-backed gull design-based abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun-16	10.00	-	29.00	1.00	8.07	18.07	0.03	10.00	-	29.00	8.07	18.07	0.03	-	-	-	-	-	-
Jul-16	-	-	-	-	1.67	1.67	0.00	-	-	-	1.67	1.67	0.00	-	-	-	-	-	-
Aug-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-16	10.00	-	27.00	1.00	35.38	45.38	0.07	-	-	-	25.31	25.31	0.04	10.00	-	28.00	10.07	20.07	0.03
Oct-16	10.00	-	32.00	1.00	-	10.00	0.02	-	-	-	-	-	-	10.00	-	34.00	-	10.00	0.02
Nov-16	120.00	68.00	171.00	0.23	-	120.00	0.18	50.00	10.00	88.00	-	50.00	0.08	70.00	28.00	132.00	-	70.00	0.11
Dec-16	123.00	12.00	239.00	0.56	9.03	132.03	0.20	41.00	-	96.00	9.03	50.03	0.08	82.00	11.00	151.00	-	82.00	0.12
Jan-17	240.00	103.00	394.00	0.33	5.00	245.00	0.37	90.00	36.00	168.00	-	90.00	0.14	150.00	61.00	229.00	5.00	155.00	0.23
Feb-17	250.00	126.00	459.00	0.32	16.90	266.90	0.40	30.00	-	104.00	-	30.00	0.05	220.00	111.00	371.00	16.90	236.90	0.36
Mar-17	120.00	13.00	677.00	0.67	30.66	150.66	0.23	30.00	-	91.00	10.60	40.60	0.06	90.00	-	580.00	20.06	110.06	0.17
Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May-17	10.00	-	29.00	1.00	-	10.00	0.02	10.00	-	30.00	-	10.00	0.02	-	-	-	-	-	-
Jun-17	-	-	-	-	1.67	1.67	0.00	-	-	-	-	-	-	-	-	-	1.67	1.67	0.00
Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct-17	-	-	-	-	8.44	8.44	0.01	-	-	-	8.44	8.44	0.01	-	-	-	-	-	-
Nov-17	200.00	78.00	346.00	0.35	13.93	213.93	0.32	90.00	32.00	156.00	10.00	100.00	0.15	110.00	14.00	221.00	3.93	113.93	0.17
Dec-17	301.00	81.00	571.00	0.55	6.45	307.45	0.46	70.00	10.00	154.00	-	70.00	0.11	231.00	36.00	472.00	6.45	237.45	0.36
Jan-18	170.00	75.00	373.00	0.35	13.85	183.85	0.28	80.00	22.00	213.00	-	80.00	0.12	90.00	35.00	172.00	13.85	103.85	0.16
Feb-18	80.00	20.00	141.00	0.43	7.97	87.97	0.13	10.00	-	33.00	0.20	10.20	0.02	70.00	8.00	125.00	7.78	77.78	0.12
Mar-18	80.00	14.00	215.00	0.47	7.82	87.82	0.13	20.00	-	41.00	-	20.00	0.03	60.00	-	194.00	7.82	67.82	0.10

Table 21: Great black-backed gull design-based abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun-16	10.00	-	27.00	1.00	8.11	18.11	0.02	10.00	-	29.00	8.11	18.11	0.02	-	-	-	-	-	-
Jul-16	-	-	-	-	3.33	3.33	0.00	-	-	-	3.33	3.33	0.00	-	-	-	-	-	-
Aug-16	40.00	-	170.00	1.00	0.95	40.95	0.05	-	-	-	-	-	-	40.00	-	180.00	0.95	40.95	0.05
Sep-16	50.00	-	125.00	0.81	33.96	83.96	0.09	-	-	-	25.31	25.31	0.03	50.00	-	128.00	8.65	58.65	0.07
Oct-16	80.00	10.00	490.00	0.54	-	80.00	0.09	70.00	9.00	458.00	-	70.00	0.08	10.00	-	30.00	-	10.00	0.01
Nov-16	170.00	82.00	216.00	0.24	5.71	175.71	0.20	90.00	27.00	140.00	-	90.00	0.10	80.00	23.00	123.00	5.71	85.71	0.10
Dec-16	184.00	60.00	327.00	0.43	9.82	193.82	0.22	61.00	-	132.00	9.82	70.82	0.08	122.00	31.00	229.00	-	122.00	0.14
Jan-17	299.00	166.00	449.00	0.26	15.01	314.01	0.36	119.00	61.00	201.00	8.57	127.57	0.14	179.00	96.00	273.00	6.44	185.44	0.21
Feb-17	319.00	182.00	501.00	0.25	23.66	342.66	0.39	40.00	8.00	84.00	-	40.00	0.05	279.00	160.00	448.00	23.66	302.66	0.34
Mar-17	130.00	10.00	448.00	0.63	45.30	175.30	0.20	30.00	-	72.00	30.51	60.51	0.07	100.00	-	375.00	14.80	114.80	0.13
Apr-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May-17	10.00	-	29.00	1.00	-	10.00	0.01	10.00	-	27.00	-	10.00	0.01	-	-	-	-	-	-
Jun-17	-	-	-	-	1.67	1.67	0.00	-	-	-	-	-	-	-	-	-	1.67	1.67	0.00
Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct-17	-	-	-	-	9.00	9.00	0.01	-	-	-	9.00	9.00	0.01	-	-	-	-	-	-
Nov-17	290.00	99.00	474.00	0.38	13.53	303.53	0.34	110.00	39.00	172.00	10.00	120.00	0.14	180.00	11.00	317.00	3.53	183.53	0.21
Dec-17	400.00	125.00	696.00	0.46	5.35	405.35	0.46	110.00	39.00	177.00	-	110.00	0.12	290.00	53.00	548.00	5.35	295.35	0.33
Jan-18	219.00	108.00	346.00	0.29	18.95	237.95	0.27	100.00	35.00	174.00	-	100.00	0.11	120.00	43.00	195.00	18.95	138.95	0.16
Feb-18	120.00	52.00	200.00	0.33	6.00	126.00	0.14	40.00	-	120.00	0.67	40.67	0.05	80.00	10.00	141.00	5.33	85.33	0.10
Mar-18	140.00	60.00	262.00	0.34	21.70	161.70	0.18	40.00	-	74.00	1.86	41.86	0.05	100.00	31.00	224.00	19.84	119.84	0.14

4.4 Kittiwake

Table 22: Kittiwake design-based abundance estimates for the DCO array area including apportionment of unidentified species groups.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	1,389.00	760.00	2,657.00	0.31	2.43	1,391.43	2.97	1,049.00	491.00	1,858.00	-	1,049.00	2.24	340.00	120.00	1,241.00	2.43	342.43	0.73
May-16	907.00	498.00	2,116.00	0.35	21.94	928.94	1.98	608.00	395.00	1,747.00	-	608.00	1.30	299.00	46.00	589.00	21.94	320.94	0.69
Jun-16	1,446.00	613.00	2,644.00	0.32	69.62	1,515.62	3.24	968.00	552.00	1,291.00	9.42	977.42	2.09	479.00	41.00	1,422.00	60.20	539.20	1.15
Jul-16	1,172.00	459.00	2,881.00	0.35	29.10	1,201.10	2.57	521.00	183.00	1,953.00	-	521.00	1.11	651.00	152.00	1,661.00	29.10	680.10	1.45
Aug-16	449.00	262.00	580.00	0.23	5.12	454.12	0.97	429.00	219.00	585.00	-	429.00	0.92	20.00	-	64.00	5.12	25.12	0.05
Sep-16	2,374.00	113.00	6,505.00	0.88	19.84	2,393.84	5.12	491.00	122.00	872.00	-	491.00	1.05	1,883.00	-	5,624.00	19.84	1,902.84	4.07
Oct-16	50.00	10.00	74.00	0.36	5.73	55.73	0.12	40.00	5.00	61.00	5.71	45.71	0.10	10.00	-	37.00	0.02	10.02	0.02
Nov-16	40.00	-	101.00	0.56	0.11	40.11	0.09	20.00	-	57.00	-	20.00	0.04	20.00	-	51.00	0.11	20.11	0.04
Dec-16	200.00	74.00	320.00	0.39	17.04	217.04	0.46	190.00	55.00	315.00	7.04	197.04	0.42	10.00	-	29.00	10.00	20.00	0.04
Jan-17	219.00	55.00	356.00	0.44	-	219.00	0.47	130.00	33.00	187.00	-	130.00	0.28	90.00	-	179.00	-	90.00	0.19
Feb-17	30.00	-	58.00	0.52	10.44	40.44	0.09	20.00	-	45.00	10.00	30.00	0.06	10.00	-	28.00	0.44	10.44	0.02
Mar-17	350.00	206.00	491.00	0.24	-	350.00	0.75	240.00	133.00	341.00	-	240.00	0.51	110.00	29.00	184.00	-	110.00	0.24
Apr-17	170.00	73.00	302.00	0.31	-	170.00	0.36	150.00	62.00	215.00	-	150.00	0.32	20.00	-	82.00	-	20.00	0.04
May-17	1,153.00	541.00	2,057.00	0.35	9.12	1,162.12	2.48	1,023.00	458.00	1,885.00	-	1,023.00	2.19	130.00	39.00	314.00	9.12	139.12	0.30
Jun-17	160.00	84.00	266.00	0.30	-	160.00	0.34	160.00	78.00	264.00	-	160.00	0.34	-	-	-	-	-	-
Jul-17	411.00	203.00	694.00	0.36	0.70	411.70	0.88	331.00	197.00	528.00	-	331.00	0.71	80.00	-	228.00	0.70	80.70	0.17
Aug-17	5,047.00	2,258.00	9,996.00	0.32	14.62	5,061.62	10.82	1,556.00	698.00	4,607.00	-	1,556.00	3.32	3,491.00	1,069.00	6,145.00	14.62	3,505.62	7.49
Sep-17	30.00	4.00	62.00	0.52	-	30.00	0.06	20.00	-	49.00	-	20.00	0.04	10.00	-	28.00	-	10.00	0.02
Oct-17	120.00	33.00	201.00	0.40	15.00	135.00	0.29	90.00	-	172.00	-	90.00	0.19	30.00	-	62.00	15.00	45.00	0.10
Nov-17	339.00	135.00	473.00	0.34	0.09	339.09	0.72	259.00	123.00	343.00	-	259.00	0.55	80.00	-	192.00	0.09	80.09	0.17
Dec-17	958.00	298.00	2,140.00	0.49	21.35	979.35	2.09	519.00	259.00	1,272.00	8.67	527.67	1.13	439.00	-	1,018.00	12.68	451.68	0.97
Jan-18	70.00	21.00	111.00	0.33	2.19	72.19	0.15	70.00	21.00	110.00	2.19	72.19	0.15	-	-	-	-	-	-
Feb-18	260.00	161.00	367.00	0.27	13.99	273.99	0.59	220.00	144.00	321.00	7.59	227.59	0.49	40.00	8.00	66.00	6.40	46.40	0.10
Mar-18	180.00	70.00	320.00	0.30	20.75	200.75	0.43	100.00	45.00	197.00	-	100.00	0.21	80.00	10.00	157.00	20.75	100.75	0.22

Table 23: Kittiwake design-based abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	1,883.00	1,032.00	3,408.00	0.30	2.19	1,885.19	2.84	1,413.00	864.00	2,435.00	-	1,413.00	2.13	471.00	131.00	977.00	2.19	473.19	0.71
May-16	2,452.00	1,180.00	8,532.00	0.33	63.49	2,515.49	3.79	1,481.00	712.00	5,072.00	-	1,481.00	2.23	971.00	338.00	3,321.00	63.49	1,034.49	1.56
Jun-16	2,132.00	1,430.00	3,271.00	0.20	71.88	2,203.88	3.32	1,421.00	1,121.00	2,086.00	9.59	1,430.59	2.15	711.00	180.00	1,583.00	62.29	773.29	1.16
Jul-16	1,292.00	478.00	2,330.00	0.34	28.75	1,320.75	1.99	601.00	231.00	1,363.00	-	601.00	0.91	691.00	172.00	1,607.00	28.75	719.75	1.08
Aug-16	922.00	541.00	1,361.00	0.27	15.90	937.90	1.41	651.00	422.00	951.00	-	651.00	0.98	270.00	24.00	573.00	15.90	285.90	0.43
Sep-16	3,608.00	302.00	10,604.00	0.63	31.05	3,639.05	5.48	600.00	132.00	943.00	-	600.00	0.90	3,008.00	38.00	9,745.00	31.05	3,039.05	4.58
Oct-16	60.00	14.00	97.00	0.40	4.47	64.47	0.10	40.00	9.00	63.00	4.44	44.44	0.07	20.00	-	49.00	0.02	20.02	0.03
Nov-16	40.00	-	91.00	0.57	0.08	40.08	0.06	20.00	-	54.00	-	20.00	0.03	20.00	-	47.00	0.08	20.08	0.03
Dec-16	298.00	141.00	438.00	0.30	17.18	315.18	0.47	288.00	127.00	439.00	7.18	295.18	0.44	10.00	-	30.00	10.00	20.00	0.03
Jan-17	340.00	201.00	573.00	0.35	5.00	345.00	0.52	190.00	95.00	339.00	-	190.00	0.29	150.00	44.00	281.00	5.00	155.00	0.23
Feb-17	50.00	7.00	92.00	0.47	10.72	60.72	0.09	30.00	-	56.00	10.00	40.00	0.06	20.00	-	43.00	0.72	20.72	0.03
Mar-17	601.00	336.00	1,758.00	0.27	52.70	653.70	0.98	451.00	229.00	1,509.00	9.00	460.00	0.69	150.00	70.00	288.00	43.70	193.70	0.29
Apr-17	250.00	119.00	419.00	0.29	10.14	260.14	0.39	230.00	126.00	361.00	-	230.00	0.35	20.00	-	70.00	10.14	30.14	0.05
May-17	1,482.00	771.00	2,437.00	0.33	19.43	1,501.43	2.26	1,292.00	625.00	2,116.00	9.92	1,301.92	1.96	190.00	82.00	410.00	9.51	199.51	0.30
Jun-17	390.00	194.00	1,386.00	0.33	33.06	423.06	0.64	320.00	150.00	1,007.00	-	320.00	0.48	70.00	-	409.00	33.06	103.06	0.16
Jul-17	731.00	467.00	1,330.00	0.23	0.50	731.50	1.10	641.00	445.00	1,245.00	-	641.00	0.97	90.00	-	227.00	0.50	90.50	0.14
Aug-17	5,705.00	2,446.00	9,650.00	0.31	23.20	5,728.20	8.63	1,905.00	753.00	3,979.00	9.60	1,914.60	2.88	3,800.00	1,242.00	6,331.00	13.60	3,813.60	5.74
Sep-17	40.00	-	89.00	0.57	-	40.00	0.06	30.00	-	81.00	-	30.00	0.05	10.00	-	28.00	-	10.00	0.02
Oct-17	140.00	37.00	237.00	0.42	12.00	152.00	0.23	110.00	-	225.00	-	110.00	0.17	30.00	-	69.00	12.00	42.00	0.06
Nov-17	550.00	289.00	698.00	0.23	5.10	555.10	0.84	410.00	231.00	510.00	-	410.00	0.62	140.00	17.00	281.00	5.10	145.10	0.22
Dec-17	1,624.00	596.00	3,066.00	0.42	58.42	1,682.42	2.53	782.00	438.00	1,480.00	17.14	799.14	1.20	842.00	12.00	1,886.00	41.28	883.28	1.33
Jan-18	150.00	59.00	241.00	0.35	5.88	155.88	0.23	150.00	57.00	231.00	5.88	155.88	0.23	-	-	-	-	-	-
Feb-18	480.00	303.00	1,221.00	0.23	15.15	495.15	0.75	420.00	257.00	1,135.00	8.24	428.24	0.64	60.00	20.00	117.00	6.91	66.91	0.10
Mar-18	261.00	126.00	492.00	0.28	20.98	281.98	0.42	180.00	85.00	414.00	-	180.00	0.27	80.00	13.00	148.00	20.98	100.98	0.15

Table 24: Kittiwake design-based abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/km2)
Apr-16	2,811.00	1,650.00	4,894.00	0.26	5.38	2,816.38	3.19	2,060.00	1,345.00	3,421.00	-	2,060.00	2.33	750.00	299.00	1,512.00	5.38	755.38	0.85
May-16	3,603.00	1,895.00	8,004.00	0.28	121.40	3,724.40	4.21	2,156.00	1,356.00	4,627.00	-	2,156.00	2.44	1,447.00	495.00	3,529.00	121.40	1,568.40	1.77
Jun-16	2,677.00	2,024.00	4,060.00	0.17	85.25	2,762.25	3.12	1,788.00	1,510.00	2,791.00	19.25	1,807.25	2.04	889.00	316.00	1,673.00	66.00	955.00	1.08
Jul-16	1,706.00	878.00	2,671.00	0.29	70.79	1,776.79	2.01	808.00	457.00	1,495.00	-	808.00	0.91	898.00	275.00	1,824.00	70.79	968.79	1.10
Aug-16	4,219.00	1,531.00	7,413.00	0.42	77.55	4,296.55	4.86	2,214.00	926.00	3,580.00	6.59	2,220.59	2.51	2,005.00	296.00	4,095.00	70.97	2,075.97	2.35
Sep-16	3,894.00	618.00	8,289.00	0.58	50.02	3,944.02	4.46	809.00	350.00	1,427.00	19.52	828.52	0.94	3,085.00	58.00	7,609.00	30.50	3,115.50	3.52
Oct-16	89.00	29.00	145.00	0.32	5.40	94.40	0.11	70.00	20.00	120.00	5.38	75.38	0.09	20.00	-	45.00	0.02	20.02	0.02
Nov-16	50.00	9.00	97.00	0.48	2.23	52.23	0.06	20.00	-	53.00	-	20.00	0.02	30.00	-	58.00	2.23	32.23	0.04
Dec-16	357.00	189.00	533.00	0.26	17.08	374.08	0.42	347.00	178.00	533.00	7.08	354.08	0.40	10.00	-	30.00	10.00	20.00	0.02
Jan-17	537.00	260.00	732.00	0.29	11.10	548.10	0.62	229.00	120.00	320.00	-	229.00	0.26	308.00	96.00	444.00	11.10	319.10	0.36
Feb-17	70.00	20.00	149.00	0.41	11.57	81.57	0.09	40.00	10.00	122.00	10.00	50.00	0.06	30.00	-	54.00	1.57	31.57	0.04
Mar-17	897.00	448.00	1,733.00	0.27	72.89	969.89	1.10	538.00	276.00	1,128.00	9.15	547.15	0.62	359.00	161.00	802.00	63.74	422.74	0.48
Apr-17	319.00	170.00	491.00	0.27	10.08	329.08	0.37	299.00	161.00	447.00	-	299.00	0.34	20.00	-	66.00	10.08	30.08	0.03
May-17	2,078.00	1,105.00	3,506.00	0.31	29.25	2,107.25	2.38	1,758.00	893.00	3,018.00	9.83	1,767.83	2.00	320.00	118.00	537.00	19.42	339.42	0.38
Jun-17	1,017.00	361.00	6,088.00	0.50	47.06	1,064.06	1.20	817.00	314.00	4,553.00	-	817.00	0.92	199.00	-	1,435.00	47.06	246.06	0.28
Jul-17	958.00	697.00	1,547.00	0.17	10.35	968.35	1.10	868.00	678.00	1,477.00	-	868.00	0.98	90.00	-	226.00	10.35	100.35	0.11
Aug-17	13,023.00	6,436.00	29,020.00	0.31	50.88	13,073.88	14.79	3,778.00	1,603.00	8,767.00	9.72	3,787.72	4.28	9,245.00	4,092.00	22,618.00	41.16	9,286.16	10.50
Sep-17	40.00	-	87.00	0.57	7.50	47.50	0.05	30.00	-	76.00	7.50	37.50	0.04	10.00	-	26.00	-	10.00	0.01
Oct-17	148.00	43.00	242.00	0.38	16.28	164.28	0.19	120.00	18.00	222.00	4.88	124.88	0.14	28.00	-	65.00	11.40	39.40	0.04
Nov-17	879.00	541.00	1,208.00	0.20	6.08	885.08	1.00	589.00	358.00	788.00	-	589.00	0.67	290.00	68.00	592.00	6.08	296.08	0.33
Dec-17	3,257.00	1,273.00	5,259.00	0.37	89.62	3,346.62	3.79	1,389.00	924.00	2,186.00	17.71	1,406.71	1.59	1,868.00	66.00	3,576.00	71.91	1,939.91	2.19
Jan-18	219.00	104.00	324.00	0.28	6.20	225.20	0.25	219.00	101.00	334.00	6.20	225.20	0.25	-	-	-	-	-	-
Feb-18	588.00	326.00	927.00	0.26	16.16	604.16	0.68	468.00	245.00	728.00	7.83	475.83	0.54	120.00	43.00	211.00	8.33	128.33	0.15
Mar-18	389.00	181.00	834.00	0.27	40.70	429.70	0.49	309.00	144.00	799.00	14.42	323.42	0.37	80.00	12.00	149.00	26.28	106.28	0.12

4.5 Guillemot

Table 25: Guillemot design-based abundance estimates for the DCO array area including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	859.00	492.00	1,141.00	0.22	101.34	1,225.88	2.62	70.00	-	131.00	42.00	112.00	0.24	790.00	427.00	1,066.00	59.34	1,113.88	2.38
May-16	3,778.00	2,033.00	7,516.00	0.27	291.14	5,273.28	11.27	169.00	53.00	339.00	30.00	199.00	0.43	3,608.00	1,743.00	7,773.00	261.14	5,074.28	10.84
Jun-16	3,980.00	2,317.00	7,213.00	0.28	369.82	5,586.64	11.94	359.00	191.00	612.00	20.00	379.00	0.81	3,621.00	2,036.00	6,454.00	349.82	5,207.64	11.13
Jul-16	5,178.00	4,055.00	6,925.00	0.13	226.74	7,041.67	15.05	140.00	70.00	247.00	9.33	149.33	0.32	5,038.00	3,816.00	6,845.00	217.41	6,892.34	14.73
Aug-16	3,230.00	1,343.00	10,752.00	0.42	149.02	4,431.50	9.47	-	-	-	-	-	-	3,230.00	1,309.00	10,923.00	149.02	4,431.50	9.47
Sep-16	13,260.00	5,632.00	28,512.00	0.32	453.70	17,985.19	38.43	-	-	-	-	-	-	13,260.00	5,736.00	29,003.00	453.70	17,985.19	38.43
Oct-16	5,932.00	3,911.00	6,841.00	0.20	561.45	8,491.71	18.14	60.00	15.00	93.00	18.00	78.00	0.17	5,872.00	3,935.00	6,748.00	543.45	8,413.71	17.98
Nov-16	1,632.00	1,074.00	1,982.00	0.17	11.10	2,151.15	4.60	10.00	-	36.00	2.00	12.00	0.03	1,622.00	1,107.00	1,976.00	9.10	2,139.15	4.57
Dec-16	808.00	430.00	1,112.00	0.29	70.00	1,151.48	2.46	-	-	-	-	-	-	808.00	407.00	1,155.00	70.00	1,151.48	2.46
Jan-17	2,232.00	1,332.00	2,700.00	0.18	25.90	2,951.83	6.31	30.00	-	70.00	-	30.00	0.06	2,202.00	1,328.00	2,620.00	25.90	2,921.83	6.24
Feb-17	2,592.00	1,846.00	3,413.00	0.17	138.81	3,525.32	7.53	180.00	66.00	348.00	-	180.00	0.38	2,412.00	1,688.00	3,166.00	138.81	3,345.32	7.15
Mar-17	5,003.00	2,534.00	10,707.00	0.43	368.70	6,799.78	14.53	740.00	368.00	1,247.00	46.84	786.84	1.68	4,263.00	1,966.00	9,512.00	321.87	6,012.94	12.85
Apr-17	881.00	444.00	2,414.00	0.35	123.28	1,290.92	2.76	70.00	19.00	187.00	14.00	84.00	0.18	811.00	388.00	2,250.00	109.28	1,206.92	2.58
May-17	2,737.00	1,754.00	4,277.00	0.22	229.28	3,776.56	8.07	331.00	186.00	459.00	33.85	364.85	0.78	2,406.00	1,430.00	3,973.00	195.43	3,411.71	7.29
Jun-17	270.00	97.00	500.00	0.42	10.00	357.87	0.76	30.00	-	90.00	-	30.00	0.06	240.00	70.00	432.00	10.00	327.87	0.70
Jul-17	2,233.00	961.00	3,571.00	0.34	79.02	3,016.59	6.45	50.00	17.00	91.00	-	50.00	0.11	2,183.00	1,002.00	3,573.00	79.02	2,966.59	6.34
Aug-17	22,921.00	14,507.00	30,796.00	0.20	2,047.35	32,742.26	69.96	10.00	-	34.00	-	10.00	0.02	22,911.00	14,109.00	30,531.00	2,047.35	32,732.26	69.94
Sep-17	1,350.00	884.00	1,768.00	0.20	173.71	1,950.55	4.17	140.00	-	374.00	13.33	153.33	0.33	1,210.00	833.00	1,659.00	160.38	1,797.21	3.84
Oct-17	800.00	543.00	968.00	0.17	57.41	1,078.20	2.30	130.00	62.00	245.00	18.57	148.57	0.32	670.00	399.00	851.00	38.84	929.63	1.99
Nov-17	8,979.00	5,942.00	12,554.00	0.26	571.94	12,428.91	26.56	160.00	53.00	276.00	151.11	311.11	0.66	8,819.00	5,842.00	12,526.00	420.82	12,117.80	25.89
Dec-17	3,294.00	2,311.00	4,748.00	0.24	123.15	4,456.17	9.52	80.00	11.00	166.00	1.33	81.33	0.17	3,214.00	2,225.00	4,491.00	121.82	4,374.84	9.35
Jan-18	1,148.00	870.00	1,495.00	0.19	208.88	1,698.21	3.63	249.00	112.00	349.00	7.81	256.81	0.55	898.00	681.00	1,317.00	201.06	1,441.40	3.08
Feb-18	1,592.00	983.00	2,169.00	0.20	60.89	2,097.64	4.48	200.00	44.00	453.00	25.00	225.00	0.48	1,392.00	765.00	1,938.00	35.89	1,872.64	4.00
Mar-18	870.00	685.00	1,515.00	0.18	26.10	1,156.53	2.47	50.00	-	116.00	10.00	60.00	0.13	820.00	593.00	1,505.00	16.10	1,096.53	2.34

Table 26: Guillemot design-based abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	1,453.00	714.00	4,009.00	0.28	156.59	2,066.58	3.11	80.00	12.00	167.00	58.18	138.18	0.21	1,372.00	647.00	3,688.00	98.40	1,928.40	2.90
May-16	6,586.00	4,153.00	15,482.00	0.22	511.51	9,196.08	13.85	320.00	166.00	502.00	40.00	360.00	0.54	6,266.00	3,728.00	14,814.00	471.51	8,836.08	13.31
Jun-16	6,406.00	4,689.00	10,645.00	0.18	470.39	8,832.33	13.30	561.00	349.00	1,201.00	40.00	601.00	0.91	5,846.00	3,960.00	9,547.00	430.39	8,231.33	12.40
Jul-16	6,899.00	5,330.00	8,878.00	0.14	306.87	9,381.94	14.13	210.00	106.00	305.00	9.55	219.55	0.33	6,689.00	5,158.00	8,828.00	297.33	9,162.40	13.80
Aug-16	6,953.00	3,363.00	11,734.00	0.36	265.61	9,467.03	14.26	-	-	-	-	-	-	6,953.00	3,215.00	12,398.00	265.61	9,467.03	14.26
Sep-16	17,979.00	8,126.00	31,634.00	0.33	613.26	24,383.29	36.72	-	-	-	-	-	-	17,979.00	8,070.00	31,507.00	613.26	24,383.29	36.72
Oct-16	8,624.00	7,127.00	10,242.00	0.12	774.06	12,278.11	18.49	120.00	45.00	293.00	31.58	151.58	0.23	8,504.00	7,017.00	9,836.00	742.48	12,126.53	18.26
Nov-16	2,427.00	1,583.00	2,950.00	0.19	78.59	3,263.53	4.91	50.00	-	121.00	22.22	72.22	0.11	2,377.00	1,527.00	2,979.00	56.37	3,191.30	4.81
Dec-16	1,286.00	761.00	1,688.00	0.24	68.90	1,776.91	2.68	-	-	-	-	-	-	1,286.00	758.00	1,768.00	68.90	1,776.91	2.68
Jan-17	3,001.00	2,225.00	3,693.00	0.15	52.91	3,977.09	5.99	90.00	19.00	233.00	-	90.00	0.14	2,911.00	2,175.00	3,511.00	52.91	3,887.09	5.85
Feb-17	3,718.00	2,567.00	5,426.00	0.17	167.55	5,027.28	7.57	220.00	74.00	334.00	-	220.00	0.33	3,498.00	2,336.00	5,258.00	167.55	4,807.28	7.24
Mar-17	6,108.00	3,184.00	11,134.00	0.36	493.56	8,312.33	12.52	1,041.00	626.00	1,679.00	63.86	1,104.86	1.66	5,066.00	2,299.00	9,418.00	429.70	7,207.47	10.85
Apr-17	1,351.00	820.00	2,562.00	0.23	230.97	2,042.67	3.08	90.00	21.00	175.00	12.86	102.86	0.15	1,261.00	766.00	2,463.00	218.11	1,939.82	2.92
May-17	4,115.00	2,812.00	6,189.00	0.20	340.86	5,653.62	8.51	581.00	302.00	833.00	33.62	614.62	0.93	3,535.00	2,385.00	5,755.00	307.24	5,039.00	7.59
Jun-17	480.00	307.00	918.00	0.23	66.72	685.87	1.03	100.00	45.00	221.00	-	100.00	0.15	380.00	183.00	743.00	66.72	585.87	0.88
Jul-17	3,573.00	1,998.00	5,470.00	0.26	128.83	4,836.16	7.28	60.00	25.00	126.00	-	60.00	0.09	3,513.00	2,024.00	5,526.00	128.83	4,776.16	7.19
Aug-17	33,820.00	23,914.00	48,891.00	0.17	2,391.72	47,487.67	71.52	10.00	-	33.00	-	10.00	0.02	33,810.00	23,103.00	47,228.00	2,391.72	47,477.67	71.50
Sep-17	2,204.00	1,669.00	2,720.00	0.14	310.84	3,232.93	4.87	170.00	19.00	408.00	35.17	205.17	0.31	2,033.00	1,416.00	2,631.00	275.67	3,027.76	4.56
Oct-17	1,167.00	896.00	1,426.00	0.14	71.41	1,533.35	2.31	269.00	128.00	434.00	22.50	291.50	0.44	898.00	592.00	1,157.00	48.91	1,241.85	1.87
Nov-17	13,498.00	9,853.00	17,203.00	0.17	731.87	18,514.88	27.88	300.00	185.00	460.00	172.73	472.73	0.71	13,198.00	9,793.00	16,628.00	559.14	18,042.15	27.17
Dec-17	5,402.00	3,681.00	8,345.00	0.20	222.62	7,335.17	11.05	130.00	25.00	372.00	2.86	132.86	0.20	5,272.00	3,771.00	8,272.00	219.77	7,202.32	10.85
Jan-18	1,663.00	1,250.00	1,966.00	0.15	293.38	2,447.22	3.69	351.00	208.00	626.00	33.73	384.73	0.58	1,313.00	932.00	1,528.00	259.65	2,062.49	3.11
Feb-18	2,371.00	1,480.00	3,451.00	0.18	105.33	3,146.69	4.74	290.00	85.00	549.00	34.12	324.12	0.49	2,081.00	1,322.00	3,171.00	71.21	2,822.57	4.25
Mar-18	1,253.00	969.00	1,676.00	0.15	52.90	1,687.74	2.54	70.00	16.00	130.00	10.00	80.00	0.12	1,183.00	861.00	1,607.00	42.90	1,607.74	2.42

Table 27: Guillemot design-based abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km²)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km²)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km²)
Apr-16	1,800.00	1,089.00	3,065.00	0.23	246.20	2,606.54	2.95	130.00	36.00	199.00	117.23	247.23	0.28	1,670.00	970.00	2,977.00	128.97	2,359.31	2.67
May-16	9,312.00	6,174.00	17,603.00	0.23	683.31	12,964.33	14.67	409.00	183.00	614.00	50.00	459.00	0.52	8,902.00	5,548.00	17,112.00	633.31	12,505.33	14.15
Jun-16	9,699.00	7,734.00	17,286.00	0.14	692.58	13,360.74	15.11	789.00	578.00	1,348.00	70.00	859.00	0.97	8,910.00	6,817.00	16,675.00	622.58	12,501.74	14.14
Jul-16	9,566.00	7,513.00	11,987.00	0.14	542.34	13,154.46	14.88	319.00	175.00	482.00	9.70	328.70	0.37	9,247.00	7,054.00	11,796.00	532.65	12,825.77	14.51
Aug-16	13,494.00	7,405.00	21,392.00	0.31	424.62	18,253.93	20.65	-	-	-	-	-	-	13,494.00	7,490.00	20,977.00	424.62	18,253.93	20.65
Sep-16	23,004.00	11,164.00	36,357.00	0.31	801.60	31,217.34	35.31	10.00	-	29.00	-	10.00	0.01	22,994.00	10,173.00	35,654.00	801.60	31,207.34	35.30
Oct-16	11,439.00	10,198.00	12,475.00	0.10	946.74	16,182.93	18.31	169.00	76.00	282.00	25.76	194.76	0.22	11,270.00	9,894.00	12,276.00	920.98	15,988.17	18.09
Nov-16	3,201.00	1,812.00	4,070.00	0.22	95.54	4,295.30	4.86	60.00	-	128.00	30.00	90.00	0.10	3,141.00	1,849.00	4,030.00	65.54	4,205.30	4.76
Dec-16	1,785.00	1,152.00	2,380.00	0.22	90.96	2,460.28	2.78	-	-	-	-	-	-	1,785.00	1,083.00	2,365.00	90.96	2,460.28	2.78
Jan-17	3,662.00	2,410.00	4,484.00	0.16	131.81	4,920.10	5.57	159.00	22.00	375.00	18.82	177.82	0.20	3,503.00	2,366.00	4,233.00	112.99	4,742.28	5.36
Feb-17	4,845.00	3,413.00	7,207.00	0.17	246.93	6,569.24	7.43	349.00	221.00	511.00	-	349.00	0.39	4,496.00	3,104.00	6,741.00	246.93	6,220.24	7.04
Mar-17	7,936.00	4,265.00	12,980.00	0.32	599.16	10,764.60	12.18	1,286.00	834.00	2,045.00	91.49	1,377.49	1.56	6,650.00	3,076.00	10,856.00	507.67	9,387.11	10.62
Apr-17	2,303.00	1,525.00	3,901.00	0.21	336.51	3,387.21	3.83	209.00	92.00	547.00	30.00	239.00	0.27	2,094.00	1,334.00	3,569.00	306.51	3,148.21	3.56
May-17	5,544.00	4,062.00	7,415.00	0.18	504.15	7,712.93	8.73	669.00	354.00	893.00	34.36	703.36	0.80	4,875.00	3,485.00	6,659.00	469.79	7,009.57	7.93
Jun-17	1,406.00	619.00	6,944.00	0.40	76.22	1,893.06	2.14	159.00	69.00	378.00	-	159.00	0.18	1,246.00	498.00	6,331.00	76.22	1,734.06	1.96
Jul-17	5,090.00	2,928.00	7,587.00	0.23	208.06	6,917.13	7.82	100.00	41.00	143.00	-	100.00	0.11	4,990.00	2,806.00	7,360.00	208.06	6,817.13	7.71
Aug-17	56,271.00	38,041.00	99,621.00	0.20	3,921.27	78,937.57	89.30	10.00	-	30.00	-	10.00	0.01	56,261.00	38,761.00	97,822.00	3,921.27	78,927.57	89.28
Sep-17	3,071.00	2,231.00	3,779.00	0.14	453.53	4,552.01	5.15	189.00	30.00	454.00	32.57	221.57	0.25	2,881.00	1,988.00	3,649.00	420.96	4,330.44	4.90
Oct-17	1,388.00	1,076.00	1,632.00	0.14	192.79	1,949.20	2.20	278.00	149.00	445.00	120.00	398.00	0.45	1,110.00	774.00	1,351.00	72.79	1,551.20	1.75
Nov-17	21,253.00	15,127.00	30,662.00	0.15	1,049.76	29,064.40	32.88	399.00	244.00	575.00	195.35	594.35	0.67	20,854.00	14,720.00	29,580.00	854.42	28,470.05	32.21
Dec-17	7,722.00	5,593.00	10,946.00	0.18	331.80	10,505.58	11.88	180.00	53.00	364.00	2.29	182.29	0.21	7,542.00	5,629.00	10,682.00	329.51	10,323.29	11.68
Jan-18	2,484.00	2,020.00	3,161.00	0.13	373.15	3,593.85	4.07	459.00	283.00	644.00	32.96	491.96	0.56	2,025.00	1,619.00	2,628.00	340.19	3,101.89	3.51
Feb-18	3,286.00	2,247.00	4,096.00	0.17	221.63	4,455.19	5.04	349.00	116.00	582.00	120.65	469.65	0.53	2,938.00	1,976.00	3,649.00	100.98	3,985.55	4.51
Mar-18	1,756.00	1,206.00	2,125.00	0.16	63.22	2,354.71	2.66	90.00	30.00	154.00	10.00	100.00	0.11	1,666.00	1,090.00	2,041.00	53.22	2,254.71	2.55

4.6 Razorbill

Table 28: Razorbill design-based abundance estimates for the DCO array area including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	100.00	35.00	158.00	0.32	12.76	133.13	0.28	10.00	-	26.00	6.00	16.00	0.03	90.00	24.00	151.00	6.76	117.13	0.25
May-16	30.00	-	80.00	1.00	2.16	38.93	0.08	-	-	-	-	-	-	30.00	-	80.00	2.16	38.93	0.08
Jun-16	170.00	21.00	326.00	0.49	16.38	225.62	0.48	-	-	-	-	-	-	170.00	21.00	329.00	16.38	225.62	0.48
Jul-16	70.00	23.00	138.00	0.38	3.26	86.44	0.18	10.00	-	70.00	0.67	10.67	0.02	60.00	11.00	118.00	2.59	75.77	0.16
Aug-16	10.00	-	66.00	1.00	0.46	12.66	0.03	-	-	-	-	-	-	10.00	-	66.00	0.46	12.66	0.03
Sep-16	1,963.00	624.00	4,215.00	0.37	67.16	2,457.53	5.25	-	-	-	-	-	-	1,963.00	665.00	4,264.00	67.16	2,457.53	5.25
Oct-16	280.00	154.00	444.00	0.22	34.18	369.37	0.79	40.00	-	79.00	12.00	52.00	0.11	240.00	116.00	413.00	22.18	317.37	0.68
Nov-16	180.00	92.00	313.00	0.30	8.79	218.42	0.47	40.00	-	110.00	8.00	48.00	0.10	140.00	62.00	283.00	0.79	170.42	0.36
Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan-17	359.00	130.00	472.00	0.32	4.10	437.43	0.93	10.00	-	34.00	-	10.00	0.02	349.00	116.00	469.00	4.10	427.43	0.91
Feb-17	40.00	-	97.00	0.56	1.15	45.60	0.10	20.00	-	79.00	-	20.00	0.04	20.00	-	47.00	1.15	25.60	0.05
Mar-17	290.00	87.00	691.00	0.56	21.30	365.64	0.78	50.00	-	152.00	3.16	53.16	0.11	240.00	75.00	558.00	18.13	312.47	0.67
Apr-17	150.00	29.00	334.00	0.46	22.19	200.86	0.43	30.00	-	109.00	6.00	36.00	0.08	120.00	10.00	296.00	16.19	164.86	0.35
May-17	311.00	68.00	759.00	0.43	26.51	394.63	0.84	60.00	-	136.00	6.15	66.15	0.14	251.00	44.00	720.00	20.36	328.48	0.70
Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-17	3,152.00	1,737.00	6,430.00	0.33	281.66	4,156.46	8.88	-	-	-	-	-	-	3,152.00	1,749.00	6,667.00	281.66	4,156.46	8.88
Sep-17	340.00	141.00	535.00	0.33	42.45	446.82	0.95	70.00	-	203.00	6.67	76.67	0.16	270.00	90.00	464.00	35.79	370.16	0.79
Oct-17	170.00	-	636.00	0.87	22.59	197.04	0.42	150.00	-	575.00	21.43	171.43	0.37	20.00	-	51.00	1.16	25.61	0.05
Nov-17	399.00	41.00	934.00	0.69	36.98	519.57	1.11	20.00	-	138.00	18.89	38.89	0.08	379.00	-	847.00	18.09	480.68	1.03
Dec-17	60.00	-	264.00	0.83	2.27	75.38	0.16	-	-	-	-	-	-	60.00	-	267.00	2.27	75.38	0.16
Jan-18	40.00	-	72.00	0.56	8.94	59.24	0.13	-	-	-	-	-	-	40.00	-	75.00	8.94	59.24	0.13
Feb-18	180.00	35.00	325.00	0.51	8.61	218.85	0.47	40.00	-	85.00	5.00	45.00	0.10	140.00	15.00	288.00	3.61	173.85	0.37
Mar-18	160.00	-	380.00	0.77	3.14	197.48	0.42	-	-	-	-	-	-	160.00	-	368.00	3.14	197.48	0.42

Table 29: Razorbill design-based abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	110.00	33.00	178.00	0.35	14.46	147.02	0.22	10.00	-	29.00	7.27	17.27	0.03	100.00	27.00	157.00	7.18	129.75	0.20
May-16	30.00	-	83.00	1.00	2.26	39.05	0.06	-	-	-	-	-	-	30.00	-	82.00	2.26	39.05	0.06
Jun-16	200.00	59.00	338.00	0.41	14.74	259.94	0.39	-	-	-	-	-	-	200.00	54.00	361.00	14.74	259.94	0.39
Jul-16	70.00	20.00	124.00	0.40	3.13	86.32	0.13	10.00	-	42.00	0.45	10.45	0.02	60.00	11.00	108.00	2.67	75.86	0.11
Aug-16	50.00	10.00	91.00	0.47	1.91	62.84	0.09	-	-	-	-	-	-	50.00	9.00	93.00	1.91	62.84	0.09
Sep-16	3,088.00	1,007.00	8,170.00	0.36	105.34	3,865.56	5.82	-	-	-	-	-	-	3,088.00	992.00	7,498.00	105.34	3,865.56	5.82
Oct-16	440.00	274.00	650.00	0.20	50.74	575.43	0.87	70.00	22.00	107.00	18.42	88.42	0.13	370.00	235.00	587.00	32.32	487.01	0.73
Nov-16	190.00	74.00	291.00	0.33	21.33	243.65	0.37	40.00	-	110.00	17.78	57.78	0.09	150.00	42.00	259.00	3.55	185.88	0.28
Dec-16	21.00	-	155.00	1.00	1.10	26.76	0.04	-	-	-	-	-	-	21.00	-	153.00	1.10	26.76	0.04
Jan-17	400.00	165.00	552.00	0.30	7.09	490.68	0.74	10.00	-	33.00	-	10.00	0.02	390.00	150.00	554.00	7.09	480.68	0.72
Feb-17	70.00	29.00	163.00	0.34	2.39	83.42	0.13	20.00	-	72.00	-	20.00	0.03	50.00	21.00	142.00	2.39	63.42	0.10
Mar-17	451.00	151.00	861.00	0.42	35.86	565.80	0.85	100.00	18.00	239.00	6.14	106.14	0.16	350.00	93.00	677.00	29.72	459.66	0.69
Apr-17	200.00	87.00	383.00	0.38	33.11	270.15	0.41	50.00	-	168.00	7.14	57.14	0.09	150.00	49.00	328.00	25.97	213.01	0.32
May-17	411.00	105.00	768.00	0.42	32.49	511.14	0.77	110.00	22.00	215.00	6.38	116.38	0.18	300.00	46.00	584.00	26.11	394.76	0.59
Jun-17	10.00	-	42.00	1.00	1.76	14.23	0.02	-	-	-	-	-	-	10.00	-	42.00	1.76	14.23	0.02
Jul-17	10.00	-	30.00	1.00	0.37	12.55	0.02	-	-	-	-	-	-	10.00	-	30.00	0.37	12.55	0.02
Aug-17	3,670.00	2,207.00	5,647.00	0.28	259.60	4,756.81	7.16	-	-	-	-	-	-	3,670.00	2,162.00	5,654.00	259.60	4,756.81	7.16
Sep-17	431.00	177.00	735.00	0.32	66.92	572.25	0.86	120.00	-	268.00	24.83	144.83	0.22	311.00	135.00	563.00	42.10	427.43	0.64
Oct-17	229.00	20.00	633.00	0.66	18.59	252.03	0.38	209.00	11.00	582.00	17.50	226.50	0.34	20.00	-	51.00	1.09	25.53	0.04
Nov-17	520.00	118.00	1,061.00	0.53	38.03	665.55	1.00	30.00	-	95.00	17.27	47.27	0.07	490.00	86.00	998.00	20.76	618.27	0.93
Dec-17	60.00	-	177.00	0.84	2.51	75.66	0.11	-	-	-	-	-	-	60.00	-	178.00	2.51	75.66	0.11
Jan-18	50.00	10.00	82.00	0.47	9.91	72.52	0.11	-	-	-	-	-	-	50.00	8.00	83.00	9.91	72.52	0.11
Feb-18	270.00	121.00	482.00	0.34	13.41	331.31	0.50	50.00	-	126.00	5.88	55.88	0.08	220.00	74.00	391.00	7.53	275.43	0.41
Mar-18	180.00	-	427.00	0.68	6.54	225.81	0.34	-	-	-	-	-	-	180.00	-	423.00	6.54	225.81	0.34

Table 30: Razorbill design-based abundance estimates for the DCO array area plus 4 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	120.00	41.00	185.00	0.33	17.51	162.46	0.18	10.00	-	28.00	9.02	19.02	0.02	110.00	34.00	172.00	8.50	143.44	0.16
May-16	60.00	-	155.00	0.68	4.26	77.79	0.09	-	-	-	-	-	-	60.00	-	160.00	4.26	77.79	0.09
Jun-16	320.00	222.00	541.00	0.24	22.33	414.40	0.47	-	-	-	-	-	-	320.00	209.00	527.00	22.33	414.40	0.47
Jul-16	90.00	27.00	149.00	0.39	4.90	112.71	0.13	10.00	-	36.00	0.30	10.30	0.01	80.00	15.00	137.00	4.60	102.40	0.12
Aug-16	259.00	58.00	468.00	0.44	8.16	323.40	0.37	-	-	-	-	-	-	259.00	68.00	472.00	8.16	323.40	0.37
Sep-16	3,614.00	1,103.00	6,584.00	0.37	126.00	4,527.30	5.12	-	-	-	-	-	-	3,614.00	1,181.00	6,486.00	126.00	4,527.30	5.12
Oct-16	696.00	480.00	965.00	0.19	68.10	886.37	1.00	159.00	50.00	274.00	24.24	183.24	0.21	537.00	316.00	816.00	43.86	703.13	0.80
Nov-16	249.00	126.00	337.00	0.25	24.37	318.29	0.36	40.00	-	106.00	20.00	60.00	0.07	209.00	98.00	313.00	4.37	258.29	0.29
Dec-16	20.00	-	85.00	1.00	1.04	25.47	0.03	-	-	-	-	-	-	20.00	-	82.00	1.04	25.47	0.03
Jan-17	537.00	182.00	775.00	0.36	18.19	669.71	0.76	10.00	-	33.00	1.18	11.18	0.01	527.00	165.00	761.00	17.01	658.53	0.74
Feb-17	70.00	21.00	126.00	0.35	2.74	83.84	0.09	20.00	-	66.00	-	20.00	0.02	50.00	15.00	98.00	2.74	63.84	0.07
Mar-17	638.00	272.00	1,185.00	0.36	48.09	803.46	0.91	120.00	16.00	286.00	8.51	128.51	0.15	518.00	195.00	1,060.00	39.58	674.95	0.76
Apr-17	329.00	123.00	1,007.00	0.36	47.95	439.46	0.50	70.00	-	216.00	10.00	80.00	0.09	259.00	89.00	849.00	37.95	359.46	0.41
May-17	430.00	124.00	735.00	0.40	36.45	540.29	0.61	110.00	18.00	198.00	5.64	115.64	0.13	320.00	74.00	572.00	30.81	424.65	0.48
Jun-17	40.00	3.00	229.00	0.57	2.44	51.37	0.06	-	-	-	-	-	-	40.00	-	249.00	2.44	51.37	0.06
Jul-17	30.00	-	90.00	0.72	1.25	37.83	0.04	-	-	-	-	-	-	30.00	-	90.00	1.25	37.83	0.04
Aug-17	5,357.00	3,078.00	11,829.00	0.24	373.39	6,936.68	7.85	-	-	-	-	-	-	5,357.00	3,009.00	12,303.00	373.39	6,936.68	7.85
Sep-17	498.00	222.00	1,054.00	0.30	76.95	657.74	0.74	160.00	18.00	530.00	27.43	187.43	0.21	339.00	147.00	617.00	49.52	470.31	0.53
Oct-17	213.00	16.00	571.00	0.66	85.21	302.47	0.34	194.00	9.00	534.00	84.00	278.00	0.31	19.00	-	48.00	1.21	24.47	0.03
Nov-17	1,109.00	478.00	2,002.00	0.30	58.85	1,404.29	1.59	30.00	-	82.00	14.65	44.65	0.05	1,079.00	482.00	1,990.00	44.19	1,359.63	1.54
Dec-17	70.00	-	189.00	0.86	3.06	88.43	0.10	-	-	-	-	-	-	70.00	-	195.00	3.06	88.43	0.10
Jan-18	50.00	7.00	84.00	0.48	8.38	70.67	0.08	-	-	-	-	-	-	50.00	8.00	83.00	8.38	70.67	0.08
Feb-18	598.00	261.00	1,526.00	0.29	45.38	756.17	0.86	80.00	10.00	161.00	27.58	107.58	0.12	518.00	208.00	1,453.00	17.80	648.59	0.73
Mar-18	200.00	21.00	423.00	0.62	6.37	249.82	0.28	-	-	-	-	-	-	200.00	16.00	407.00	6.37	249.82	0.28

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Table 31: Puffin design-based abundance estimates for the DCO array area including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	200.00	75.00	266.00	0.28	23.47	255.07	0.55	20.00	-	59.00	12.00	32.00	0.07	180.00	67.00	257.00	11.47	223.07	0.48
May-16	30.00	-	77.00	1.00	1.42	36.61	0.08	-	-	-	-	-	-	30.00	-	74.00	1.42	36.61	0.08
Jun-16	10.00	-	38.00	1.00	0.44	12.16	0.03	-	-	-	-	-	-	10.00	-	40.00	0.44	12.16	0.03
Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-16	10.00	-	39.00	1.00	0.40	12.11	0.03	-	-	-	-	-	-	10.00	-	41.00	0.40	12.11	0.03
Sep-16	20.00	-	45.00	0.67	0.13	23.45	0.05	-	-	-	-	-	-	20.00	-	45.00	0.13	23.45	0.05
Oct-16	90.00	31.00	183.00	0.33	14.35	121.56	0.26	-	-	-	-	-	-	90.00	31.00	187.00	14.35	121.56	0.26
Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr-17	40.00	-	174.00	0.67	4.54	51.88	0.11	-	-	-	-	-	-	40.00	-	182.00	4.54	51.88	0.11
May-17	60.00	-	137.00	0.67	3.75	74.27	0.16	-	-	-	-	-	-	60.00	5.00	138.00	3.75	74.27	0.16
Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-17	10.00	-	37.00	1.00	0.27	11.97	0.03	-	-	-	-	-	-	10.00	-	37.00	0.27	11.97	0.03
Aug-17	499.00	233.00	672.00	0.27	11.35	594.55	1.27	-	-	-	-	-	-	499.00	231.00	658.00	11.35	594.55	1.27
Sep-17	130.00	49.00	233.00	0.34	12.84	166.41	0.36	-	-	-	-	-	-	130.00	46.00	231.00	12.84	166.41	0.36
Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-18	40.00	9.00	70.00	0.42	0.25	46.89	0.10	-	-	-	-	-	-	40.00	10.00	70.00	0.25	46.89	0.10
Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 32: Puffin design-based abundance estimates for the DCO array area plus 2 km buffer including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 2 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	230.00	120.00	310.00	0.25	26.77	293.44	0.44	20.00	-	59.00	14.55	34.55	0.05	210.00	101.00	300.00	12.23	258.89	0.39
May-16	30.00	-	88.00	1.00	1.59	36.80	0.06	-	-	-	-	-	-	30.00	-	82.00	1.59	36.80	0.06
Jun-16	20.00	-	93.00	0.68	0.68	24.09	0.04	-	-	-	-	-	-	20.00	-	95.00	0.68	24.09	0.04
Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-16	20.00	-	57.00	0.68	0.62	24.03	0.04	-	-	-	-	-	-	20.00	-	60.00	0.62	24.03	0.04
Sep-16	30.00	-	66.00	0.53	0.15	35.13	0.05	-	-	-	-	-	-	30.00	-	67.00	0.15	35.13	0.05
Oct-16	110.00	36.00	204.00	0.35	15.14	145.79	0.22	-	-	-	-	-	-	110.00	40.00	205.00	15.14	145.79	0.22
Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar-17	10.00	-	41.00	1.00	0.31	12.01	0.02	-	-	-	-	-	-	10.00	-	43.00	0.31	12.01	0.02
Apr-17	40.00	-	106.00	0.68	5.79	53.34	0.08	-	-	-	-	-	-	40.00	-	114.00	5.79	53.34	0.08
May-17	90.00	22.00	220.00	0.47	6.19	112.06	0.17	-	-	-	-	-	-	90.00	19.00	232.00	6.19	112.06	0.17
Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-17	10.00	-	33.00	1.00	0.31	12.01	0.02	-	-	-	-	-	-	10.00	-	33.00	0.31	12.01	0.02
Aug-17	622.00	411.00	923.00	0.20	11.05	737.51	1.11	-	-	-	-	-	-	622.00	410.00	940.00	11.05	737.51	1.11
Sep-17	210.00	77.00	406.00	0.37	22.24	270.55	0.41	-	-	-	-	-	-	210.00	88.00	401.00	22.24	270.55	0.41
Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan-18	10.00	-	78.00	1.00	0.44	12.16	0.02	-	-	-	-	-	-	10.00	-	77.00	0.44	12.16	0.02
Feb-18	60.00	16.00	100.00	0.40	1.01	71.08	0.11	-	-	-	-	-	-	60.00	19.00	101.00	1.01	71.08	0.11
Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 33: Puffin design-based abundance estimates for the DCO array area including apportionment of unidentified species groups and correction for availability bias.

DCO Array Area plus 4 km Buffer	All Behaviours							Flying						Sitting					
Survey	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Precision (CV)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (including apportionment)	Final Density (birds/ km^2)	Abundance Estimate (pre-apportionment)	LCL (pre-apportionment)	UCL (pre-apportionment)	Apportioned Abundance	Final Abundance Estimate (Apportioned & Corrected)	Final Density (birds/ km^2)
Apr-16	280.00	131.00	376.00	0.26	30.91	356.64	0.40	20.00	-	57.00	13.75	33.75	0.04	260.00	123.00	363.00	17.16	322.89	0.37
May-16	40.00	-	98.00	0.77	2.04	48.97	0.06	-	-	-	-	-	-	40.00	-	98.00	2.04	48.97	0.06
Jun-16	20.00	-	62.00	0.68	0.70	24.12	0.03	-	-	-	-	-	-	20.00	-	61.00	0.70	24.12	0.03
Jul-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aug-16	40.00	9.00	122.00	0.44	0.99	47.76	0.05	-	-	-	-	-	-	40.00	11.00	121.00	0.99	47.76	0.05
Sep-16	70.00	23.00	141.00	0.35	0.36	81.97	0.09	-	-	-	-	-	-	70.00	21.00	147.00	0.36	81.97	0.09
Oct-16	229.00	105.00	498.00	0.30	19.06	288.99	0.33	-	-	-	-	-	-	229.00	93.00	493.00	19.06	288.99	0.33
Nov-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-17	10.00	-	26.00	1.00	0.26	11.96	0.01	-	-	-	-	-	-	10.00	-	26.00	0.26	11.96	0.01
Mar-17	10.00	-	38.00	1.00	0.28	11.97	0.01	-	-	-	-	-	-	10.00	-	38.00	0.28	11.97	0.01
Apr-17	120.00	53.00	250.00	0.33	14.46	156.65	0.18	-	-	-	-	-	-	120.00	52.00	255.00	14.46	156.65	0.18
May-17	110.00	22.00	206.00	0.43	8.26	137.78	0.16	-	-	-	-	-	-	110.00	24.00	211.00	8.26	137.78	0.16
Jun-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-17	10.00	-	30.00	1.00	0.34	12.04	0.01	-	-	-	-	-	-	10.00	-	32.00	0.34	12.04	0.01
Aug-17	780.00	460.00	1,018.00	0.21	11.72	922.36	1.04	-	-	-	-	-	-	780.00	460.00	1,014.00	11.72	922.36	1.04
Sep-17	229.00	83.00	387.00	0.35	28.52	300.01	0.34	-	-	-	-	-	-	229.00	82.00	385.00	28.52	300.01	0.34
Oct-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan-18	10.00	-	42.00	1.00	0.43	12.15	0.01	-	-	-	-	-	-	10.00	-	40.00	0.43	12.15	0.01
Feb-18	100.00	28.00	187.00	0.38	2.67	116.02	0.13	20.00	-	81.00	1.78	21.78	0.02	80.00	27.00	125.00	0.89	94.24	0.11
Mar-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

4.8 Key Species Age Classification

Table 34: Number of adult, immature and juveniles recorded within the Hornsea Four AfL plus 4 km buffer for gannet, kittiwake, guillemot and razorbill.

Survey	Gannet			Kittiwake			Guillemot			Razorbill		
	Adult	Immature	Juvenile	Adult	Immature	Juvenile	Adult	Immature	Juvenile	Adult	Immature	Juvenile
Apr-16	41	0	0	383	2	0	0	0	0	0	0	0
May-16	44	1	0	477	9	0	0	0	0	0	0	0
Jun-16	94	12	0	349	2	0	51	0	49	0	0	0
Jul-16	42	0	0	164	0	0	194	0	195	1	0	1
Aug-16	43	11	0	565	9	0	3	0	0	0	0	0
Sep-16	5	32	3	494	10	42	0	0	0	0	0	0
Oct-16	42	4	2	9	0	2	0	0	0	0	0	0
Nov-16	63	4	0	4	0	1	0	0	0	0	0	0
Dec-16	45	2	0	44	11	0	0	0	0	0	0	0
Jan-17	2	0	0	32	9	0	0	0	0	0	0	0
Feb-17	12	0	0	6	1	0	0	0	0	0	0	0
Mar-17	19	0	0	56	3	0	0	0	0	0	0	0
Apr-17	17	2	0	381	55	0	1	0	0	0	0	0
May-17	32	3	0	742	21	0	0	0	0	0	0	0
Jun-17	18	5	0	229	5	0	0	0	0	0	0	0
Jul-17	93	4	0	142	0	0	221	3	217	2	0	2
Aug-17	83	6	0	495	7	10	52	0	50	2	0	2
Sep-17	50	8	0	7	0	1	0	0	0	0	0	0
Oct-17	42	1	0	15	3	3	0	0	0	0	0	0
Nov-17	129	1	0	54	4	6	0	0	0	0	0	0
Dec-17	12	1	0	185	36	0	0	0	0	0	0	0
Jan-18	26	0	0	40	6	0	0	0	0	0	0	0
Feb-18	3	0	0	59	22	0	0	0	0	0	0	0
Mar-18	12	0	0	35	12	0	0	0	0	0	0	0
Total	**969**	**97**	**5**	**4,967**	**227**	**65**	**522**	**3**	**511**	**5**	**0**	**5**

5 References

JNCC (2021). Special Protection Areas (SPAs) of Great Britain (including offshore areas): shapefile. Contains public sector data from © JNCC/NE/NRW/NatureScot 2021. Contains OS data © Crown Copyright and database right 2016. Available at https://hub.jncc.gov.uk/assets/20dbc9b4-ceac-4bf2-8763-4ae387fa88c4 [Accessed 03/12/2021].

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Appendix A Details of MRSea_V2 rerun for kittiwake

This appendix provides model outputs and diagnostic for the best-fitting kittiwake model using the MRSea package. The best fitting kittiwake model was a 2D spatially smoothed model that used survey month and depth as environmental variables. Candidate GLM and 1D smoothed models, and models using survey_ID instead of month and distance to coast and/or distance to FFC SPA were also considered but either failed to fit or produced worse model fits as indicated by higher 10-fold cross validation error scores.

```
initial_kittiwake_model_month_depth_2 <- glm(response ~  as.factor(month) + offset(log(area)),
                                             family = "quasipoisson", data = kittiwake_model_data)

varlist <- c('mean_depth')

salsa1dlist <-list(fitnessMeasure = "cv.gamMRSea",
                   minKnots_1d = c(1),
                   maxKnots_1d = c(3),
                   startKnots_1d = c(1),
                   degree=c(2),
                   maxIterations = 10,
                   gaps = c(1),
                   cv.opts = list(cv.gamMRSea.seed = 1, K=10))

salsa1dOutput_kittiwake_month_depth <- runSALSA1D(initialModel=initial_kittiwake_model_month_depth_2,
                                                  salsa1dlist=salsa1dlist,
                                                  varlist=varlist,
                                                  factorlist=c("month"),
                                                  datain = kittiwake_model_data,
                                                  panelid = kittiwake_model_data$blockID,
                                                  predictionData = predict_grid_kittiwake_month)

summary(salsa1dOutput_kittiwake_month_depth$bestModel)

# ~~~ have a look at the 1D relationship - is it sensible?
runPartialPlots(salsa1dOutput_kittiwake_month_depth$bestModel,
                data = kittiwake_model_data,
                factorlist.in = c("month"),
                varlist.in = varlist)


#####
# Set up knot grid for Salsa 2d

# ~~ use in built MRSea function to get knotgrid
knot_grid <- getKnotgrid(kittiwake_model_data[, c("x.pos", "y.pos")])

#Make distance matrices
distMats <-makeDists(cbind(kittiwake_model_data$x.pos, kittiwake_model_data$y.pos), knot_grid)

salsa2dlist <-list(fitnessMeasure = "cv.gamMRSea",
                   cv.opts = list(cv.gamMRSea.seed = 1, K=10),
                   knotgrid = knot_grid,
                   startKnots = 6,    # ~~~
                   minKnots = 4,
                   maxKnots = 20,
                   gap = 0,
                   interactionTerm = "as.factor(month)")


# ~~~ removed spline params from 2d and updated block structure
salsa2dOutput_kittiwake_month_depth <-runSALSA2D(salsa1dOutput_kittiwake_month_depth$bestModel,
                                                 salsa2dlist,
                                                 distMats$dataDist,
                                                 distMats$knotDist,
                                                 panels = kittiwake_model_data$blockID)
```

Figure 1: Code used to create best fitting kittiwake model

```
> anova(best_model_kittiwake_month_depth)
Analysis of 'Wald statistic' Table
Model: quasipoisson, link: log
Response: response
Marginal Testing
Max Panel Size = 66; Number of panels = 572

                                Df      X2 P(>|Chi|)
as.factor(month)                11 118.703 < 2.2e-16 ***
s(mean_depth)                    4  11.856 0.0184581 *
s(x.pos, y.pos)                  4  19.008 0.0007832 ***
s(x.pos, y.pos):as.factor(month) 44 206.590 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
```

Figure 2: ANOVA results of best-fitting kittiwake model

```
> vif(initial_kittiwake_model_month_depth)
                    GVIF Df GVIF^(1/(2*Df))
mean_depth      5.102755  1        2.258928
as.factor(month) 1.000195 11        1.000009
x.pos           1.304565  1        1.142176
y.pos           5.745264  1        2.396928
>
```

Figure 3: Variance Inflation Factors for the input variables used for the best-fitting kittiwake model.

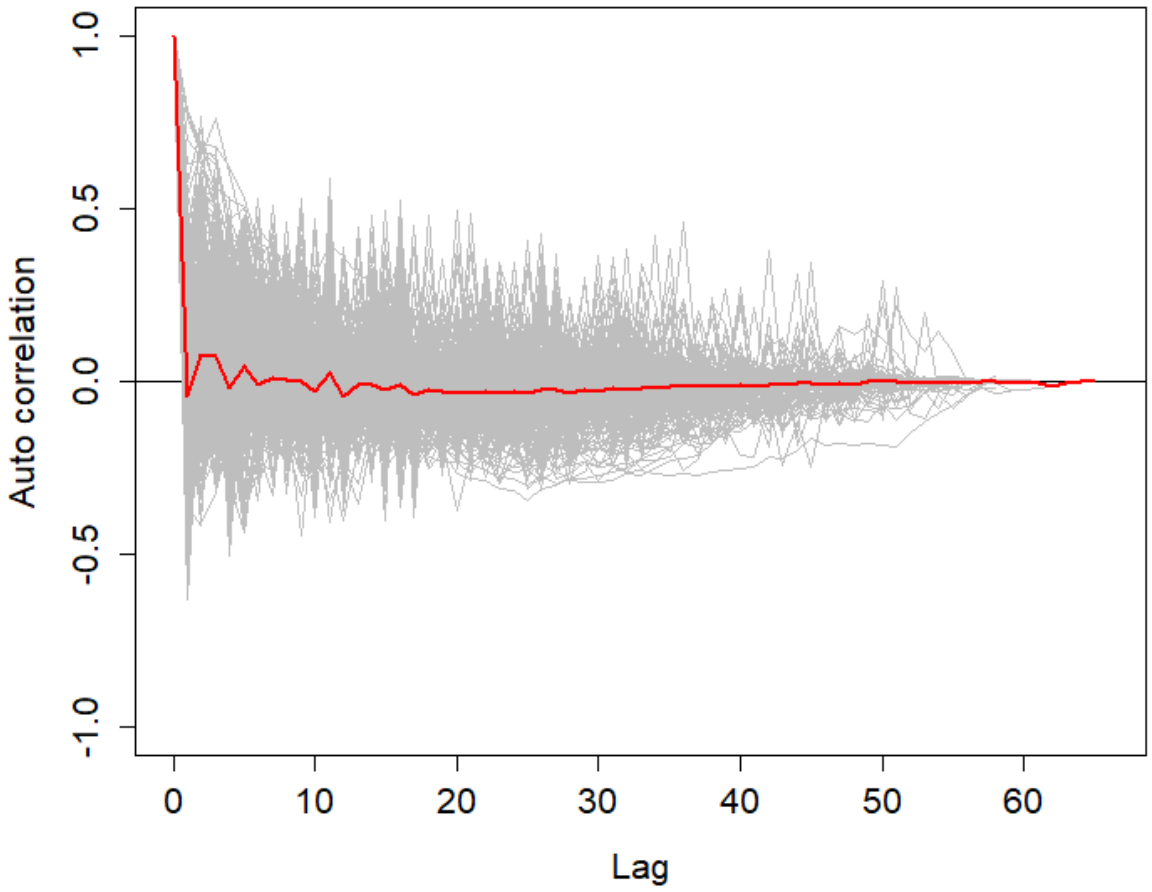

Figure 4: Auto-correlation function plot for the best-fitting kittiwake model, using transect ID as a blocking structure.

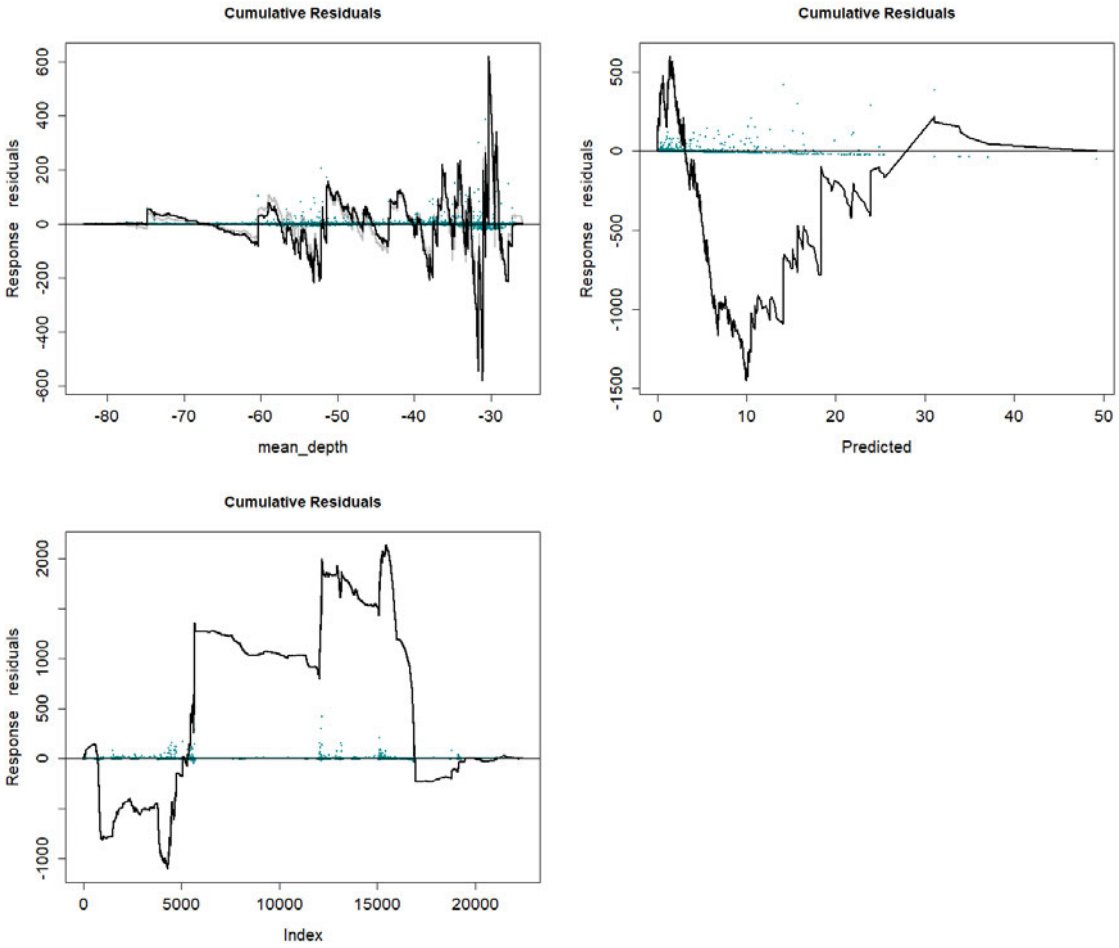

Figure 5: Plots showing cumulative residuals of the best fitting kittiwake model ordered by a) mean depth; b) predicted response and c) data index order.

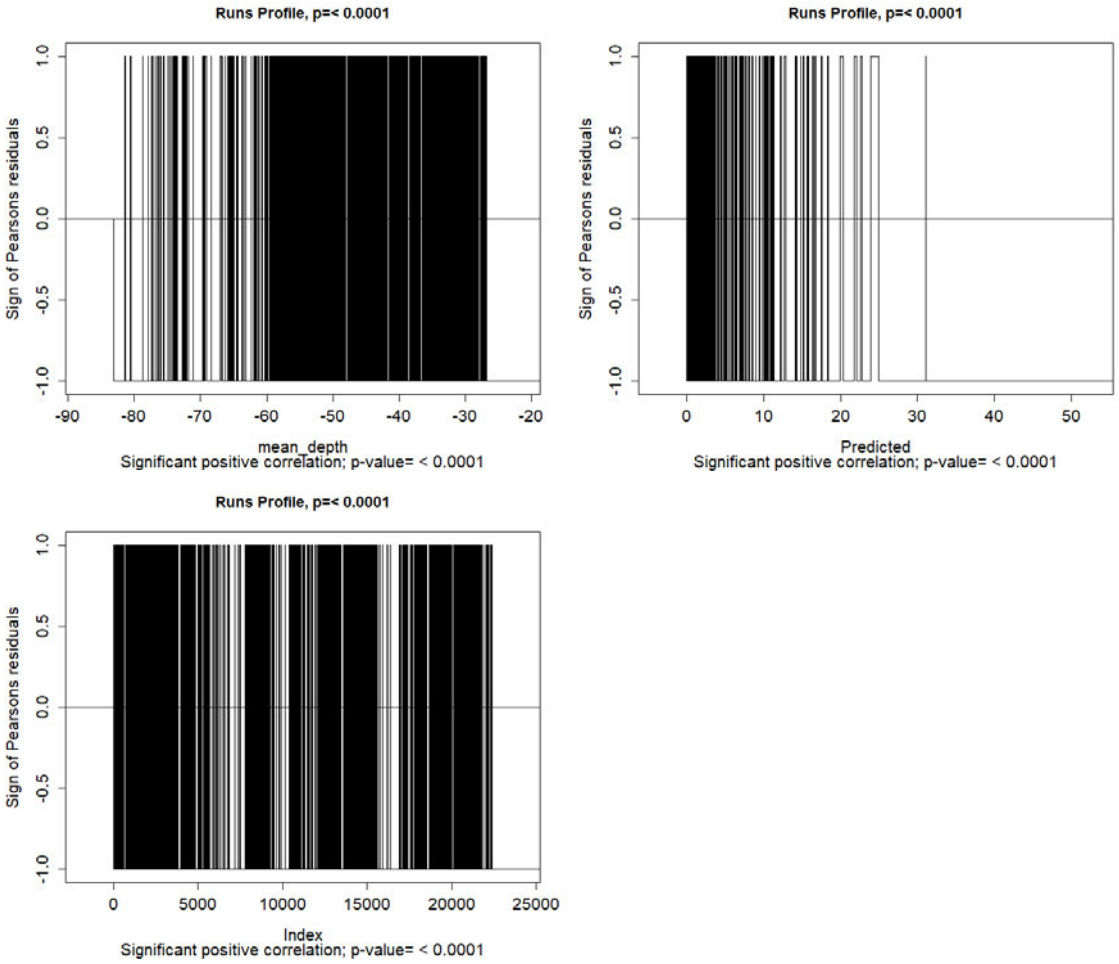

Figure 6: Runs profiles for the best fitting kittiwake model.

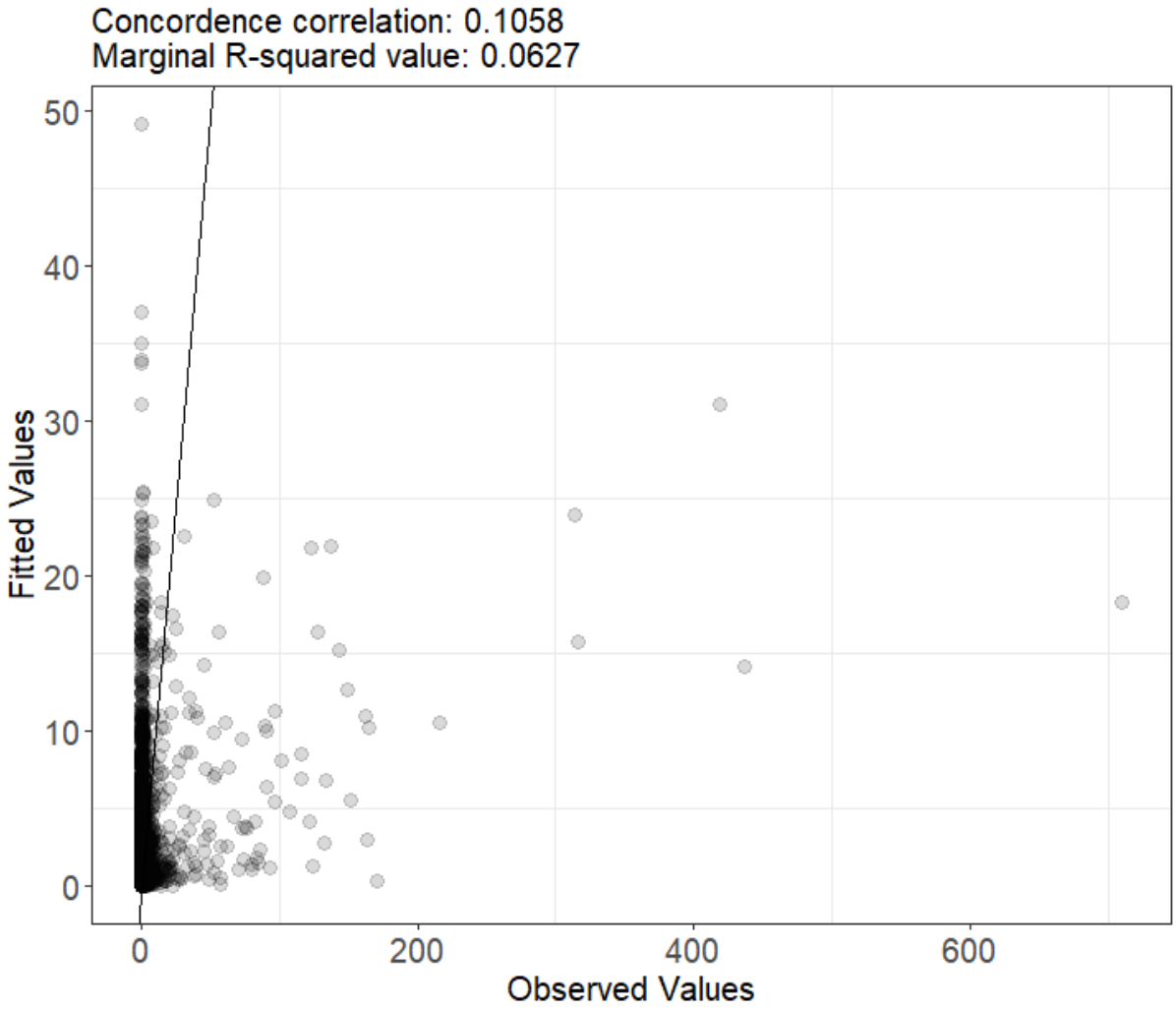

Figure 7: Plot of observed versus fitted values for best-fitting kittiwake model.

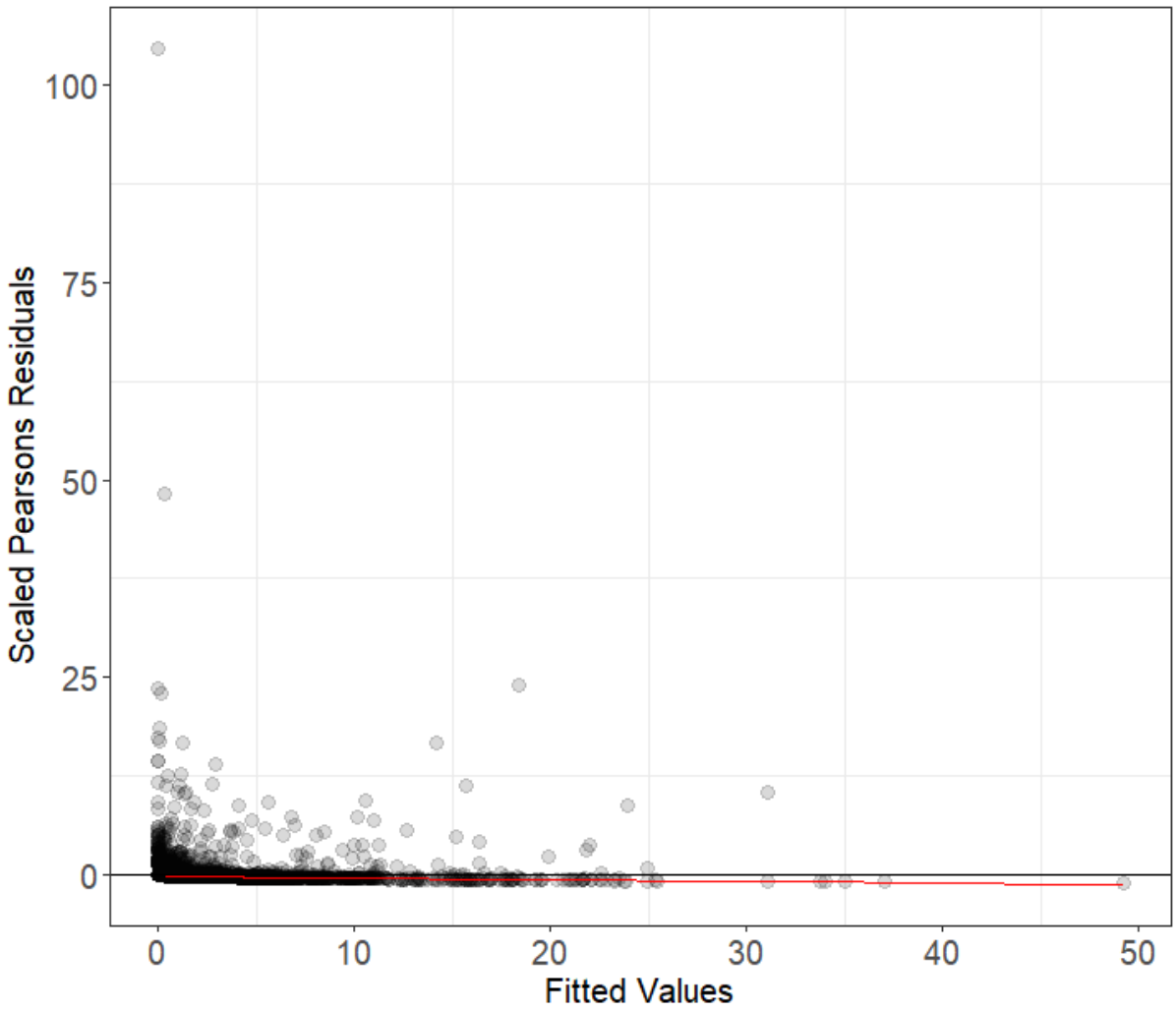

Figure 8: Plot of scaled Pearson residuals against fitted values for best-fitting kittiwake model.

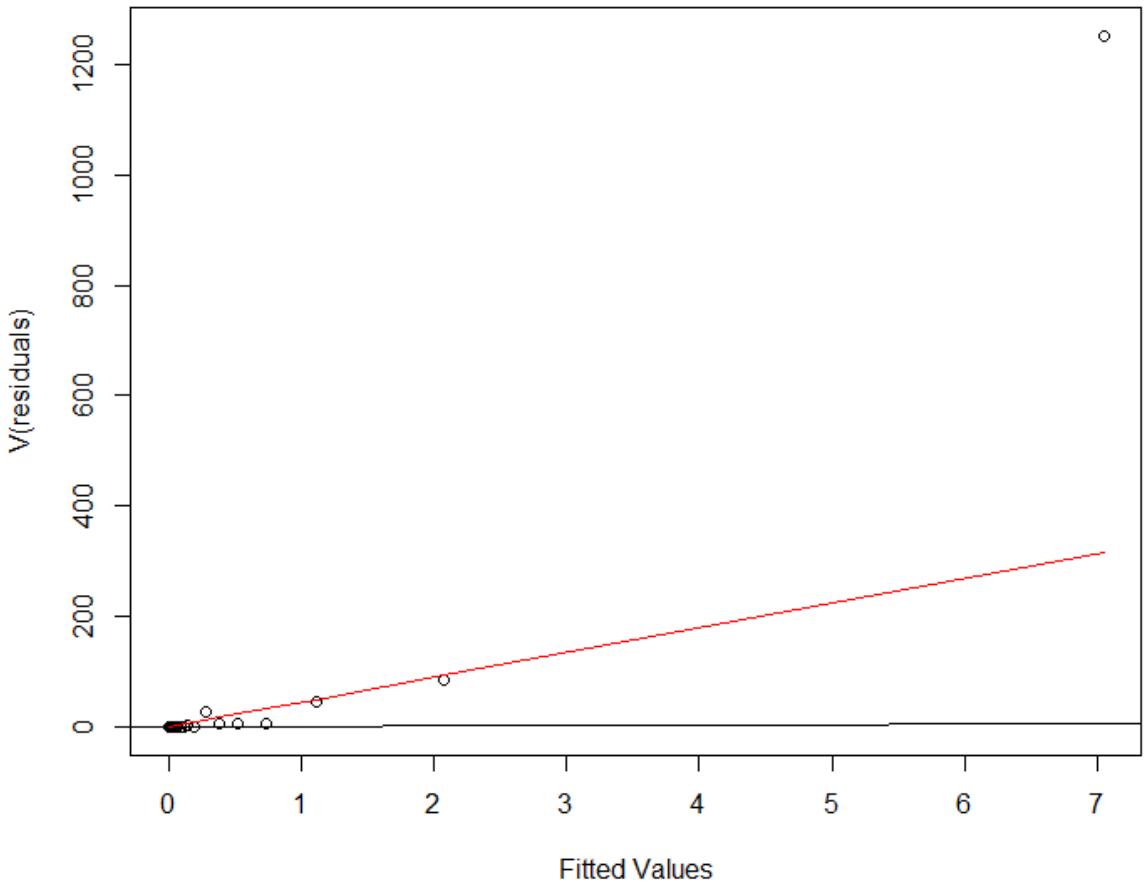

Figure 9: Mean-variance plot for best fitting kittiwake model.

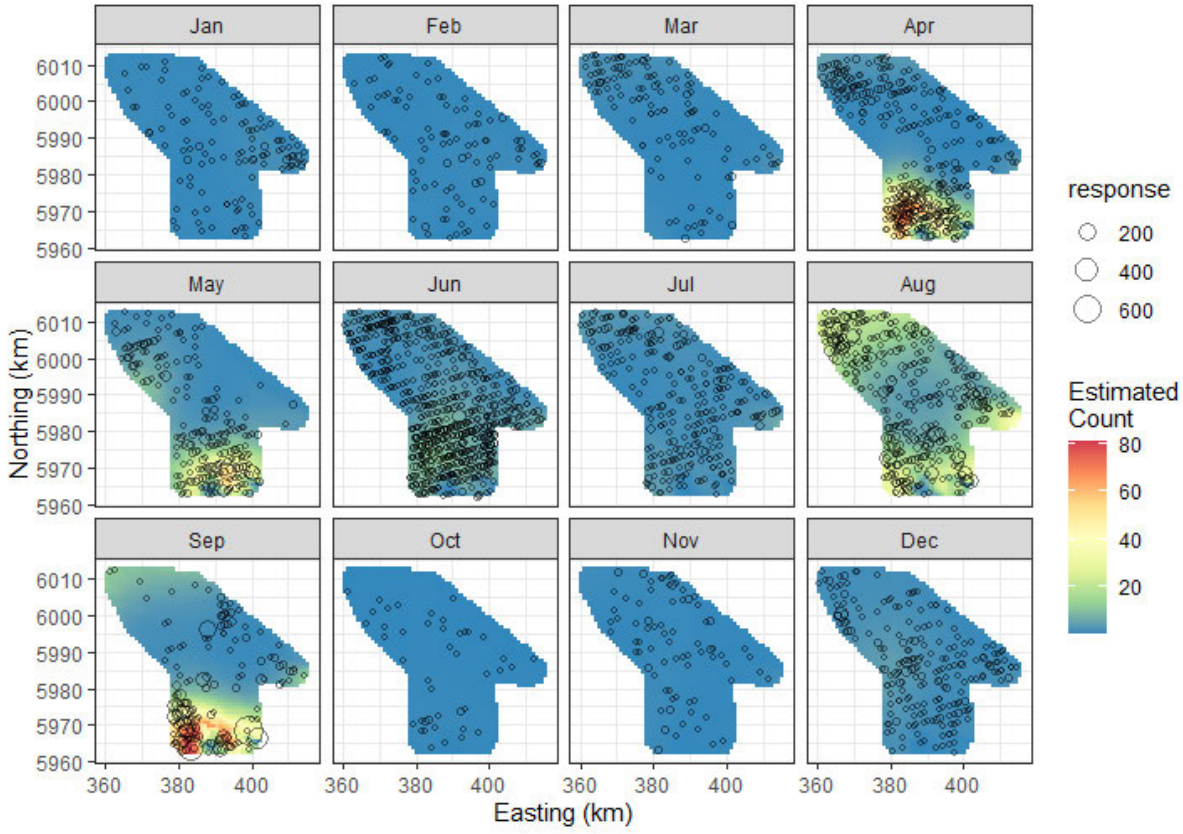

Figure 10: Predicted results for best-fitting kittiwake model. Response refers to the number of birds identified per transect segment in the observation data.

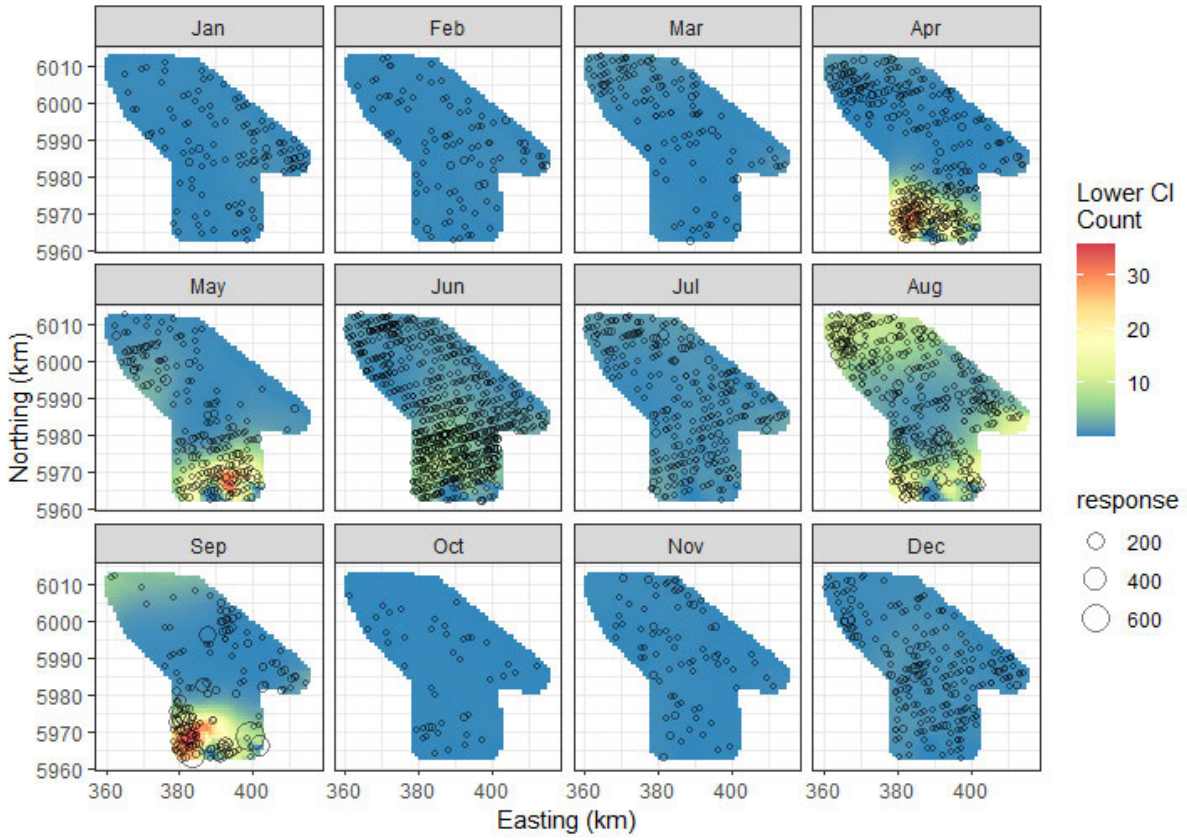

Figure 11: Lower 95% confidence limit predictions for kittiwake, generated using a robust parametric bootstrap of the best fitting kittiwake model. Response refers to the number of birds identified per transect segment in the observation data.

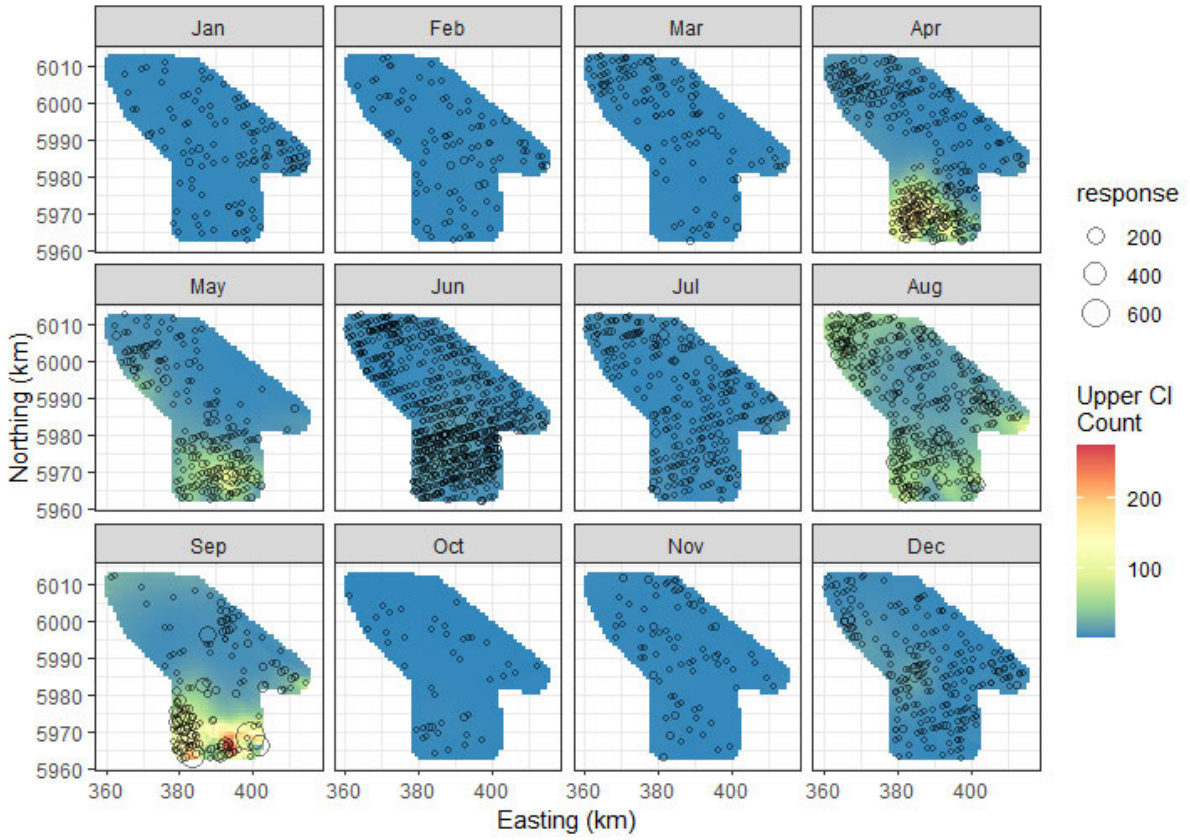

Figure 12: Upper 95% confidence limit predictions for kittiwake, generated using a robust parametric bootstrap of the best fitting kittiwake model. Response refers to the number of birds identified per transect segment in the observation data.

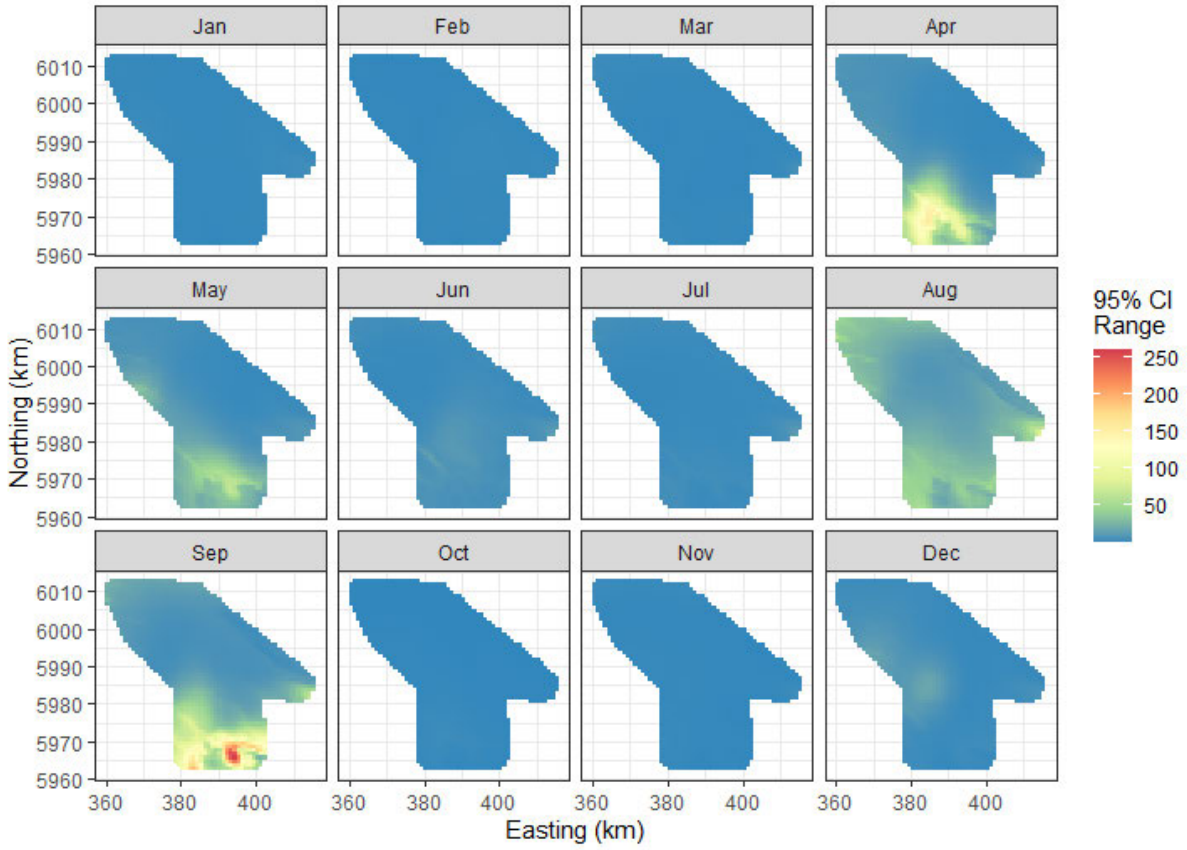

Figure 13: Range of the 95% confidence limit predictions for kittiwake, generated using a robust parametric bootstrap of the best fitting kittiwake model.

Appendix B Details of MRSea_V2 rerun for guillemot

This appendix provides model outputs and diagnostic for the best-fitting guillemot model using the MRSea package. The best fitting guillemot model was a 2D spatially smoothed model that used survey_ID and depth as environmental variables. Candidate GLM and 1D smoothed models, and models using month instead of survey_ID and distance to coast and/or distance to FFC SPA were also considered but either failed to fit or produced worse model fits as indicated by higher 10-fold cross validation error scores.

```
#Set up an initial model without the spline terms
initial_guillemot_model_survey_depth_2 <- glm(response ~  as.factor(survey_id) + offset(log(area)),
                                              family = "quasipoisson", data = guillemot_model_data)

varlist <- c('mean_depth')

salsa1dlist <-list(fitnessMeasure = "cv.gamMRSea",
                   minKnots_1d = c(1),
                   maxKnots_1d = c(3),
                   startKnots_1d = c(1),
                   degree=c(2),
                   maxIterations = 10,
                   gaps = c(1),
                   cv.opts = list(cv.gamMRSea.seed = 1, K=10))

salsa1dOutput_guillemot_survey_depth <- runSALSA1D(initialModel=initial_guillemot_model_survey_depth_2,
                                        salsa1dlist=salsa1dlist,
                                        varlist=varlist,
                                        factorlist=c("survey_id"),
                                        datain = guillemot_model_data,
                                        panelid = guillemot_model_data$blockID,
                                        predictionData = predict_grid_guillemot_survey)

summary(salsa1dOutput_guillemot_survey_depth$bestModel)

# ~~~ have a look at the 1D relationship - is it sensible?
runPartialPlots(salsa1dOutput_guillemot_survey_depth$bestModel,
                data = guillemot_model_data,
                factorlist.in = c("survey_id"),
                varlist.in = varlist)


#####
# Set up knot grid for Salsa 2d

# ~~ use in built MRSea function to get knotgrid
knot_grid <- getKnotgrid(guillemot_model_data[, c("x.pos", "y.pos")])

#Make distance matrices
distMats <-makeDists(cbind(guillemot_model_data$x.pos, guillemot_model_data$y.pos), knot_grid)

salsa2dlist <-list(fitnessMeasure = "cv.gamMRSea",
                   cv.opts = list(cv.gamMRSea.seed = 1, K=10),
                   knotgrid = knot_grid,
                   startKnots = 6,    # ~~~
                   minKnots = 4,
                   maxKnots = 20,
                   gap = 0,
                   interactionTerm = "as.factor(survey_id)")


# ~~~ removed spline params from 2d and updated block structure
salsa2dOutput_guillemot_survey_depth <-runSALSA2D(salsa1dOutput_guillemot_survey_depth$bestModel,
                                        salsa2dlist,
                                        distMats$dataDist,
                                        distMats$knotDist,
                                        panels = guillemot_model_data$blockID)
```

Figure 14: Code used to create best fitting guillemot model

```
> anova(best_guillemot_model_survey_depth)
Analysis of 'Wald statistic' Table
Model: quasipoisson, link: log
Response: response
Marginal Testing
Max Panel Size = 66; Number of panels = 572

                                    Df      X2 P(>|Chi|)
as.factor(survey_id)                23  197.50 < 2.2e-16 ***
s(mean_depth)                        5   16.14  0.006457 **
s(x.pos, y.pos)                      5   61.65 5.529e-12 ***
s(x.pos, y.pos):as.factor(survey_id) 115 2086.06 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
```

Figure 15: ANOVA results of best-fitting guillemot model

```
> vif(initial_guillemot_model_survey_depth)
                        GVIF Df GVIF^(1/(2*Df))
mean_depth          4.210079  1        2.051848
as.factor(survey_id) 1.000513 23        1.000011
x.pos               1.373977  1        1.172168
y.pos               4.854308  1        2.203249
```

Figure 16: Variance Inflation Factors for the input variables used for the best-fitting guillemot model.

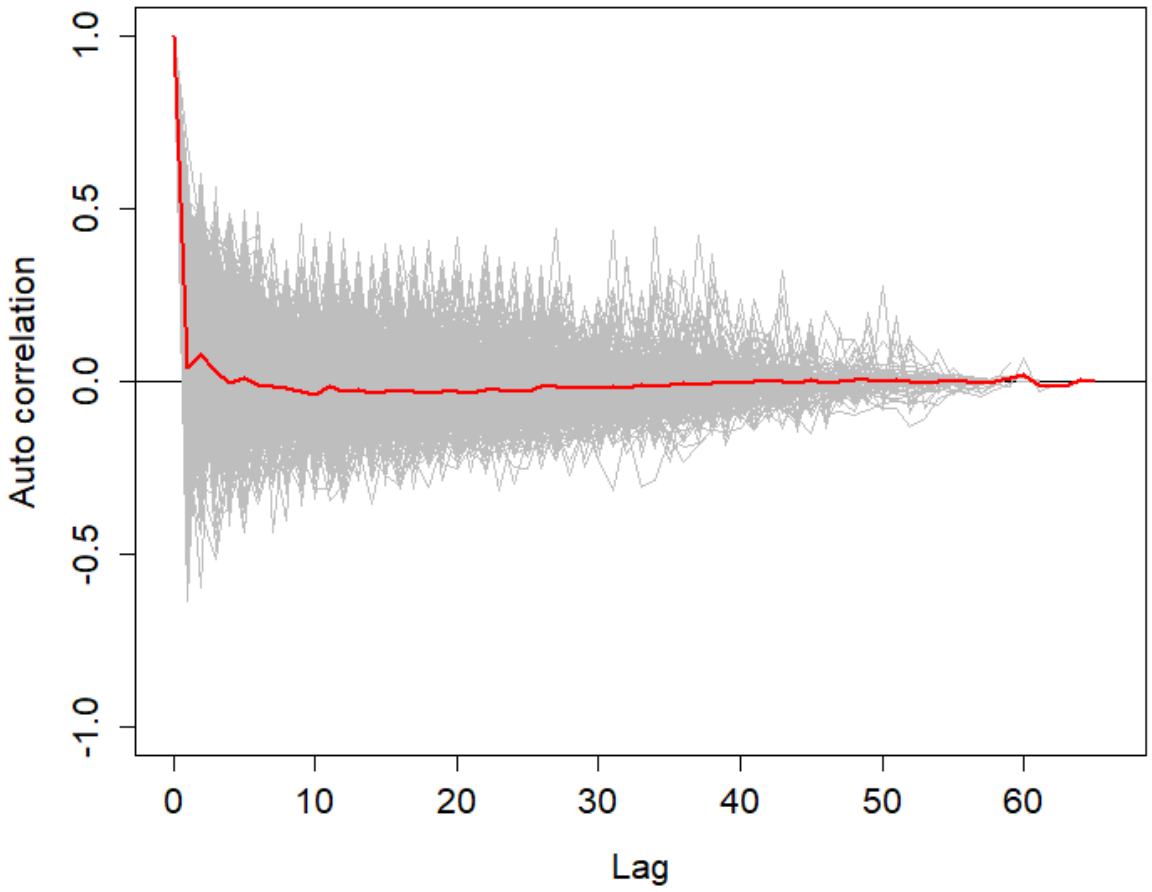

Figure 17: Auto-correlation function plot for the best-fitting guillemot model, using transect ID as a blocking structure.

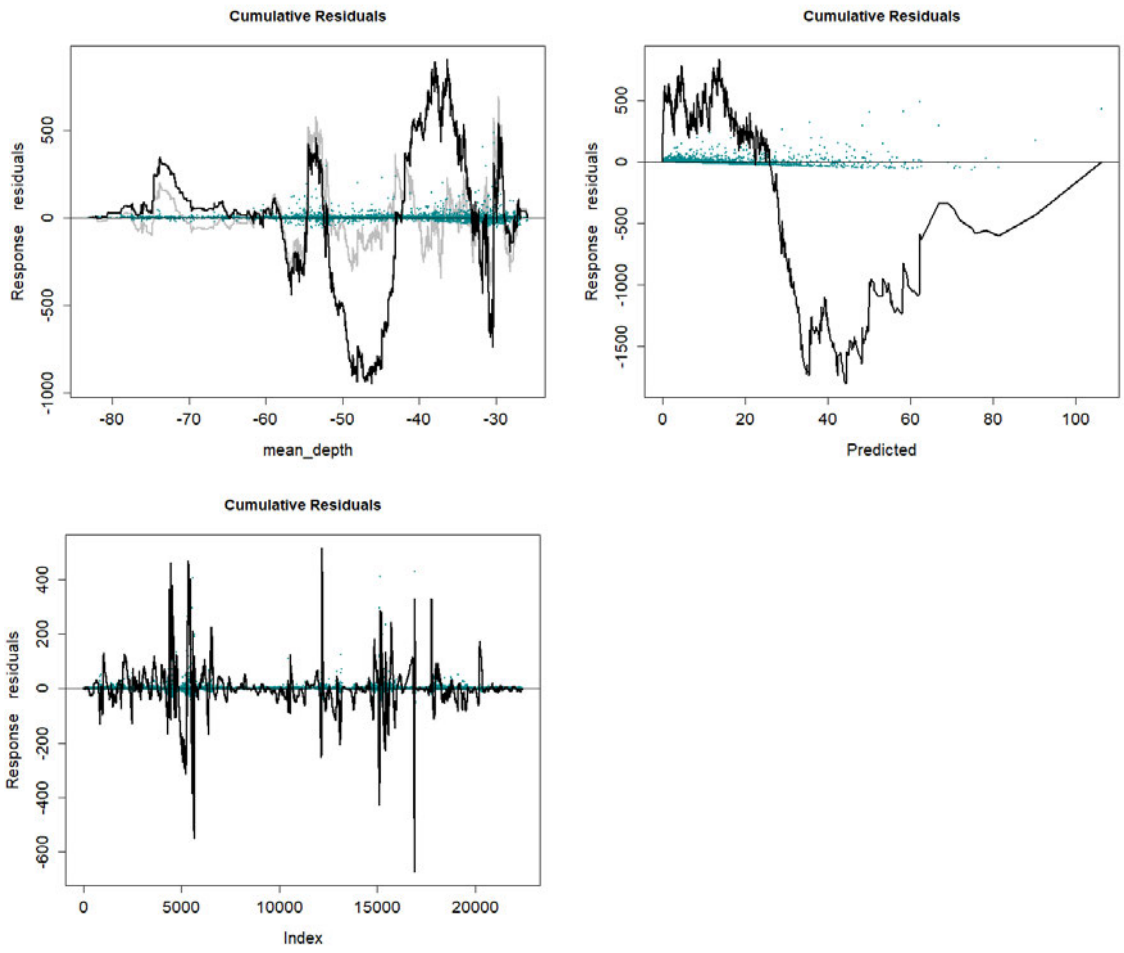

Figure 18: Plots showing cumulative residuals of the best fitting kittiwake model ordered by a) mean depth; b) predicted response and c) data index order.

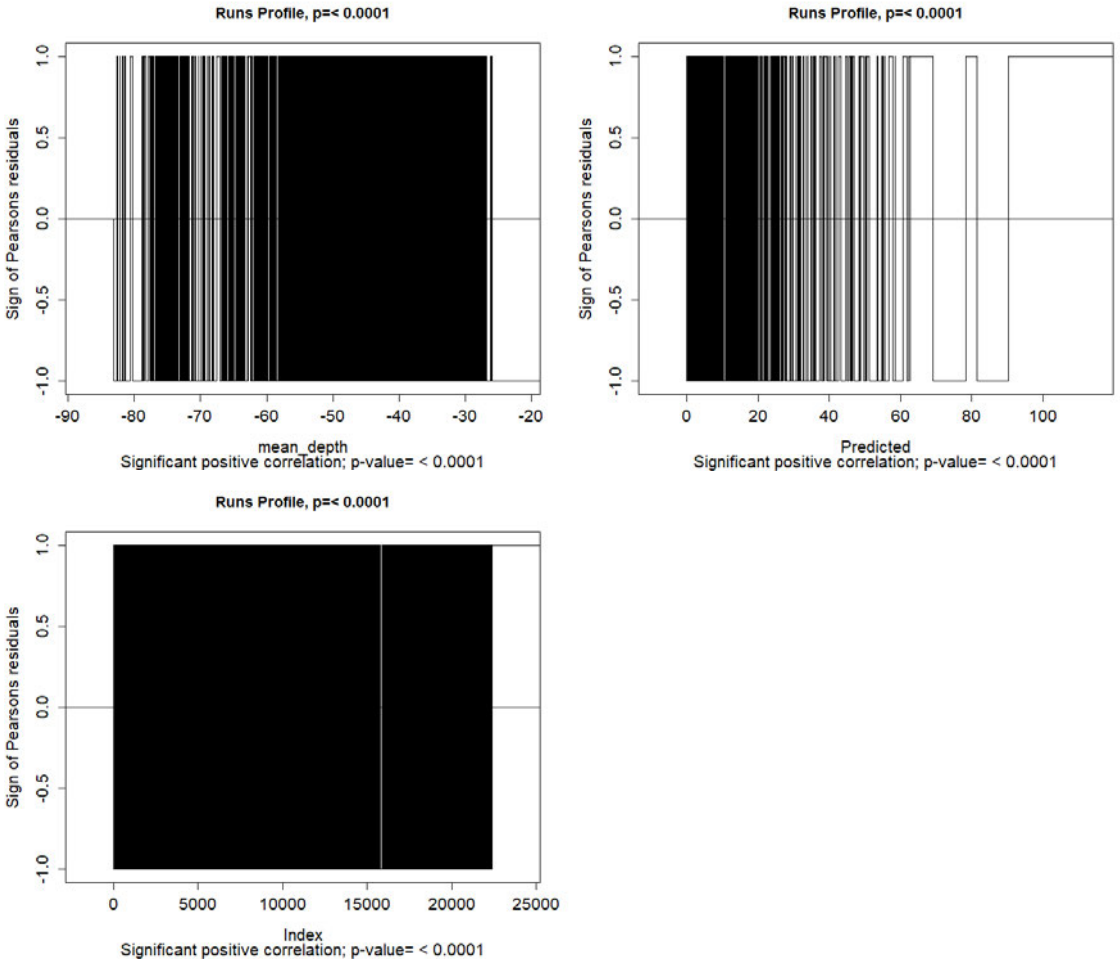

Figure 19: Runs profiles for the best fitting guillemot model.

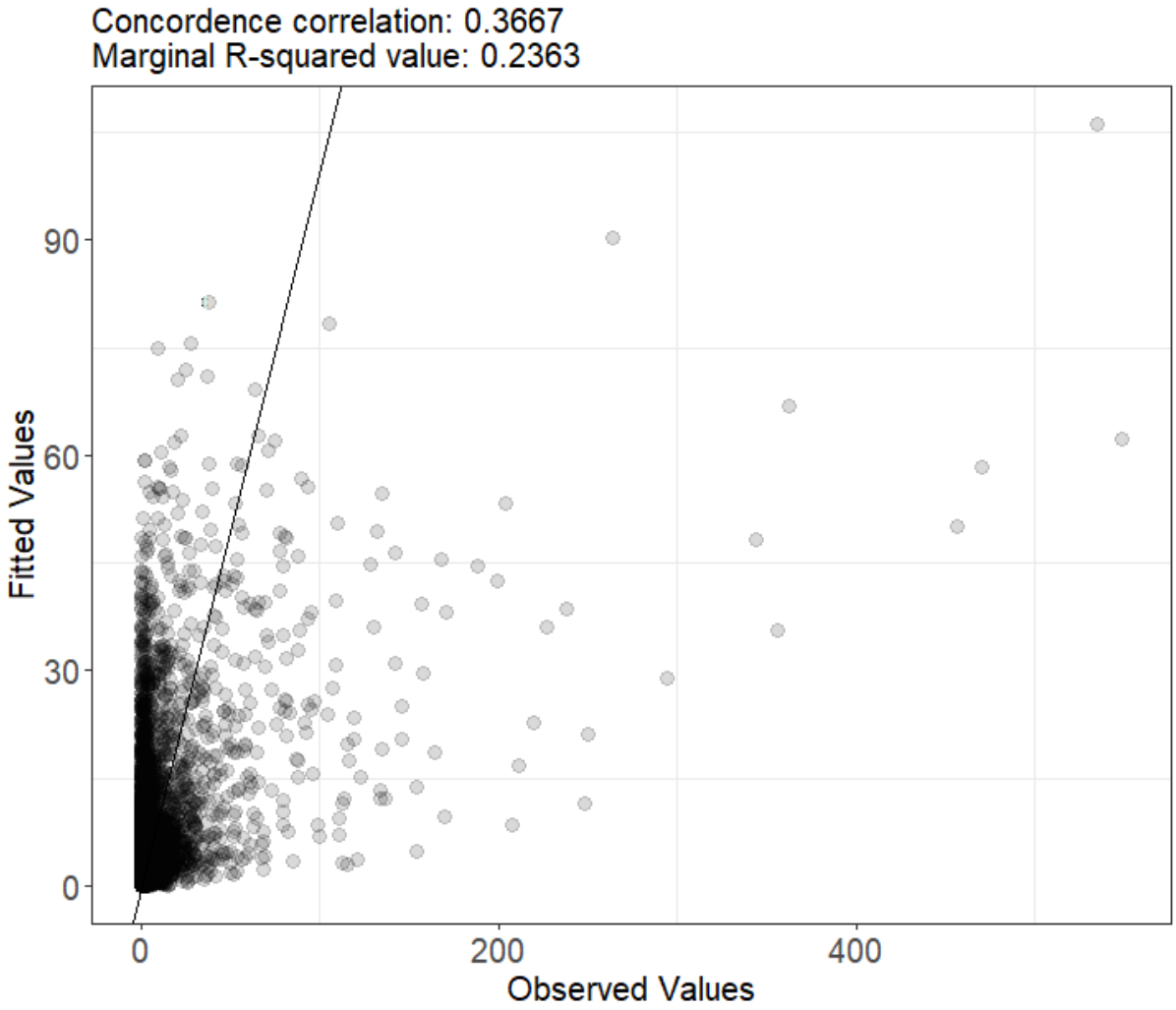

Figure 20: Plot of observed versus fitted values for best-fitting guillemot model.

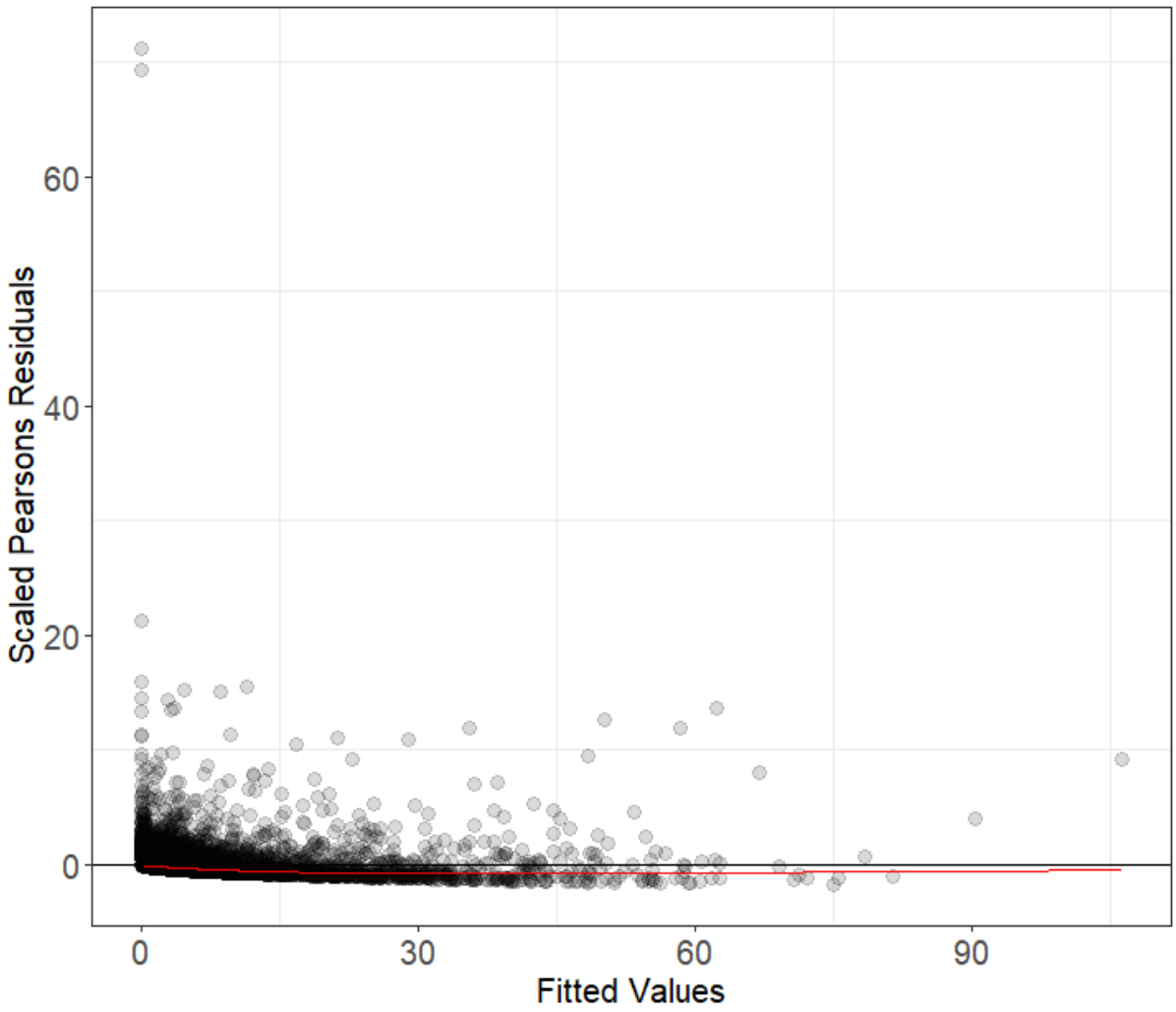

Figure 21: Plot of scaled Pearson residuals against fitted values for best-fitting guillemot model.

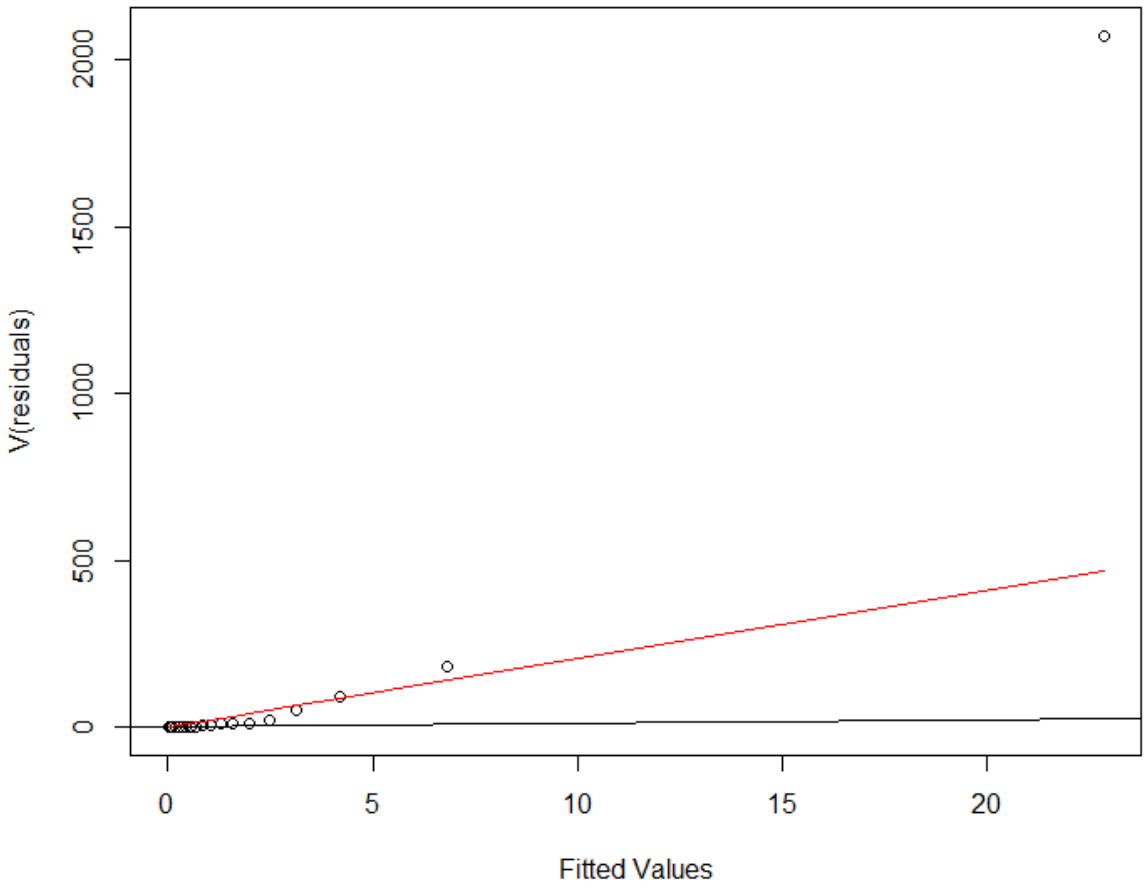

Figure 22: Mean-variance plot for best fitting guillemot model.

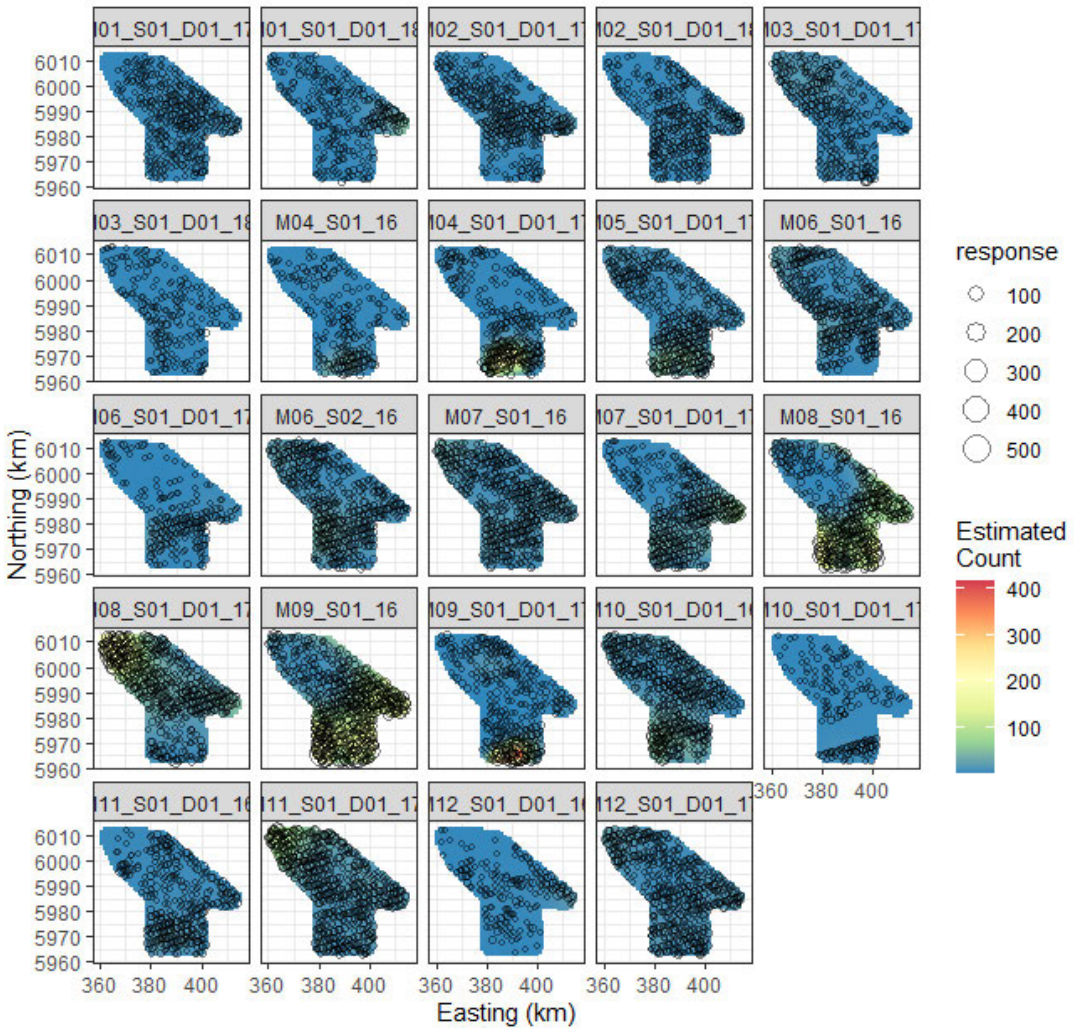

Figure 23: Predicted results for best-fitting guillemot model. Response refers to the number of birds identified per transect segment in the observation data.

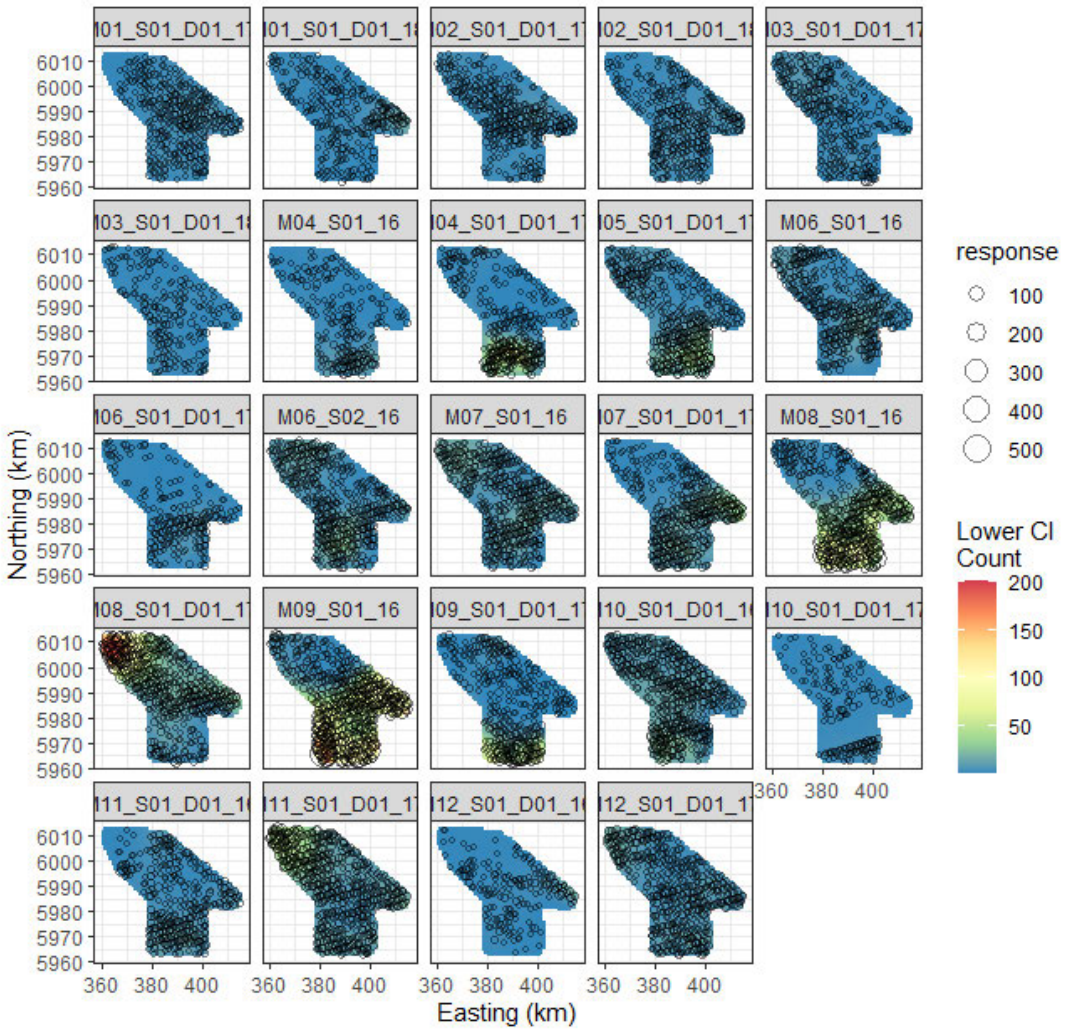

Figure 24: Lower 95% confidence limit predictions for guillemot, generated using a robust parametric bootstrap of the best fitting guillemot model. Response refers to the number of birds identified per transect segment in the observation data.

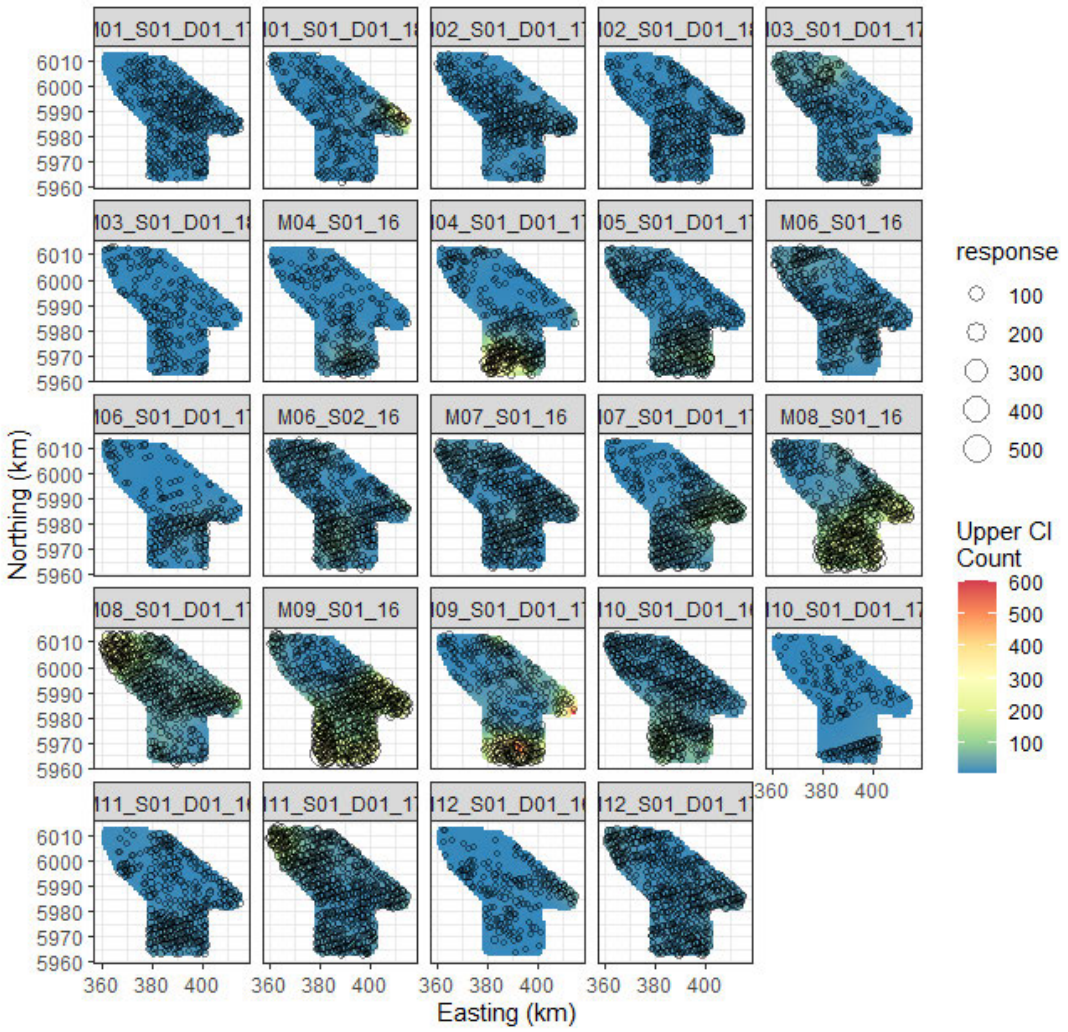

Figure 25: Upper 95% confidence limit predictions for guillemot, generated using a robust parametric bootstrap of the best fitting guillemot model. Response refers to the number of birds identified per transect segment in the observation data.

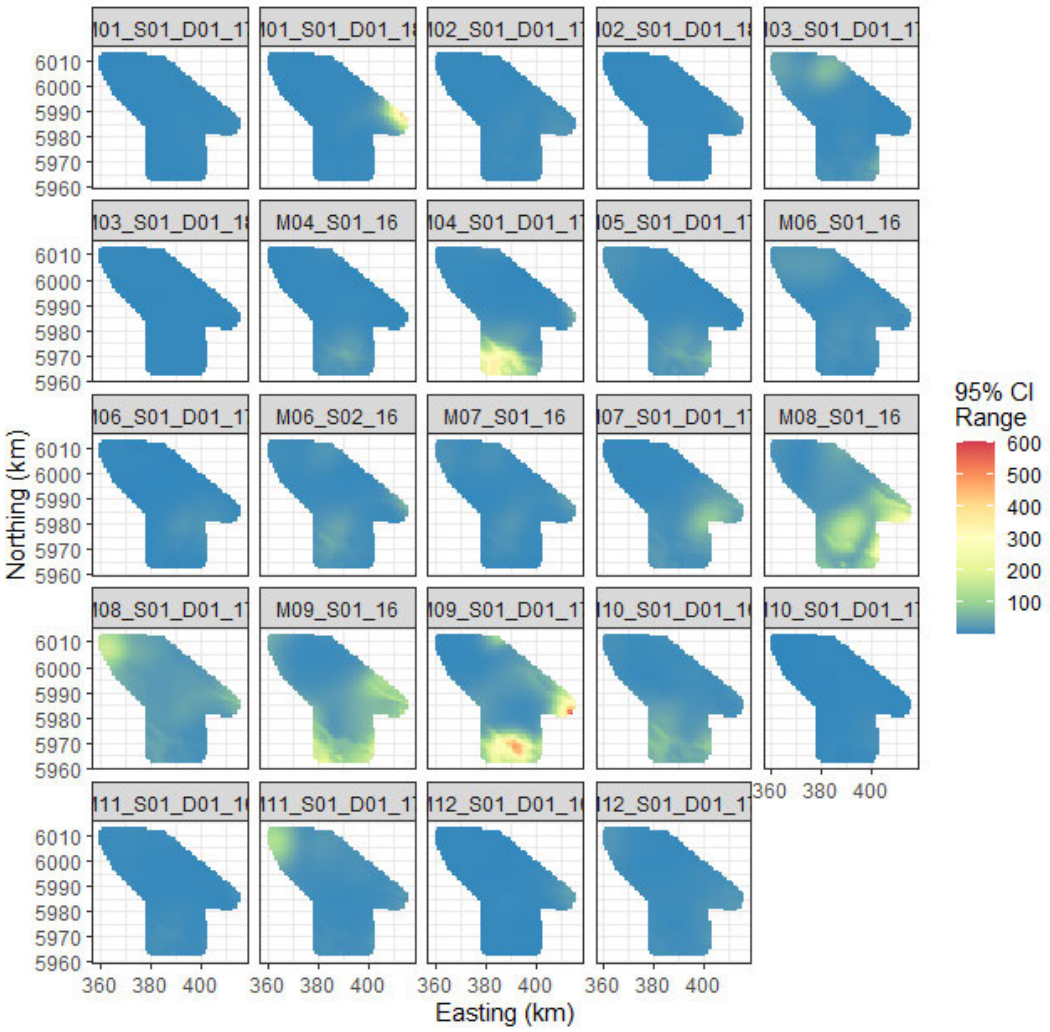

Figure 26: Range of the 95% confidence limit predictions for guillemot, generated using a robust parametric bootstrap of the best fitting kittiwake model.

Appendix C Details of MRSea_V2 rerun for razorbill

This appendix provides model outputs and diagnostic for the best-fitting razorbill model using the MRSea package. The best fitting razorbill model was a 2D spatially smoothed model that used survey month and depth as environmental variables. Candidate GLM and 1D smoothed models, and models using survey_ID instead of month and distance to coast and/or distance to FFC SPA were also considered but either failed to fit or produced worse model fits as indicated by higher 10-fold cross validation error scores.

```
initial_razorbill_model_month_depth_2 <- glm(response ~  as.factor(month) + offset(log(area)),
                                             family = "quasipoisson", data = razorbill_model_data)

varlist <- c('mean_depth')

salsa1dlist <-list(fitnessMeasure = "cv.gamMRSea",
                   minKnots_1d = c(1),
                   maxKnots_1d = c(3),
                   startKnots_1d = c(1),
                   degree=c(2),
                   maxIterations = 10,
                   gaps = c(1),
                   cv.opts = list(cv.gamMRSea.seed = 1, K=10))

salsa1dOutput_razorbill_month_depth <- runSALSA1D(initialModel=initial_razorbill_model_month_depth_2,
                                        salsa1dlist=salsa1dlist,
                                        varlist=varlist,
                                        factorlist=c("month"),
                                        datain = razorbill_model_data,
                                        panelid = razorbill_model_data$blockID,
                                        predictionData = predict_grid_razorbill_month)

summary(salsa1dOutput_razorbill_month_depth$bestModel)

# ~~~ have a look at the 1D relationship - is it sensible?
runPartialPlots(salsa1dOutput_razorbill_month_depth$bestModel,
                data = razorbill_model_data,
                factorlist.in = c("month"),
                varlist.in = varlist)


#####
# Set up knot grid for Salsa 2d

# ~~ use in built MRSea function to get knotgrid
knot_grid <- getKnotgrid(razorbill_model_data[, c("x.pos", "y.pos")])

#Make distance matrices
distMats <-makeDists(cbind(razorbill_model_data$x.pos, razorbill_model_data$y.pos), knot_grid)

salsa2dlist <-list(fitnessMeasure = "cv.gamMRSea",
                   cv.opts = list(cv.gamMRSea.seed = 1, K=10),
                   knotgrid = knot_grid,
                   startKnots = 6,    # ~~~
                   minKnots = 4,
                   maxKnots = 20,
                   gap = 0,
                   interactionTerm = "as.factor(month)")


# ~~~ removed spline params from 2d and updated block structure
salsa2dOutput_razorbill_month_depth <-runSALSA2D(salsa1dOutput_razorbill_month_depth$bestModel,
                                       salsa2dlist,
                                       distMats$dataDist,
                                       distMats$knotDist,
                                       panels = razorbill_model_data$blockID)
```

Figure 27: Code used to create best fitting razorbill model

```
> anova(best_razorbill_model_month_depth)
Analysis of 'Wald statistic' Table
Model: quasipoisson, link: log
Response: response
Marginal Testing
Max Panel Size = 66; Number of panels = 572

                                Df      X2 P(>|Chi|)
as.factor(month)                11  58.778 1.562e-08 ***
s(mean_depth)                    4  17.701  0.001412 **
s(x.pos, y.pos)                  6  12.146  0.058780 .
s(x.pos, y.pos):as.factor(month) 66 287.552 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>
```

Figure 28: ANOVA results of best-fitting razorbill model

```
> vif(initial_razorbill_model_month_depth)
                     GVIF Df GVIF^(1/(2*Df))
mean_depth       4.879909  1        2.209052
as.factor(month) 1.000548 11        1.000025
x.pos            1.236394  1        1.111933
y.pos            5.365775  1        2.316414
>
```

Figure 29: Variance Inflation Factors for the input variables used for the best-fitting razorbill model.

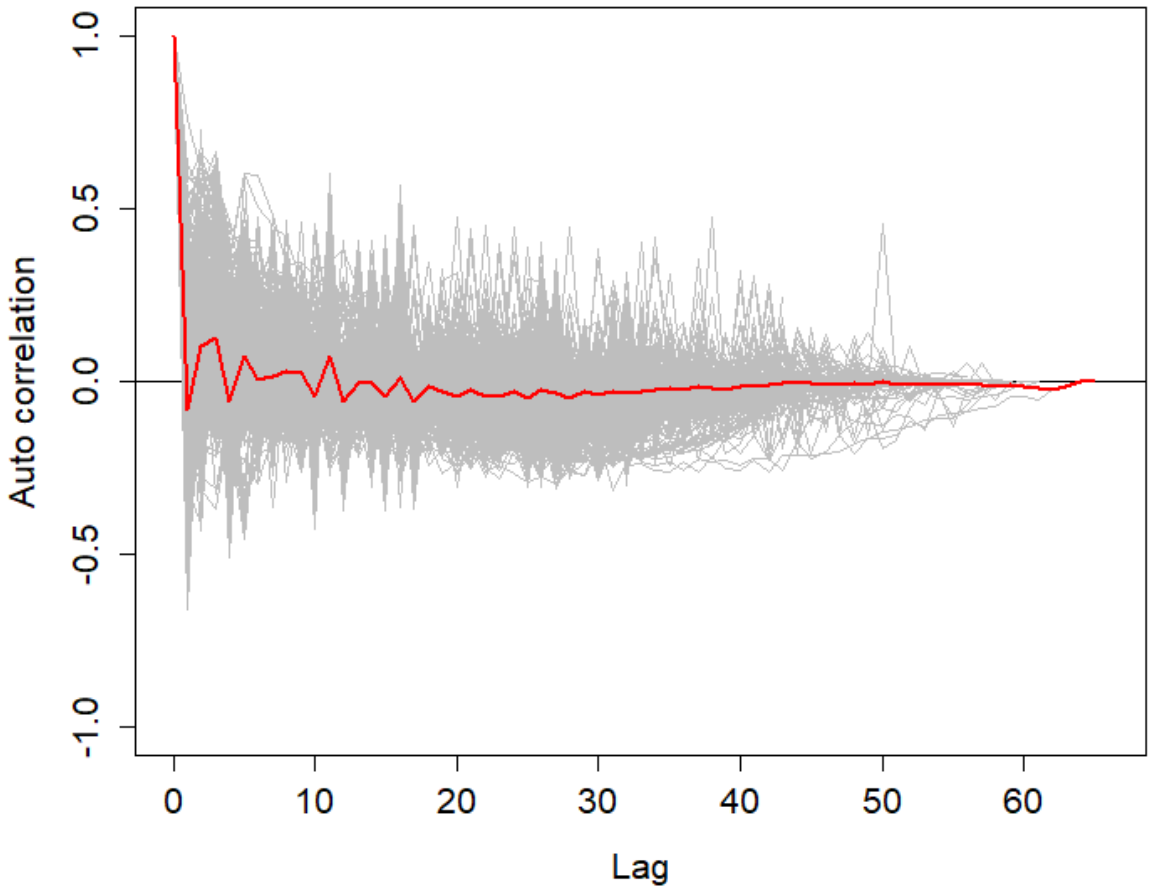

Figure 30: Auto-correlation function plot for the best-fitting razorbill model, using transect ID as a blocking structure.

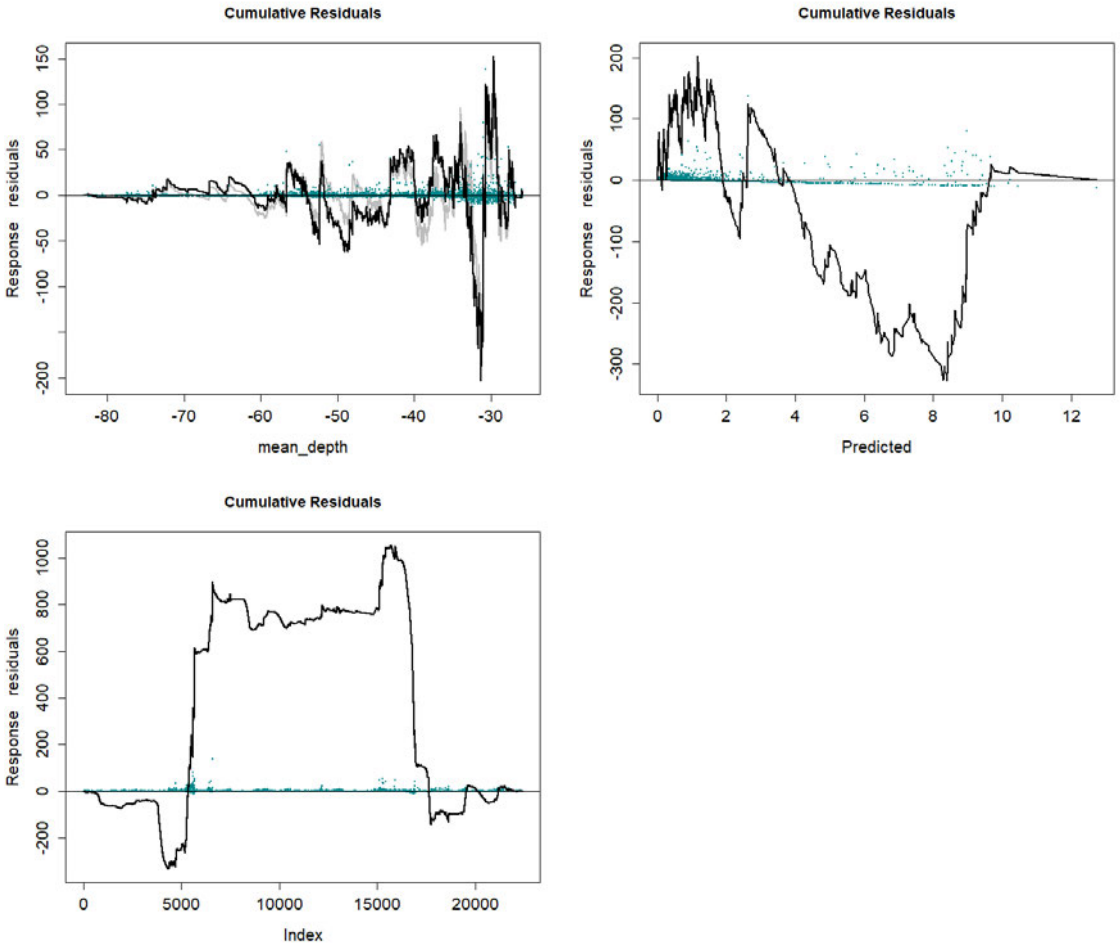

Figure 31: Plots showing cumulative residuals of the best fitting razorbill model ordered by a) mean depth; b) predicted response and c) data index order.

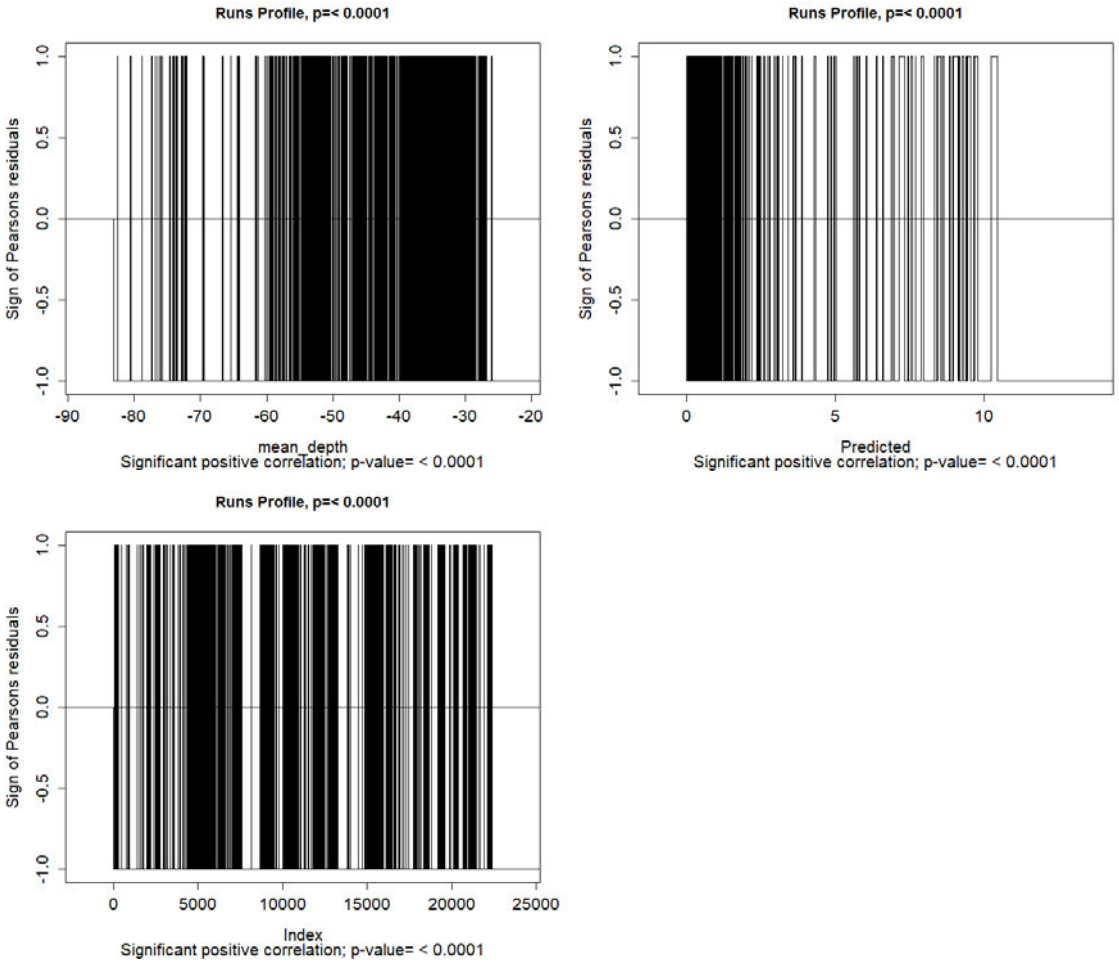

Figure 32: Runs profiles for the best fitting razorbill model.

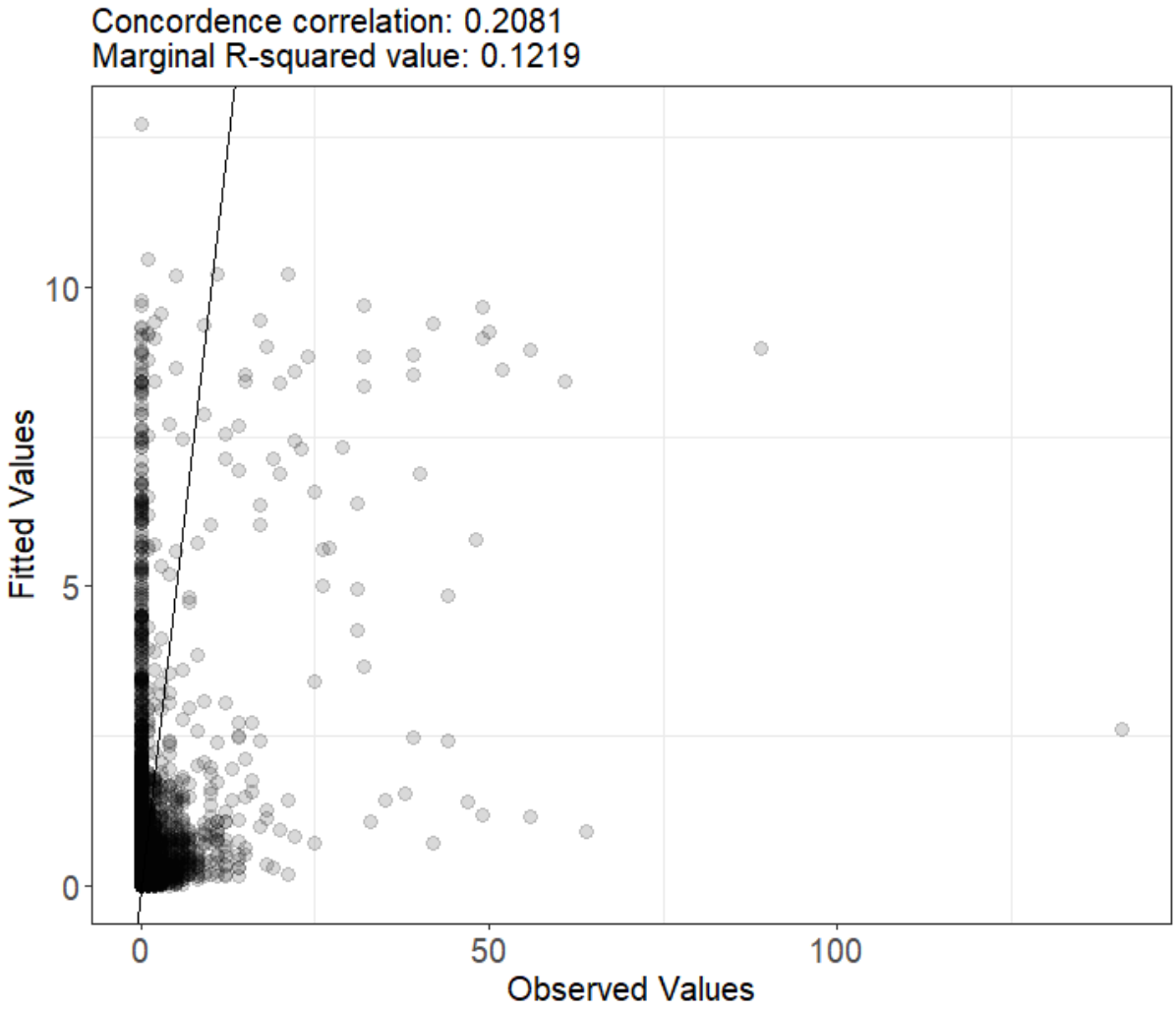

Figure 33: Plot of observed versus fitted values for best-fitting razorbill model.

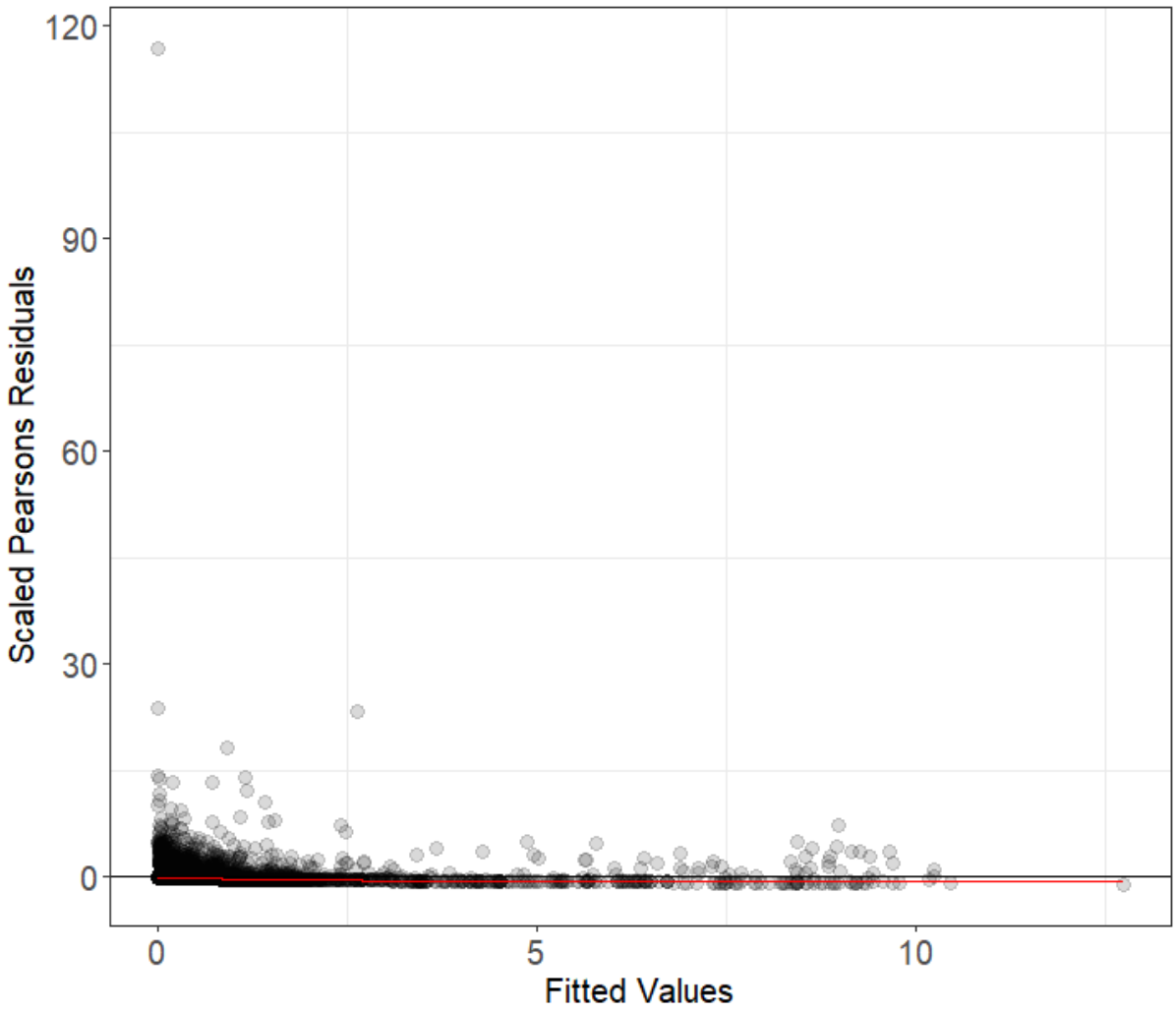

Figure 34: Plot of scaled Pearson residuals against fitted values for best-fitting razorbill model.

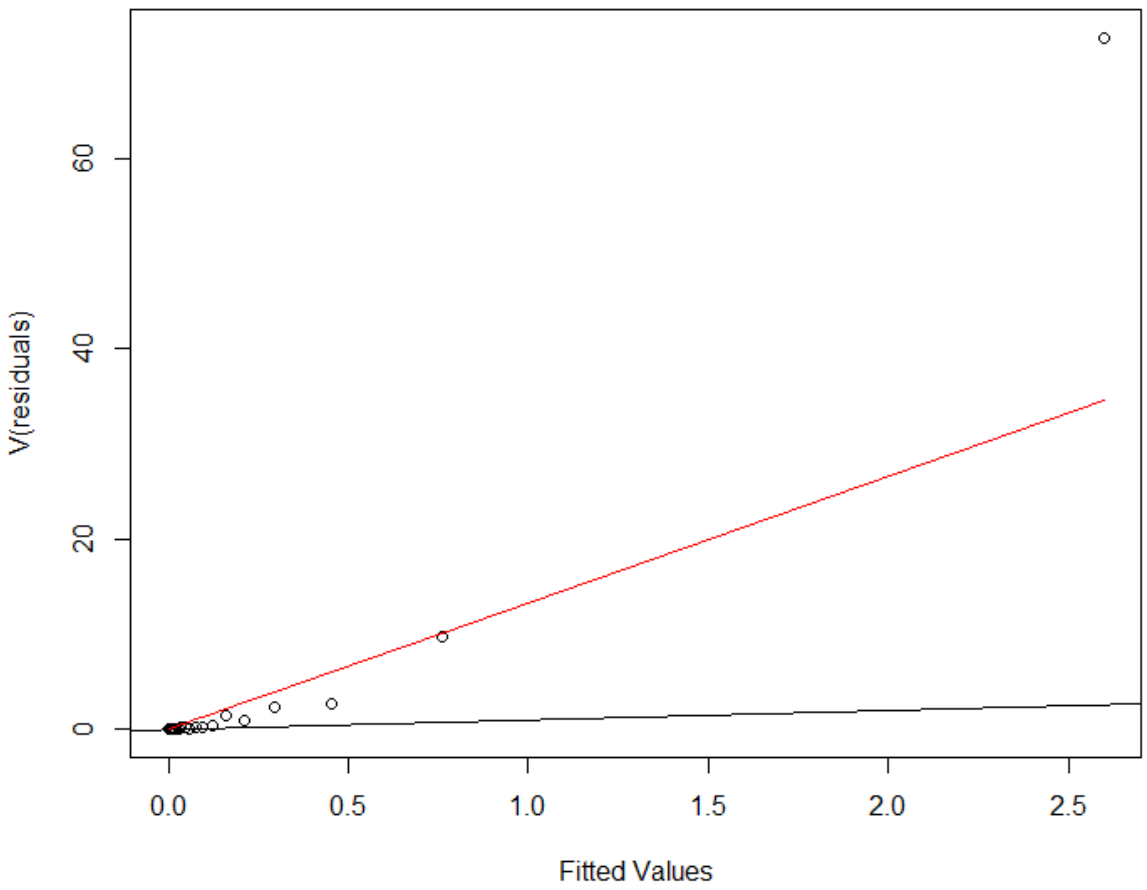

Figure 35: Mean-variance plot for best fitting razorbill model.

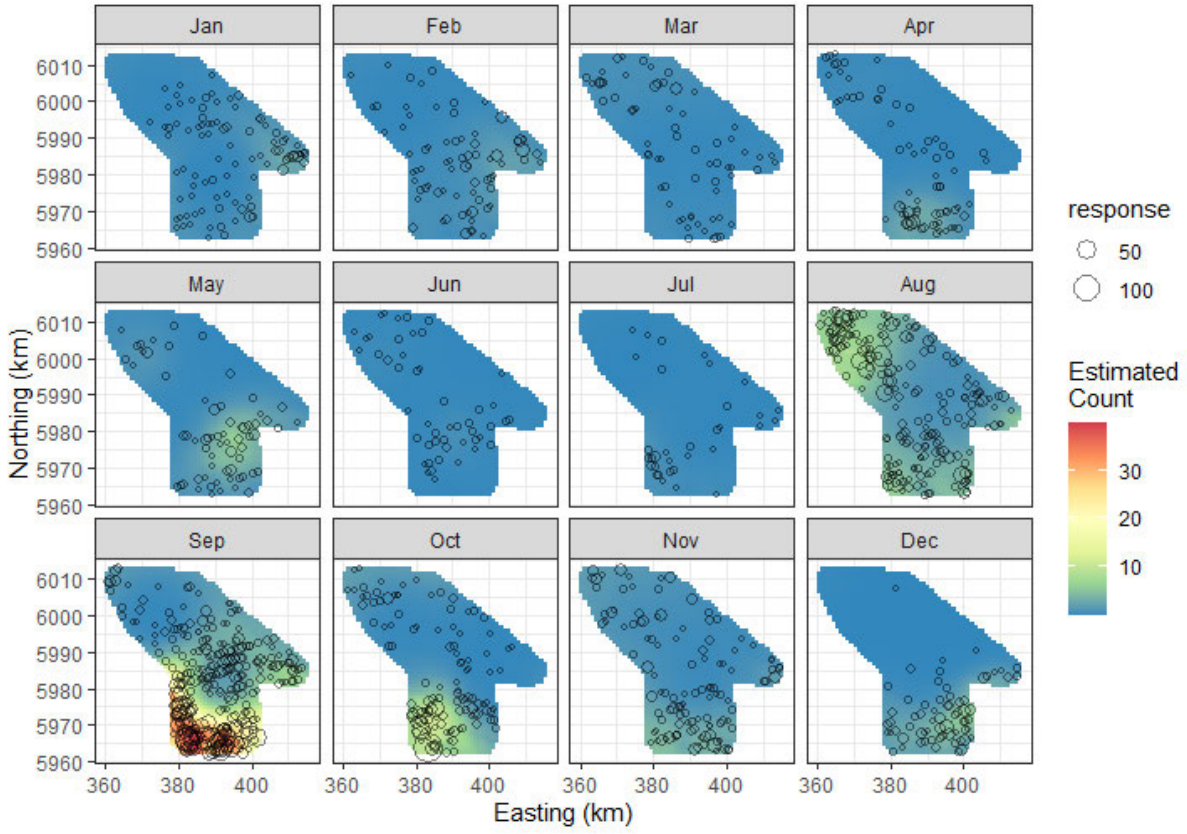

Figure 36: Predicted results for best-fitting razorbill model. Response refers to the number of birds identified per transect segment in the observation data.

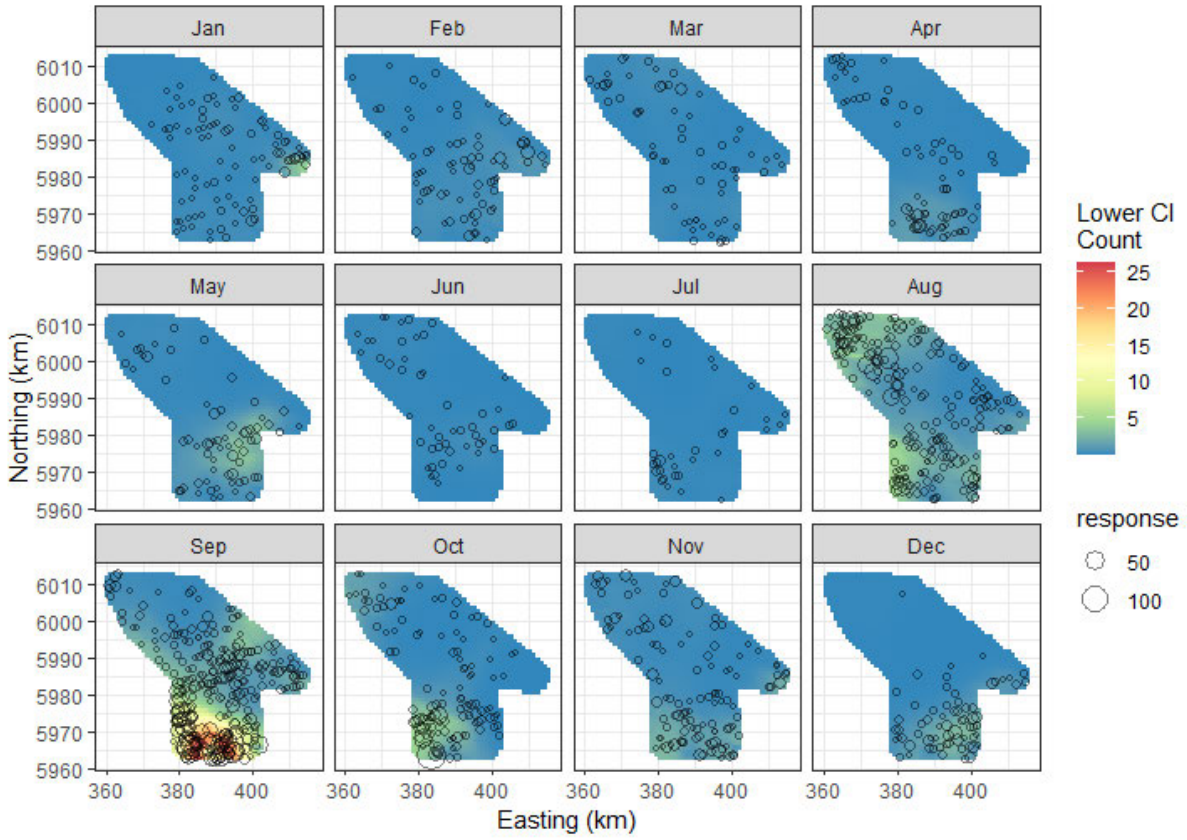

Figure 37: Lower 95% confidence limit predictions for razorbill, generated using a robust parametric bootstrap of the best fitting razorbill model. Response refers to the number of birds identified per transect segment in the observation data.

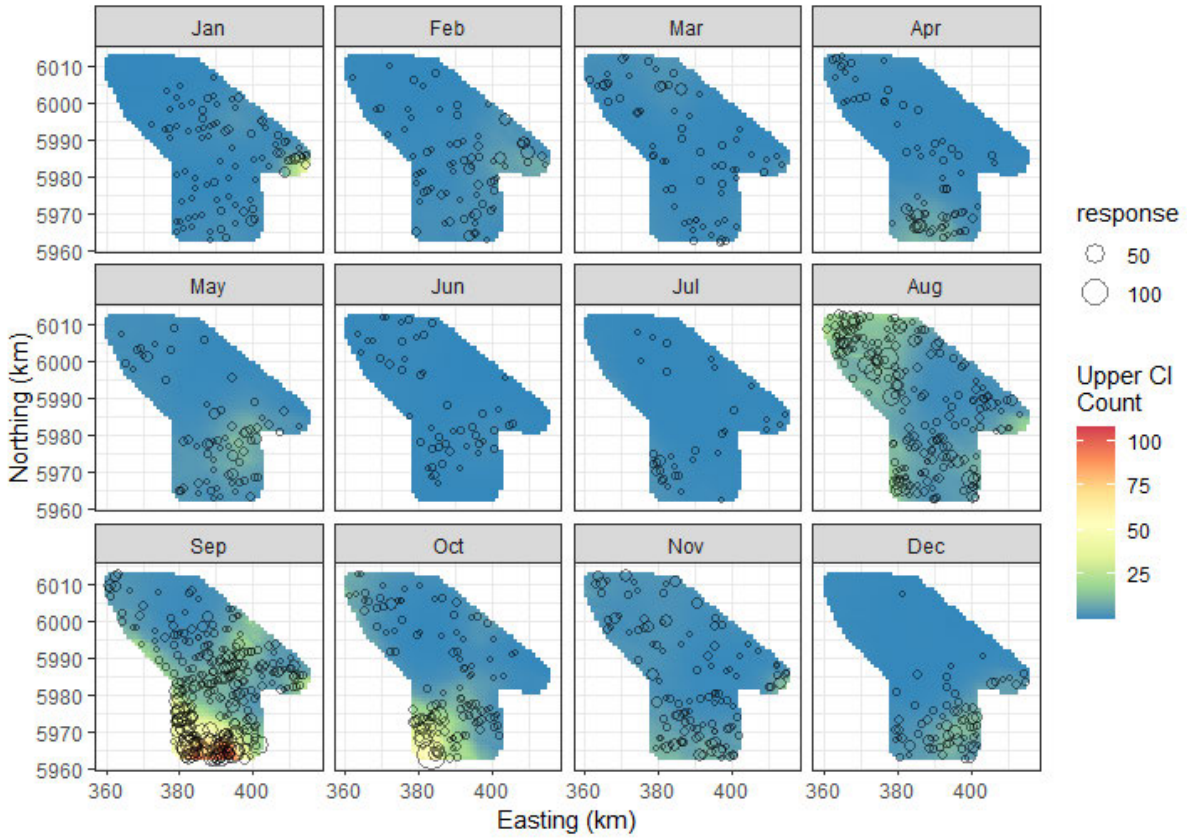

Figure 38: Upper 95% confidence limit predictions for razorbill, generated using a robust parametric bootstrap of the best fitting razorbill model. Response refers to the number of birds identified per transect segment in the observation data.

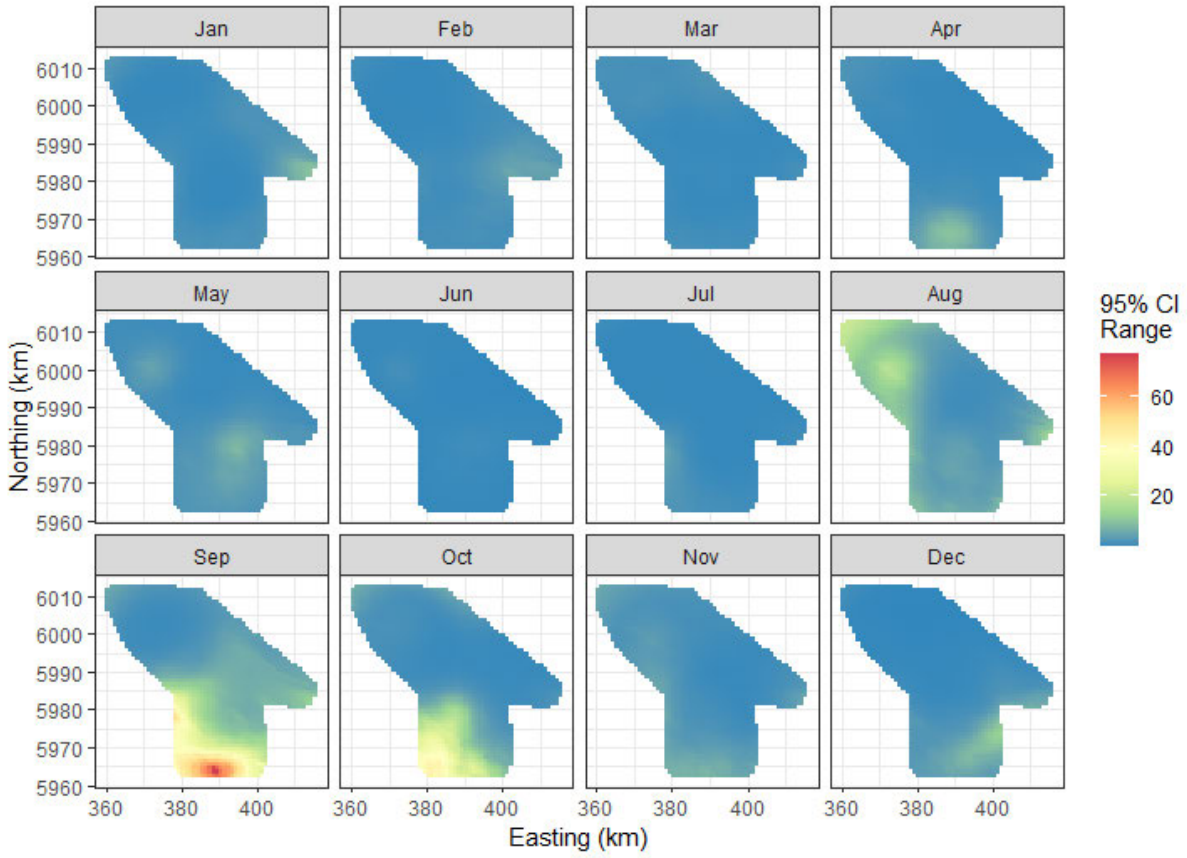

Figure 39: Range of the 95% confidence limit predictions for razorbill, generated using a robust parametric bootstrap of the best fitting razorbill model.