MacArthur Green

West of Orkney Windfarm

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West of Orkney Windfarm

Offshore Ornithology Technical Supporting Study 12

Annex 1R: Comparison of design- and model-based abundance estimates

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1 COMPARISON OF DESIGN- AND MODEL-BASED ABUNDANCE ESTIMATES

1. Abundance of birds within the OAA plus 4 km buffer estimated using the design-based method were compared against estimates produced from the MRSea model-based method (Scott-Hayward *et al.*, 2021). It was agreed during post-application consultation with NatureScot (7 May 2024) that the comparison of design- and model-based estimates should be carried out for OAA plus 4 km buffer as this area contains the greatest number of bird observations recorded during baseline DAS surveys and hence the greatest likelihood that model-based estimates could successfully be produced.

2. It was agreed during consultation with NatureScot (30th April 2024) that design- and model-based abundance estimates should be compared for key species in the impact assessment and include species with the largest difference between model and design estimates. Following this advice, design- and model-based abundance estimates were compared for the following species: kittiwake, guillemot, razorbill, puffin, fulmar and gannet.

3. Design and model-based abundance estimates are compared for each species in each survey in the following tables: **Table 1-1** to **Table 1-3** (kittiwake), **Table 1-4** to **Table 1-6** (guillemot), **Table 1-7** to **Table 1-9** (razorbill), **Table 1-10** to **Table 1-12** (puffin), **Table 1-13** to **Table 1-15** (fulmar) and **Table 1-16** to **Table 1-18** (gannet). For each species, three separate tables contain abundance estimates derived from i) all birds recorded (sitting + flying), ii) only birds recorded in flight (flying birds) and iii) only birds recorded on the sea (sitting birds) within the OAA plus 4 km buffer. In each table, design- and model-based abundance estimates for each of the 27 surveys are presented as the mean, standard deviation and lower and upper confidence intervals which were calculated using the 'bootstrap method'. Mean design-based estimates are coloured blue and mean model-based estimates are coloured red. The difference between the two means in each survey is presented as a bold number:

   - Bold blue = the design-based mean is higher than the model-based mean; and,
   - Bold red = model-based mean is higher than design-based mean.

4. Comparison of design- and model-based mean abundance in the OAA plus 4 km buffer with associated 95% confidence intervals for each survey have been illustrated as plots in the following figures: **Figure 1-1** to **Figure 1-3** (kittiwake), **Figure 1-4** to **Figure 1-6** (guillemot), **Figure 1-7** to **Figure 1-9** (razorbill), Figure 1-10 to **Figure 1-12** (puffin), **Figure 1-13** to **Figure 1-15** (fulmar) and **Figure 1-16** to **Figure 1-18** (gannet). For each species, three separate figures illustrate estimates derived from i) all birds recorded, ii) only birds recorded in flight and iii) only birds recorded on the sea, within the OAA plus 4 km buffer. Blue lines are mean design-based estimates and red lines are model-based estimates.

5. A key difference between design- and model-based estimates is the number of surveys for which it was possible to produce an estimate. For all species, a design-based abundance could be estimated for every survey if the species was recorded within the OAA plus 4 km, but a model-based abundance could only be estimated if a sufficient number of raw observations occurred in the OAA plus 4 km buffer. Therefore, for all species, more density-based estimates can be derived than model-based estimates.

6. For all species, design-based mean abundance estimates were generally similar to model-based mean estimates, with overlapping confidence intervals, shown in the plots below. Design-based abundance estimates tended to be higher in absolute terms than model-based abundance estimates, as illustrated by the majority of bold numbers being blue rather than red (see **Table 1-1** to **Table 1-18**). However, there were a few exceptions to this general trend.

- Kittiwake in March 2021 (survey 9) had a design-based abundance estimate that was higher than the model-based abundance estimate, for both birds in flight and on the sea (**Figure 1-1** to **Figure 1-3**). Both the design- and model-based methods produced a peak abundance in March 2021, but the design-based peak value was higher than the model-based peak value.
- Guillemot design-based estimate was higher than model-based estimates in July 2020, October 2020 and July 2022 (survey months 1, 4, and 25) for all birds (sitting and flying together) and birds on the sea. For flying birds alone, there were no significant differences between design-and model-based methods in these months. Few guillemots were recorded in flight.
- For razorbill, estimates from the two methods were similar (**Figure 1-7** and **Figure 1-9**). However, too few razorbills were recorded in flight to complete model-based estimates for any survey month, therefore no model-based estimates for flying razorbills could be produced to compare with the design-based method outputs (**Figure 1-8**).
- Similarly for puffin, the estimates from the two methods were similar for all birds (sitting and flying together), only birds sat on the water and only birds in flight (**Figure 1-10** to **Figure 1-12**). However, for 13 surveys, too few puffins were recorded in flight to produce a model-based estimate to compare with the design-based estimate.
- Likewise for fulmar and gannet, design-and model-based estimates were similar for each survey month where a model-based estimate was obtained.

1.1 Kittiwake

1.1.1 Design v Model-based comparison – Abundance tables

Table 1-1 Kittiwake design-based (blue) and model-based (red) abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight and on the sea in each survey in the OAA plus 4 km buffer.SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-`based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l c.i.	u c.i.	Mean	SD	l c.i.	u c.i.	
Jul-	1	301.63	119.83	120.31	561.63	339.57	56.71	240.34	448.54	**37.94**
Aug-	2	312.76	54.16	207.00	414.01	NM	NM	NM	NM	**N/A**
Sep-	3	16.11	9.91	0.00	38.74	NM	NM	NM	NM	**N/A**
Oct-	4	1468.73	250.87	1046.5	2023.9	1123.64	124.26	885.88	1348.97	**345.10**
Nov-	5	236.16	50.01	147.35	333.66	238.47	34.67	172.22	305.43	**2.31**
Dec-	6	123.69	38.43	54.24	201.48	103.83	18.88	65.69	141.91	**19.86**

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l c.i.	u c.i.	Mean	SD	l c.i.	u c.i.	
Jan-	7	114.91	27.28	61.98	170.46	103.57	17.17	70.03	137.94	**11.35**
Feb-	8	253.10	56.49	147.16	364.02	227.04	31.30	168.37	303.44	**26.06**
Mar-	9	1591.28	183.95	1231.50	1959.56	909.97	89.94	738.58	1092.47	**681.30**
Apr-	10	630.20	89.54	465.36	814.38	437.33	60.77	318.56	560.35	**192.87**
May-	11	77.60	54.94	0.00	201.71	NM	NM	NM	NM	**N/A**
Jun-	12	167.36	87.41	38.76	364.32	201.78	51.98	100.20	311.64	**34.42**
Jul-	13	132.44	30.49	77.52	193.79	133.42	26.22	84.85	203.42	**0.99**
Aug-	14	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-	15	154.81	52.94	61.98	263.63	159.14	23.24	112.90	199.61	**4.33**
Oct-	16	832.89	115.34	604.81	1070.0	785.17	90.67	602.25	954.84	**47.72**
Nov-	17	122.89	31.54	61.92	185.77	114.73	19.60	76.09	163.99	**8.15**
Dec-	18	52.46	17.74	23.25	85.25	NM	NM	NM	NM	**N/A**
Feb18	19	124.94	30.59	62.00	186.00	76.88	18.28	44.13	110.26	**48.06**
Feb2	20	507.45	80.36	356.32	673.92	404.32	49.94	302.71	499.48	**103.13**
Mar-	21	1777.32	245.46	1357.10	2287.6	1359.42	157.54	1041.51	1672.54	**417.90**
Apr-	22	200.71	39.29	123.78	278.70	175.99	31.47	116.65	231.30	**24.72**
May-	23	130.14	33.84	69.87	201.86	116.34	23.72	70.53	164.99	**13.80**
Jun-	24	88.72	46.39	23.23	193.58	96.01	15.12	65.80	125.64	**7.29**
Jul-	25	1873.66	634.39	785.01	3239.0	2460.71	725.60	1208.50	3900.4	**587.05**
Aug-	26	53.44	25.41	15.61	109.25	NM	NM	NM	NM	**N/A**
Sep-	27	47.30	17.15	15.81	79.05	NM	NM	NM	NM	**N/A**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-2 Kittiwake design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Season		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u..i.	
Jul-	1	199.23	81.94	80.20	384.98	247.95	66.31	141.89	389.27	**48.72**
Aug-	2	230.83	46.58	143.11	326.43	204.53	36.45	134.76	274.88	**26.30**
Sep-	3	7.72	7.26	0.00	23.24	NM	NM	NM	NM	**N/A**
Oct-	4	856.56	125.52	643.58	1132.08	590.50	56.39	478.68	697.56	**266.07**
Nov-	5	215.81	45.74	131.84	310.20	238.47	34.67	172.22	305.43	**22.66**
Dec-	6	79.24	26.82	31.00	131.74	54.97	9.34	38.17	81.52	**24.27**
Jan-	7	94.20	24.39	54.24	147.21	101.34	17.94	64.47	136.41	**7.14**
Feb-	8	155.03	34.56	92.94	224.61	139.77	22.34	95.97	179.26	**15.26**
Mar-	9	773.70	96.40	603.94	968.16	472.18	64.65	345.54	578.91	**301.52**
Apr-	10	607.21	89.76	442.09	783.55	414.37	59.31	297.95	533.91	**192.84**
May-	11	79.29	55.68	0.00	201.51	NM	NM	NM	NM	**N/A**
Jun-	12	38.99	15.37	15.50	69.76	NM	NM	NM	NM	**N/A**
Jul-	13	131.21	31.48	77.52	193.79	133.42	26.22	84.85	203.42	**2.21**
Aug-	14	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-	15	153.09	52.81	61.98	263.43	159.14	23.24	112.90	199.61	**6.04**
Oct-	16	819.97	109.27	612.57	1046.79	772.57	89.42	588.74	929.92	**47.40**
Nov-	17	124.64	31.04	69.47	193.51	114.73	19.60	76.09	163.99	**9.90**
Dec-	18	53.84	18.30	23.25	93.00	NM	NM	NM	NM	**N/A**
Feb18	19	123.84	30.71	69.75	186.00	76.88	18.28	44.13	110.26	**46.96**
Feb2	20	441.26	66.26	317.59	573.22	383.97	47.41	293.73	461.05	**57.29**
Mar-	21	1248.33	166.11	938.34	1605.26	927.57	118.0	697.01	1146.52	**320.76**
Apr-	22	201.34	40.91	123.78	286.24	175.99	31.47	116.65	231.30	**25.35**
May-	23	123.90	32.74	62.11	194.10	113.94	21.87	68.76	152.18	**9.95**
Jun-	24	31.00	14.14	7.74	61.94	NM	NM	NM	NM	**N/A**
Jul-	25	1172.73	442.06	459.82	2134.54	1124.94	227.7	683.46	1597.10	**47.79**
Aug-	26	23.46	12.29	0.00	46.82	NM	NM	NM	NM	**N/A**
Sep-	27	39.86	16.19	7.90	71.14	NM	NM	NM	NM	**N/A**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-3 Kittiwake design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-	1	96.30	41.50	24.06	184.47	96.62	18.87	62.35	138.	**0.31**
Aug-	2	78.18	23.23	31.85	119.43	53.41	9.36	35.08	71.0	**24.77**
Sep-	3	7.81	6.40	0.00	23.24	NM	NM	NM	NM	**N/A**
Oct-	4	589.95	173.64	286.90	961.49	514.47	123.52	287.58	748	**75.48**
Nov-	5	14.95	9.56	0.00	38.78	NM	NM	NM	NM	**N/A**
Dec-	6	46.14	22.32	7.75	92.99	NM	NM	NM	NM	**N/A**
Jan-	7	23.15	12.30	0.00	46.49	NM	NM	NM	NM	**N/A**
Feb-	8	100.42	38.21	38.73	185.88	93.89	16.99	60.86	125.	**6.53**
Mar-	9	815.16	141.14	557.66	1107.58	357.62	65.81	240.98	541.	**457.54**
Apr-	10	23.21	16.09	0.00	54.29	NM	NM	NM	NM	**N/A**
May-	11	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jun-	12	128.45	85.21	15.50	310.06	122.39	19.49	87.48	162.	**6.06**
Jul-	13	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Aug-	14	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-	15	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Oct-	16	15.02	10.22	0.00	38.77	NM	NM	NM	NM	**N/A**
Nov-	17	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-	18	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb18	19	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb2	20	60.94	21.72	23.24	108.45	NM	NM	NM	NM	**N/A**
Mar-	21	537.71	111.15	333.46	767.73	418.56	67.48	291.51	558	**119.15**
Apr-	22	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
May-	23	7.79	7.12	0.00	23.29	NM	NM	NM	NM	**N/A**
Jun-	24	53.91	44.04	0.00	154.86	NM	NM	NM	NM	**N/A**
Jul-	25	702.41	293.42	230.01	1324.55	NM	NM	NM	NM	**N/A**
Aug-	26	31.71	21.90	0.00	78.03	NM	NM	NM	NM	**N/A**
Sep-	27	8.49	7.50	0.00	23.71	NM	NM	NM	NM	**N/A**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

1.1.2 Design v Model-based comparison – Abundance figures

All Birds

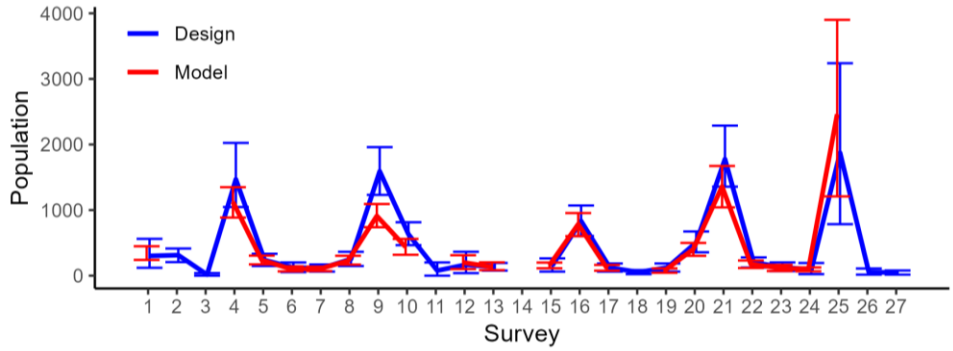

Figure 1-1 Kittiwake abundance (population) of all birds recorded in flight and on the sea in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Flying Birds

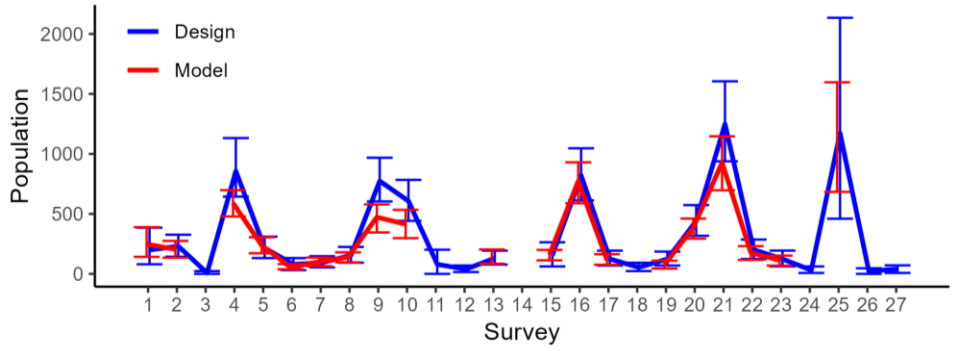

Figure 1-2 Kittiwake abundance (population) of birds recorded in flight in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Sitting Birds

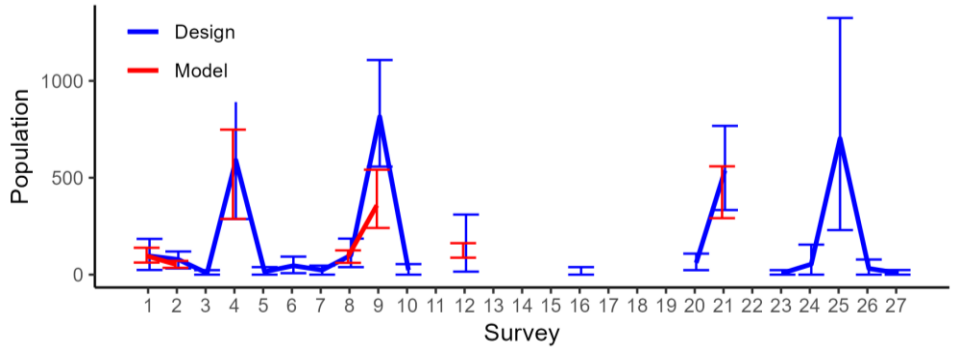

Figure 1-3 Kittiwake abundance (population) of birds recorded on the sea in the OAA plus 4 km. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

1.2 Guillemot

1.2.1 Design v Model-based comparison – Abundance tables

Table 1-4 Guillemot design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight and on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No	Mean	SD	l. c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	3530.51	385.93	2775.0	4282.93	1955.19	305.18	1488.12	2561.36	**1575.33**
Aug-2020	2	1337.45	154.80	1035.02	1640.11	918.40	99.32	717.27	1107.46	**419.05**
Sep-2020	3	4144.79	335.86	3478.3	4757.21	3200.11	444.79	2572.14	4629.9	**944.68**
Oct-2020	4	3800.9	366.12	3155.67	4621.36	2341.40	166.49	2002.35	2653.4	**1459.53**
Nov-2020	5	497.21	66.60	379.81	635.92	355.96	42.52	271.49	439.86	**141.25**
Dec-2020	6	855.74	93.19	681.92	1038.38	569.63	65.72	433.91	693.46	**286.12**
Jan-2021	7	1366.38	144.91	1092.4	1650.54	932.25	93.07	771.11	1090.8	**434.13**
Feb-2021	8	2415.87	430.04	1734.71	3361.37	2292.63	480.54	1670.30	3556.21	**123.24**
Mar-2021	9	3008.31	360.87	2339.0	3764.21	2168.51	168.27	1899.53	2572.66	**839.80**
Apr-2021	10	6995.7	488.69	6049.3	7934.41	5298.96	643.66	4314.27	6676.6	**1696.73**
May-2021	11	590.94	174.21	302.27	961.06	565.97	83.30	397.66	721.96	**24.97**
Jun-2021	12	1093.41	184.29	775.16	1480.55	NM	NM	NM	NM	**N/A**
Jul-2021	13	1667.58	208.23	1263.54	2093.18	1346.39	100.10	1149.14	1500.6	**321.19**
Aug-2021	14	3301.80	256.11	2787.31	3794.37	NM	NM	NM	NM	**N/A**
Sep-2021	15	4217.73	287.28	3664.6	4780.57	3573.00	308.89	3016.14	4254.5	**644.73**
Oct-2021	16	3339.17	289.86	2806.7	3916.17	2668.30	268.33	2139.33	3146.25	**670.87**
Nov-2021	17	1101.42	113.21	882.40	1323.60	NM	NM	NM	NM	**N/A**
Dec-2021	18	1616.20	148.65	1348.24	1921.91	1301.10	119.43	1093.74	1545.95	**315.10**
Feb18-2022	19	286.45	43.79	209.25	379.75	159.97	23.51	116.17	200.34	**126.48**
Feb26-	20	534.15	74.15	402.80	689.41	389.52	43.80	305.10	476.57	**144.64**
Mar-2022	21	326.53	55.41	224.89	442.03	NM	NM	NM	NM	**N/A**
Apr-2022	22	1773.25	159.48	1469.9	2112.01	NM	NM	NM	NM	**N/A**
May-2022	23	2615.88	386.85	1870.8	3400.76	2383.78	184.32	2000.11	2745.22	**232.10**
Jun-2022	24	2270.28	427.48	1501.96	3198.07	2219.10	426.03	1606.10	3214.71	**51.18**
Jul-2022	25	7692.11	898.24	5979.7	9398.94	4284.48	394.30	3493.47	5027.6	**3407.6**
Aug-2022	26	5602.81	701.90	4229.0	7007.56	3802.52	517.75	3092.72	4572.73	**1800.29**
Sep-2022	27	4462.4	609.23	3367.4	5644.15	3706.07	410.19	3041.92	4714.46	**756.40**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-5 Guillemot design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	87.98	31.38	32.08	152.39	60.99	11.47	38.68	84.19	**26.98**
Aug-	2	40.49	17.28	7.96	71.66	NM	NM	NM	NM	**N/A**
Sep-2020	3	78.12	26.43	30.99	131.70	88.64	26.59	41.33	148.32	**10.52**
Oct-2020	4	132.40	42.15	54.28	217.30	144.65	43.74	68.81	228.59	**12.25**
Nov-	5	39.05	15.35	7.76	69.99	NM	NM	NM	NM	**N/A**
Dec-2020	6	84.12	26.89	38.75	139.48	95.42	19.01	60.89	134.11	**11.30**
Jan-2021	7	88.37	34.89	23.24	162.71	79.95	13.47	53.56	108.67	**8.42**
Feb-2021	8	319.25	60.02	201.3	441.47	246.07	35.72	181.20	312.53	**73.19**
Mar-2021	9	231.38	52.38	139.2	348.54	195.78	36.43	122.04	263.55	**35.60**
Apr-2021	10	93.07	27.61	46.54	147.36	81.30	17.60	48.55	114.78	**11.77**
May-2021	11	31.23	17.47	0.00	69.75	NM	NM	NM	NM	**N/A**
Jun-2021	12	85.73	30.12	31.01	147.28	76.14	16.68	44.18	106.51	**9.60**
Jul-2021	13	382.64	83.63	224.8	550.38	349.87	50.49	245.39	443.10	**32.77**
Aug-2021	14	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-2021	15	30.80	14.18	7.75	61.98	NM	NM	NM	NM	**N/A**
Oct-2021	16	850.10	233.2	449.7	1364.71	766.75	146.28	475.93	1049.52	**83.35**
Nov-2021	17	92.97	24.79	46.44	139.52	96.62	22.90	55.17	143.41	**3.65**
Dec-2021	18	15.27	9.84	0.00	38.75	NM	NM	NM	NM	**N/A**
Feb18-	19	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb26-	20	7.68	7.32	0.00	23.24	NM	NM	NM	NM	**N/A**
Mar-	21	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2022	22	176.33	51.35	85.10	278.70	201.13	48.68	109.78	293.08	**24.80**
May-	23	686.04	103.5	481.3	893.04	601.95	78.34	443.76	745.64	**84.10**
Jun-2022	24	230.56	55.13	131.63	348.44	163.48	33.74	107.73	239.25	**67.08**
Jul-2022	25	276.12	63.36	166.5	412.43	214.74	44.45	127.82	306.20	**61.38**
Aug-	26	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-2022	27	23.34	11.76	0.00	47.43	NM	NM	NM	NM	**23.34**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-6 Guillemot design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	3443.48	393.42	2686.8	4210.95	1947.36	316.55	1451.38	2732.79	**1496.13**
Aug-2020	2	1303.87	153.48	1026.8	1616.42	888.05	95.56	706.27	1067.60	**415.82**
Sep-2020	3	4053.60	336.75	3393.11	4725.83	3136.86	447.25	2491.31	4544.30	**916.74**
Oct-2020	4	3667.24	362.26	3008.5	4404.25	2230.77	163.81	1895.47	2541.74	**1436.47**
Nov-2020	5	455.69	66.61	333.47	589.39	321.71	59.33	238.84	477.80	**133.98**
Dec-2020	6	771.80	90.92	596.68	960.89	484.90	63.04	365.83	613.10	**286.90**
Jan-2021	7	1285.84	151.44	1007.0	1588.75	854.85	81.38	689.84	1014.78	**430.99**
Feb-2021	8	2103.33	378.94	1448.14	2927.84	2067.01	459.30	1497.55	3302.39	**36.32**
Mar-2021	9	2768.02	341.46	2153.19	3478.41	2051.21	154.10	1732.17	2359.70	**716.81**
Apr-2021	10	6890.28	485.97	6002.3	7880.51	5219.62	654.95	4146.10	6649.87	**1670.65**
May-2021	11	548.06	161.59	271.27	899.05	528.20	121.94	370.97	797.57	**19.86**
Jun-2021	12	985.09	189.89	658.88	1387.92	987.29	170.05	734.82	1437.63	**2.19**
Jul-2021	13	1279.55	173.16	976.72	1635.63	950.51	91.35	778.63	1086.57	**329.03**
Aug-2021	14	3321.24	263.95	2810.74	3841.03	NM	NM	NM	NM	**N/A**
Sep-2021	15	4168.74	287.13	3625.71	4757.52	3542.08	311.25	2983.3	4199.71	**626.65**
Oct-2021	16	2478.24	197.72	2116.46	2861.24	1956.72	137.14	1695.63	2247.88	**521.53**
Nov-2021	17	1004.24	103.23	812.74	1207.50	810.19	111.92	595.86	1087.92	**194.05**
Dec-2021	18	1603.38	142.99	1325.19	1898.66	1283.37	117.09	1083.9	1502.27	**320.01**
Feb18-2022	19	289.07	45.91	201.50	379.75	159.97	23.51	116.17	200.34	**129.10**
Feb26-	20	524.14	75.03	387.31	689.41	396.50	42.50	311.08	475.57	**127.64**
Mar-2022	21	327.70	56.48	224.89	449.78	NM	NM	NM	NM	**N/A**
Apr-2022	22	1583.79	148.47	1291.96	1872.18	NM	NM	NM	NM	**N/A**
May-2022	23	1895.80	363.02	1234.45	2655.43	1805.92	154.84	1486.9	2081.39	**89.88**
Jun-2022	24	2058.30	443.87	1316.32	3027.73	2036.01	353.40	1409.4	2823.71	**22.29**
Jul-2022	25	7399.96	938.21	5646.7	9438.59	4044.25	376.09	3293.27	4712.05	**3355.72**
Aug-2022	26	5640.55	737.76	4283.6	7071.74	3802.52	517.75	3092.72	4572.73	**1838.03**
Sep-2022	27	4439.53	615.35	3272.54	5746.71	3658.56	403.48	3072.12	4788.75	**780.97**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

1.2.2 Design v Model-based comparison – Abundance figures

All Birds

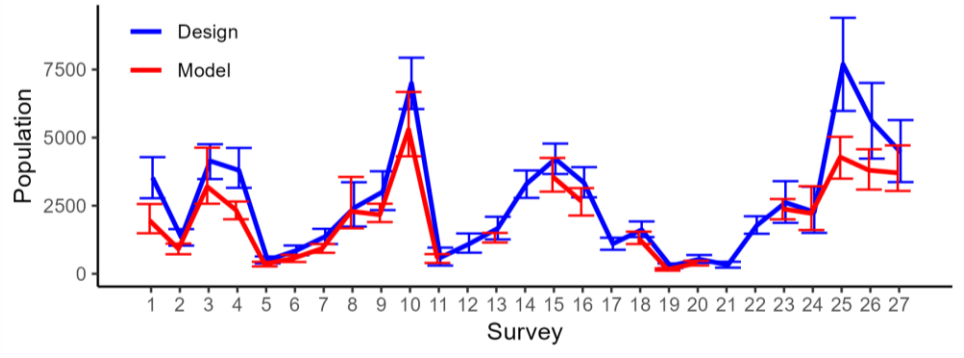

Figure 1-4 Guillemot abundance (population) of all birds recorded in flight and on the sea in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Flying Birds

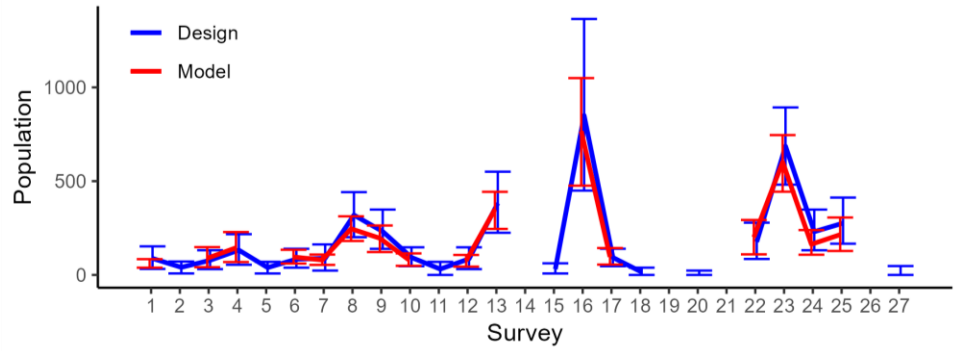

Figure 1-5 Guillemot abundance (population) of birds recorded in flight in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Sitting Birds

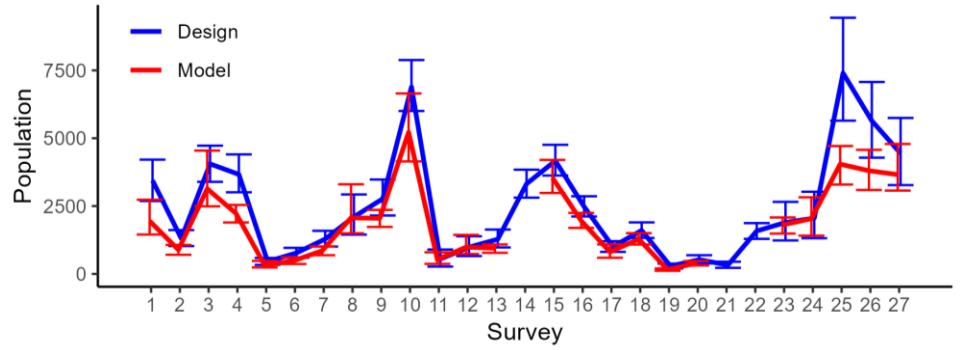

Figure 1-6 Guillemot abundance (population) of birds recorded on the sea in the OAA plus 4 km. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

1.3 Razorbill

1.3.1 Design v Model-based comparison – Abundance tables

Table 1-7 Razorbill design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight and on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	16.14	14.46	0.0	48.12	NM	NM	NM	NM	N/A
Aug-2020	2	16.42	14.03	0.0	47.77	NM	NM	NM	NM	N/A
Sep-2020	3	91.98	32.29	38.7	162.69	76.72	18.43	44.56	117.63	**15.25**
Oct-2020	4	15.63	14.22	0.0	46.52	NM	NM	NM	NM	N/A
Nov-2020	5	7.55	7.18	0.0	23.27	NM	NM	NM	NM	N/A
Dec-2020	6	NM	NM	NM	NM	NM	NM	NM	NM	N/A
Jan-2021	7	NM	NM	NM	NM	NM	NM	NM	NM	N/A
Feb-2021	8	78.24	28.81	23.2	139.41	63.86	6.68	49.83	76.55	**14.38**
Mar-2021	9	70.59	28.52	15.4	131.67	NM	NM	NM	NM	N/A
Apr-2021	10	162.57	36.30	93.	232.68	152.87	35.03	91.87	237.45	**9.70**
May-2021	11	23.58	13.09	0.0	46.50	NM	NM	NM	NM	N/A
Jun-2021	12	94.24	35.85	31.0	170.53	100.17	20.81	58.33	143.25	**5.92**
Jul-2021	13	NM	NM	NM	NM	NM	NM	NM	NM	N/A
Aug-2021	14	125.40	44.93	46.	216.82	NM	NM	NM	NM	N/A
Sep-2021	15	75.37	39.55	7.75	154.96	86.80	33.11	33.17	177.28	**11.43**
Oct-2021	16	23.23	12.45	0.0	46.52	NM	NM	NM	NM	N/A
Nov-2021	17	7.86	7.26	0.0	23.22	NM	NM	NM	NM	N/A
Dec-2021	18	23.10	12.52	0.0	46.50	NM	NM	NM	NM	N/A
Feb18-2022	19	NM	NM	NM	NM	NM	NM	NM	NM	N/A
Feb26-	20	39.99	22.40	0.0	92.95	NM	NM	NM	NM	N/A
Mar-2022	21	138.90	44.51	62.	232.65	111.59	22.26	69.91	161.95	**27.31**
Apr-2022	22	NM	NM	NM	NM	NM	NM	NM	NM	N/A
May-2022	23	7.80	6.30	0.0	23.29	NM	NM	NM	NM	N/A
Jun-2022	24	NM	NM	NM	NM	NM	NM	NM	NM	N/A
Jul-2022	25	182.22	64.15	71.3	317.26	253.30	17.44	221.20	283.46	**71.08**
Aug-2022	26	37.99	21.71	0.0	85.84	NM	NM	NM	NM	N/A
Sep-2022	27	352.08	130.78	118.	624.47	377.21	128.86	180.68	684.01	**25.14**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-8 Razorbill design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Aug-2020	2	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-2020	3	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Oct-2020	4	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Nov-2020	5	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-2020	6	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jan-2021	7	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb-2021	8	7.61	6.96	0.00	23.24	NM	NM	NM	NM	**N/A**
Mar-2021	9	7.47	7.02	0.00	23.24	NM	NM	NM	NM	**N/A**
Apr-2021	10	8.04	7.29	0.00	23.27	NM	NM	NM	NM	**N/A**
May-2021	11	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jun-2021	12	7.70	7.17	0.00	23.25	NM	NM	NM	NM	**N/A**
Jul-2021	13	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Aug-2021	14	7.56	6.99	0.00	23.23	NM	NM	NM	NM	**N/A**
Sep-2021	15	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Oct-2021	16	7.92	7.26	0.00	23.26	NM	NM	NM	NM	**N/A**
Nov-2021	17	7.64	7.20	0.00	23.22	NM	NM	NM	NM	**N/A**
Dec-2021	18	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb18-2022	19	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb26-2022	20	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Mar-2022	21	7.67	5.49	0.00	15.51	NM	NM	NM	NM	**N/A**
Apr-2022	22	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
May-2022	23	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jun-2022	24	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jul-2022	25	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Aug-2022	26	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-2022	27	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-9 Razorbill design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	16.54	14.6	0.00	48.12	NM	NM	NM	NM	**N/A**
Aug-2020	2	16.32	14.3	0.00	47.77	NM	NM	NM	NM	**N/A**
Sep-2020	3	94.53	32.0	38.74	162.6	76.72	18.43	44.56	117.63	**17.81**
Oct-2020	4	15.69	13.8	0.00	46.52	NM	NM	NM	NM	**N/A**
Nov-2020	5	7.86	7.65	0.00	23.27	NM	NM	NM	NM	**N/A**
Dec-2020	6	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jan-2021	7	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb-2021	8	68.88	26.	23.24	123.9	NM	NM	NM	NM	**N/A**
Mar-2021	9	62.02	27.9	15.49	123.9	NM	NM	NM	NM	**N/A**
Apr-2021	10	155.29	35.2	93.07	224.9	145.77	35.87	84.86	240.10	**9.52**
May-2021	11	23.31	13.1	0.00	46.50	NM	NM	NM	NM	**N/A**
Jun-2021	12	85.08	34.7	23.25	155.0	94.21	18.51	57.04	130.39	**9.13**
Jul-2021	13	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Aug-2021	14	117.69	45.	38.72	216.8	NM	NM	NM	NM	**N/A**
Sep-2021	15	76.97	39.	15.50	162.71	86.80	33.11	33.17	177.28	**9.83**
Oct-2021	16	15.51	10.2	0.00	38.77	NM	NM	NM	NM	**N/A**
Nov-2021	17	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-2021	18	23.06	12.6	0.00	54.25	NM	NM	NM	NM	**N/A**
Feb18-2022	19	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb26-2022	20	38.39	21.3	0.00	85.21	NM	NM	NM	NM	**N/A**
Mar-2022	21	131.38	42.3	54.28	217.14	111.59	22.26	69.91	161.95	**19.79**
Apr-2022	22	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
May-2022	23	7.58	6.2	0.00	23.29	NM	NM	NM	NM	**N/A**
Jun-2022	24	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jul-2022	25	181.76	64.	71.38	317.2	253.30	17.44	221.20	283.46	**71.54**
Aug-2022	26	39.28	21.8	0.00	85.84	NM	NM	NM	NM	**N/A**
Sep-2022	27	346.5	135.	110.67	640.4	377.21	128.86	180.68	684.01	**30.67**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

1.3.2 Design v Model-based comparison – Abundance figures

All Birds

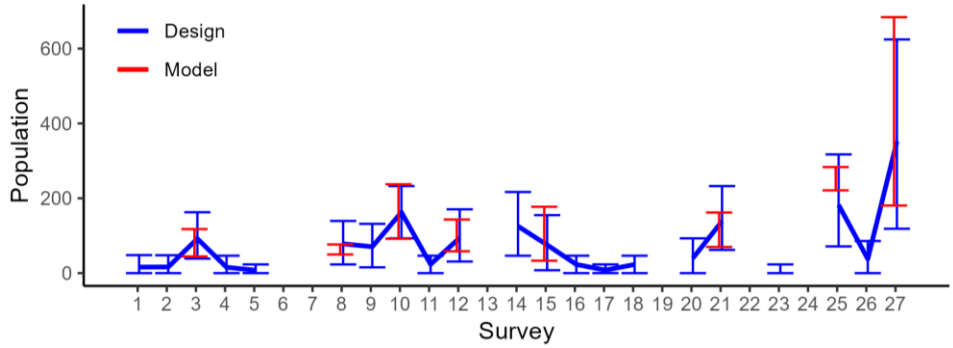

Figure 1-7 Razorbill abundance (population) of all birds recorded in flight and on the sea in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Flying Birds

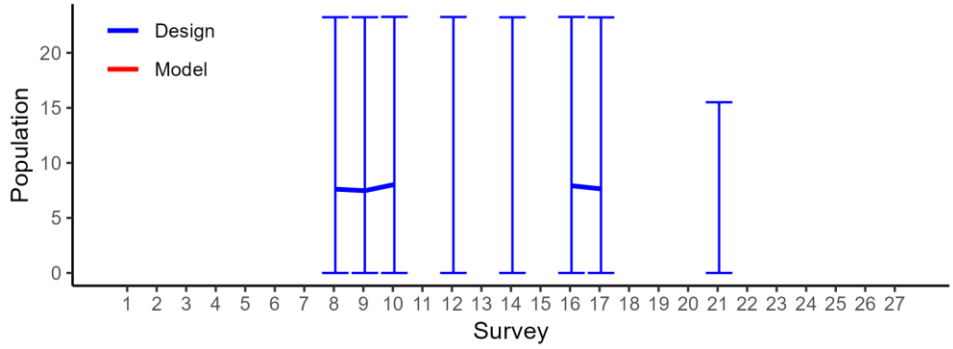

Figure 1-8 Razorbill abundance (population) of birds recorded in flight in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Sitting Birds

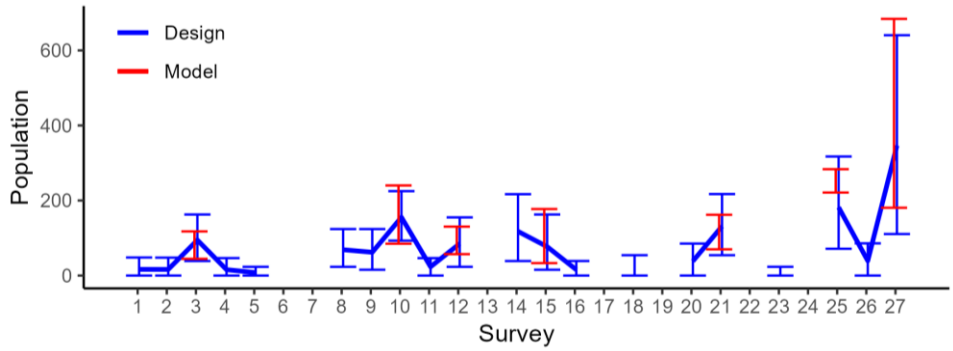

Figure 1-9 Razorbill abundance (population) of birds recorded on the sea in the OAA plus 4 km. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

1.4 Puffin

1.4.1 Design v Model-based comparison – Abundance tables

Table 1-10 Puffin design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight and on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	2573.	693.79	1539.73	4146.98	1288.37	147.87	1014.50	1564.01	**1285.27**
Aug-2020	2	2241.0	350.99	1600.3	2969.91	1375.53	245.06	1011.29	1978.43	**865.49**
Sep-2020	3	201.72	37.90	131.70	278.90	205.43	33.19	136.90	272.53	**3.71**
Oct-2020	4	125.41	28.64	69.79	186.09	109.14	18.80	71.71	143.18	**16.28**
Nov-2020	5	7.84	7.21	0.00	23.27	NM	NM	NM	NM	**N/A**
Dec-2020	6	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jan-2021	7	7.64	7.44	0.00	23.24	NM	NM	NM	NM	**7.64**
Feb-2021	8	7.83	6.83	0.00	23.24	NM	NM	NM	NM	**7.83**
Mar-2021	9	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2021	10	1341.1	137.56	1078.0	1621.01	NM	NM	NM	NM	**N/A**
May-2021	11	400.7	90.80	240.26	589.04	323.61	57.16	210.36	436.37	**77.12**
Jun-2021	12	5551.9	639.56	4356.19	6821.78	5449.3	732.96	4413.43	6686.1	**102.60**
Jul-2021	13	2695.	276.21	2177.86	3224.94	1751.46	155.95	1446.28	2023.0	**944.13**
Aug-2021	14	2284.	223.31	1873.95	2748.98	1578.18	125.40	1320.18	1799.58	**706.07**
Sep-2021	15	2777.1	257.01	2301.18	3316.18	2378.4	348.76	1832.45	3240.9	**398.71**
Oct-2021	16	209.0	40.89	139.57	294.65	210.73	30.47	149.07	274.02	**1.64**
Nov-2021	17	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-2021	18	15.83	9.25	0.00	38.75	NM	NM	NM	NM	**N/A**
Feb18-2022	19	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb26-2022	20	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Mar-2022	21	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2022	22	1358.1	133.54	1098.55	1624.62	1235.13	91.82	1043.36	1376.82	**123.03**
May-2022	23	5936.	595.51	4891.0	7119.44	5407.6	757.17	4218.05	7617.23	**528.84**
Jun-2022	24	6087.	860.93	4614.8	7913.40	5638.4	537.25	4641.44	6671.14	**449.05**
Jul-2022	25	5576.	684.05	4259.17	6972.32	4425.3	363.87	3663.92	5112.68	**1151.21**
Aug-2022	26	5258.	868.23	3690.7	7054.37	NM	NM	NM	NM	**N/A**
Sep-2022	27	682.2	97.00	505.70	893.23	549.95	59.14	429.64	646.92	**132.29**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-11 Puffin design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	15.96	9.62	0.00	32.08	NM	NM	NM	NM	**N/A**
Aug-2020	2	185.8	71.65	55.73	334.39	38.38	1.97	34.58	42.03	**147.48**
Sep-2020	3	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Oct-2020	4	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Nov-2020	5	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-2020	6	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jan-2021	7	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb-2021	8	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Mar-2021	9	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2021	10	15.96	9.71	0.00	38.78	NM	NM	NM	NM	**N/A**
May-2021	11	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jun-2021	12	552.13	101.52	364.32	759.85	618.50	192.27	473.81	871.07	**66.37**
Jul-2021	13	258.9	91.77	100.77	457.55	158.51	46.07	88.24	291.10	**100.42**
Aug-2021	14	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Sep-2021	15	7.33	6.80	0.00	23.24	NM	NM	NM	NM	**N/A**
Oct-2021	16	7.72	7.29	0.00	23.26	NM	NM	NM	NM	**N/A**
Nov-2021	17	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-2021	18	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb18-2022	19	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb26-2022	20	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Mar-2022	21	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2022	22	340.4	81.89	201.14	502.86	329.38	56.93	218.43	449.47	**11.07**
May-2022	23	764.3	163.49	481.36	1117.99	663.69	80.56	503.25	807.11	**100.63**
Jun-2022	24	151.60	59.41	46.46	278.75	93.03	13.40	68.75	122.99	**58.58**
Jul-2022	25	314.8	124.80	118.97	578.99	96.80	21.88	57.74	138.04	**218.05**
Aug-2022	26	30.54	19.54	0.00	70.23	NM	NM	NM	NM	**N/A**
Sep-2022	27	15.91	10.64	0.00	39.52	NM	NM	NM	NM	**N/A**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-12 Puffin design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i of all birds recorded on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	2604.82	742.63	1467.55	4291.15	1241.68	127.03	1009.15	1518.7	**1363.13**
Aug-2020	2	2067.72	300.64	1536.21	2699.01	1332.75	216.57	918.72	1724.	**734.98**
Sep-2020	3	201.88	39.50	131.70	286.65	205.43	33.19	136.90	272.5	**3.56**
Oct-2020	4	124.43	29.11	69.79	178.34	109.14	18.80	71.71	143.18	**15.29**
Nov-2020	5	7.89	7.44	0.00	23.27	NM	NM	NM	NM	**N/A**
Dec-2020	6	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jan-2021	7	7.66	7.22	0.00	23.24	NM	NM	NM	NM	**N/A**
Feb-2021	8	7.30	6.82	0.00	23.24	NM	NM	NM	NM	**N/A**
Mar-2021	9	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2021	10	1336.60	140.61	1070.14	1613.25	NM	NM	NM	NM	**N/A**
May-2021	11	404.87	92.87	240.07	596.98	323.61	57.16	210.36	436.3	**81.26**
Jun-2021	12	4973.17	617.50	3858.35	6247.97	4996.5	836.05	3985.0	7602.	**23.39**
Jul-2021	13	2458.90	257.40	1976.51	2961.18	1622.41	128.16	1362.48	1861.	**836.49**
Aug-2021	14	2286.71	211.51	1904.74	2702.71	1578.18	125.40	1320.18	1799.	**708.53**
Sep-2021	15	2752.17	249.04	2316.68	3254.19	2345.19	351.13	1782.36	3212.3	**406.98**
Oct-2021	16	200.99	41.05	124.06	286.90	206.79	32.17	140.04	272.1	**5.80**
Nov-2021	17	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-2021	18	15.58	9.26	0.00	38.75	NM	NM	NM	NM	**N/A**
Feb18-2022	19	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb26-2022	20	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Mar-2022	21	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2022	22	1015.04	102.07	820.05	1214.60	910.32	69.81	774.74	1044.	**104.72**
May-2022	23	5178.78	551.98	4153.27	6312.00	5046.6	799.02	3911.21	6950.	**132.18**
Jun-2022	24	5908.35	839.33	4421.09	7604.84	5407.41	657.89	4324.0	6903.	**500.94**
Jul-2022	25	5208.92	672.25	3893.34	6606.88	4298.9	380.72	3504.9	4989.	**909.99**
Aug-2022	26	5360.6	913.15	3722.17	7304.08	NM	NM	NM	NM	**N/A**
Sep-2022	27	664.05	94.42	482.19	861.61	539.65	58.02	421.79	635.9	**124.40**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

1.4.2 Design v Model-based comparison – Abundance figures

All Birds

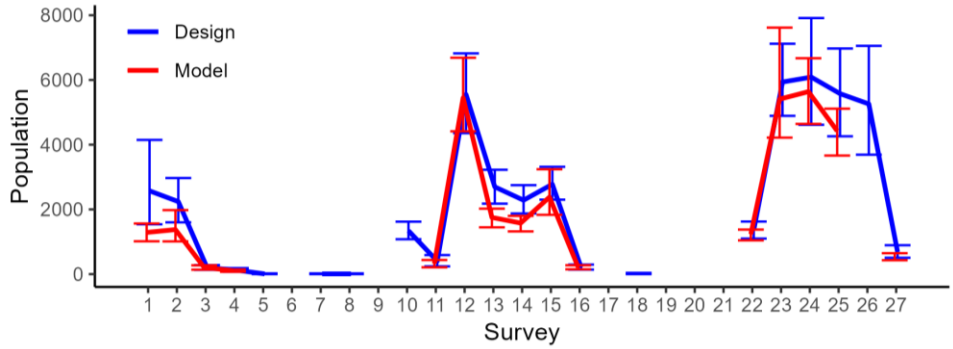

Figure 1-10 Puffin abundance (population) of all birds recorded in flight and on the sea in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Flying Birds

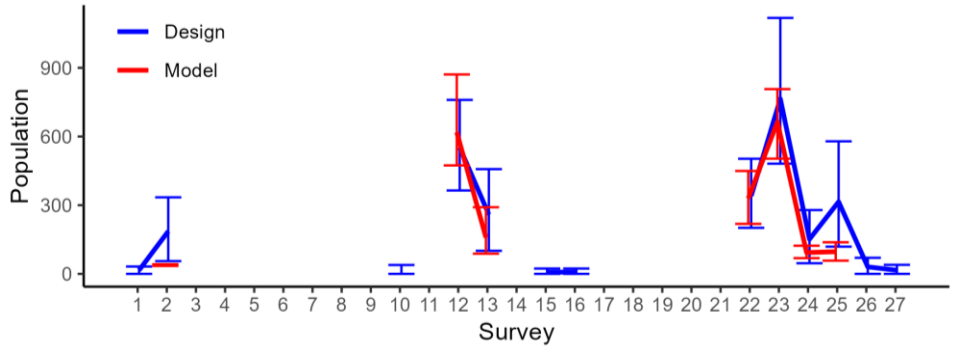

Figure 1-11 Puffin abundance (population) of birds recorded in flight in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Sitting Birds

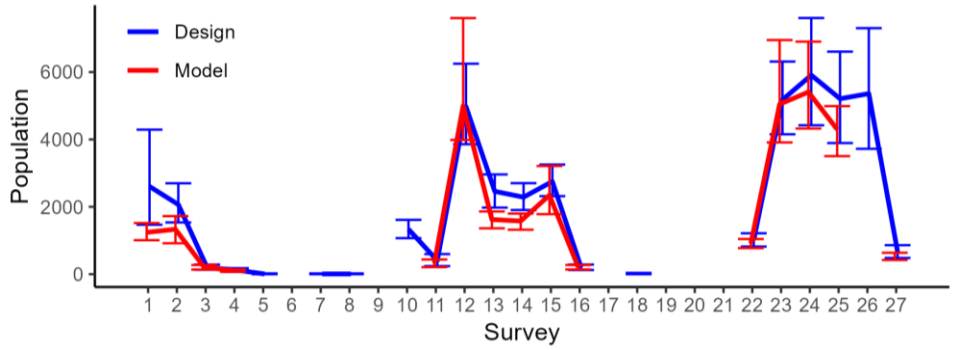

Figure 1-12 Puffin abundance (population) of birds recorded on the sea in the OAA plus 4 km. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

1.5 Fulmar

1.5.1 Design v Model-based comparison – Abundance tables

Table 1-13 Fulmar design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight and on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	1371.94	194.83	1018.60	1764.50	834.25	92.95	656.06	1011.95	**537.70**
Aug-2020	2	1764.07	772.63	493.62	3455.57	1164.88	193.9	786.01	1499.19	**599.19**
Sep-2020	3	3331.92	1420.78	1162.09	6407.18	1167.32	140.6	876.72	1459.32	**2164.60**
Oct-2020	4	3612.25	786.47	2217.63	5141.07	1701.85	234.1	1225.90	2171.87	**1910.40**
Nov-2020	5	1912.28	439.73	1039.19	2768.58	1292.34	432.4	804.27	2329.3	**619.94**
Dec-2020	6	4540.99	1075.98	2673.25	6695.82	4216.14	1350.	2574.82	7696.0	**324.85**
Jan-2021	7	2805.12	321.56	2215.96	3463.60	1987.0	159.14	1656.95	2260.6	**818.03**
Feb-2021	8	417.99	60.86	309.80	542.16	373.41	62.72	277.32	550.31	**44.59**
Mar-2021	9	1376.20	225.55	968.16	1843.38	1337.12	286.9	927.92	2048.6	**39.08**
Apr-2021	10	459.50	193.40	193.71	876.62	390.39	87.14	221.39	535.79	**69.10**
May-2021	11	252.81	70.69	124.01	403.02	77.22	8.68	60.33	92.55	**175.59**
Jun-2021	12	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jul-2021	13	343.36	45.24	255.81	434.10	221.93	28.07	172.15	275.95	**121.42**
Aug-2021	14	1659.22	120.82	1440.31	1905.12	1278.57	108.4	1094.27	1466.7	**380.66**
Sep-2021	15	1034.26	102.59	829.04	1239.89	773.97	87.45	611.77	948.99	**260.29**
Oct-2021	16	2292.31	654.07	1178.42	3753.15	2562.0	652.5	1358.74	3853.4	**269.74**
Nov-2021	17	2030.81	598.11	990.77	3274.37	1343.34	242.2	905.20	1921.94	**687.47**
Dec-2021	18	2328.09	377.99	1627.23	3146.54	1955.84	242.7	1479.35	2363.3	**372.25**
Feb18-2022	19	1576.05	123.95	1325.24	1836.73	1118.81	93.19	958.17	1313.08	**457.24**
Feb26-2022	20	2082.42	283.14	1572.47	2656.93	1852.91	176.0	1517.36	2190.54	**229.50**
Mar-2022	21	2825.94	222.73	2404.01	3295.82	2401.70	140.8	2089.3	2660.0	**424.25**
Apr-2022	22	672.57	77.23	526.07	835.52	615.72	75.78	479.13	778.17	**56.85**
May-2022	23	288.20	40.91	209.62	364.90	243.27	35.42	172.37	308.71	**44.93**
Jun-2022	24	208.87	34.34	139.37	278.75	145.74	23.17	100.83	190.98	**63.13**
Jul-2022	25	551.27	96.85	380.51	761.42	388.77	68.06	260.28	518.36	**162.51**
Aug-2022	26	640.29	60.99	522.82	756.92	513.46	49.39	412.69	611.19	**126.83**
Sep-2022	27	2211.51	155.61	1912.94	2513.69	1663.45	120.8	1402.39	1905.8	**548.06**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-14 Fulmar design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	371.79	56.48	264.68	481.23	NM	NM	NM	NM	**N/A**
Aug-	2	487.29	136.16	246.81	788.21	NM	NM	NM	NM	**N/A**
Sep-2020	3	859.69	198.53	542.31	1301.73	656.68	87.13	500.30	858.21	**203.01**
Oct-2020	4	838.38	107.25	635.82	1054.54	628.69	72.45	484.48	771.80	**209.69**
Nov-	5	1201.04	269.62	674.70	1652.03	1005.61	331.29	625.64	1651.55	**195.42**
Dec-2020	6	3455.85	941.09	1882.84	5354.8	3622.54	1226.59	1980.01	6832.0	**166.69**
Jan-2021	7	1504.23	112.12	1293.93	1720.47	987.42	92.31	811.93	1176.40	**516.82**
Feb-2021	8	278.41	45.08	193.63	364.02	NM	NM	NM	NM	**N/A**
Mar-2021	9	1116.46	226.02	735.80	1611.21	NM	NM	NM	NM	**N/A**
Apr-2021	10	211.31	35.71	147.17	286.97	128.00	24.75	80.38	179.94	**83.32**
May-2021	11	205.18	58.27	100.76	325.52	77.22	8.68	60.33	92.55	**127.95**
Jun-2021	12	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jul-2021	13	262.32	39.06	186.04	341.08	187.18	25.48	140.34	236.27	**75.14**
Aug-2021	14	480.88	63.49	356.21	604.20	410.09	46.02	317.59	489.14	**70.79**
Sep-2021	15	430.55	55.27	325.42	534.62	409.42	89.74	271.98	622.63	**21.12**
Oct-2021	16	1203.72	387.10	480.75	1993.17	1310.60	376.65	633.06	2165.73	**106.88**
Nov-2021	17	1779.62	540.90	851.25	2910.38	1378.03	286.47	853.77	1954.55	**401.59**
Dec-2021	18	1491.21	315.91	953.20	2154.40	1494.34	204.40	1100.34	1834.19	**3.13**
Feb18-	19	1434.89	111.37	1232.24	1650.93	1044.48	84.44	894.75	1204.15	**390.41**
Feb26-	20	1765.96	250.64	1293.61	2261.88	1564.64	154.06	1243.96	1848.12	**201.32**
Mar-	21	2281.60	162.74	1969.74	2621.34	1972.80	119.43	1736.45	2213.76	**308.80**
Apr-2022	22	630.52	71.20	487.39	781.37	573.12	61.70	461.19	718.94	**57.40**
May-	23	223.95	37.00	155.28	295.03	200.73	32.27	136.85	258.02	**23.22**
Jun-2022	24	155.38	34.28	92.92	224.55	119.82	21.91	77.13	161.86	**35.56**
Jul-2022	25	333.77	52.25	237.94	436.43	263.54	50.62	172.84	361.25	**70.23**
Aug-	26	522.24	54.67	413.57	632.07	448.01	46.31	353.50	528.75	**74.24**
Sep-2022	27	543.84	69.79	411.04	687.71	392.51	47.21	296.03	477.24	**151.33**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-15 Fulmar design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	1007.11	176.47	673.72	1371.50	594.43	72.85	488.50	772.96	**412.67**
Aug-2020	2	1303.54	653.82	246.81	2691.65	NM	NM	NM	NM	**N/A**
Sep-2020	3	2443.51	1332.22	457.09	5509.27	551.17	79.30	402.05	686.86	**1892.3**
Oct-2020	4	2725.29	737.97	1504.07	4187.52	1101.10	185.55	743.63	1414.68	**1624.19**
Nov-2020	5	733.39	308.18	209.19	1411.43	282.57	58.87	166.40	404.03	**450.82**
Dec-2020	6	1050.39	265.75	604.43	1596.51	719.03	186.47	496.68	1334.23	**331.37**
Jan-2021	7	1283.59	272.49	790.31	1828.75	1017.72	141.34	735.62	1274.62	**265.87**
Feb-2021	8	139.26	35.40	77.45	209.12	115.07	20.62	78.41	154.99	**24.19**
Mar-2021	9	276.67	81.94	139.42	449.23	172.33	34.03	107.02	241.66	**104.34**
Apr-2021	10	244.98	188.12	23.27	674.97	NM	NM	NM	NM	**N/A**
May-2021	11	37.80	22.47	0.00	85.26	NM	NM	NM	NM	**N/A**
Jun-2021	12	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Jul-2021	13	77.21	22.59	38.76	124.03	NM	NM	NM	NM	**N/A**
Aug-2021	14	1171.83	103.43	975.50	1370.81	NM	NM	NM	NM	**N/A**
Sep-2021	15	605.68	93.68	433.89	805.80	416.99	47.12	320.48	511.42	**188.69**
Oct-2021	16	1115.36	487.56	341.18	2140.31	1226.66	420.60	627.63	2064.95	**111.30**
Nov-2021	17	234.45	150.77	46.44	572.98	NM	NM	NM	NM	**N/A**
Dec-2021	18	840.41	179.59	511.48	1224.44	524.09	82.21	365.39	674.29	**316.32**
Feb18-2022	19	140.60	40.01	69.75	224.75	90.48	25.41	46.79	144.93	**50.12**
Feb26-2022	20	305.57	75.20	170.42	464.77	306.96	54.22	204.86	428.19	**1.39**
Mar-2022	21	543.23	113.54	333.46	783.24	468.37	63.45	337.18	588.92	**74.86**
Apr-2022	22	46.66	17.41	15.47	85.10	NM	NM	NM	NM	**N/A**
May-2022	23	62.19	20.85	23.29	108.69	NM	NM	NM	NM	**N/A**
Jun-2022	24	54.04	18.09	23.23	92.92	NM	NM	NM	NM	**N/A**
Jul-2022	25	211.62	78.63	79.31	380.91	116.73	11.46	95.90	137.66	**94.89**
Aug-2022	26	117.54	33.00	62.43	187.28	69.99	18.33	38.98	118.16	**47.55**
Sep-2022	27	1667.05	134.56	1399.13	1928.75	1299.56	116.28	1065.55	1517.48	**367.48**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

1.5.2 Design v Model-based comparison – Abundance figures

All Birds

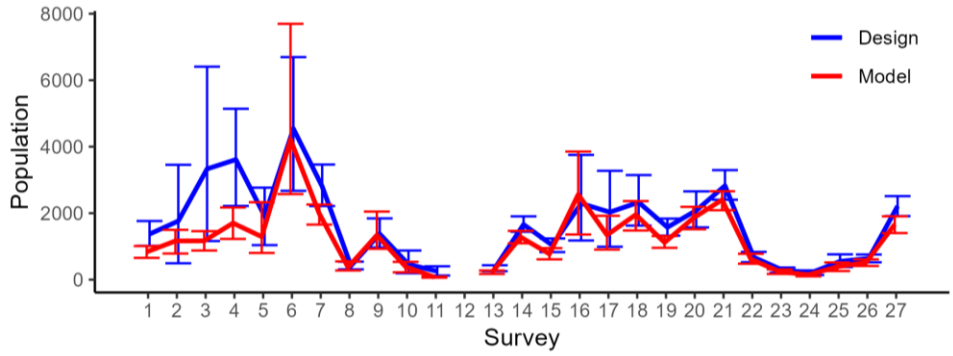

Figure 1-13 Fulmar abundance (population) of all birds recorded in flight and on the sea in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Flying Birds

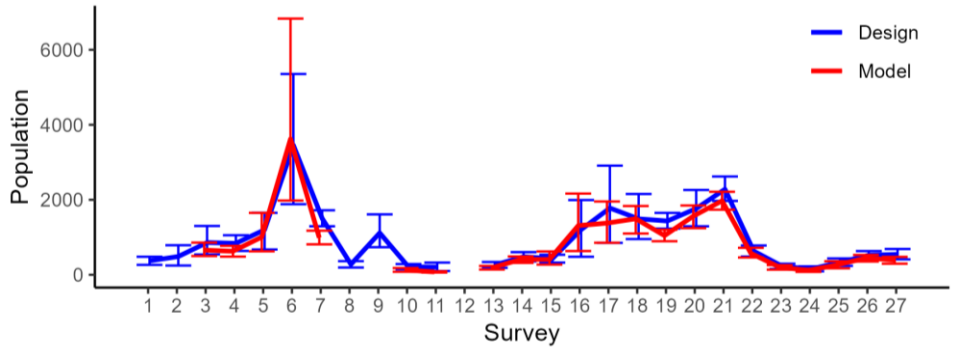

Figure 1-14 Fulmar abundance (population) of birds recorded in flight in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Sitting Birds

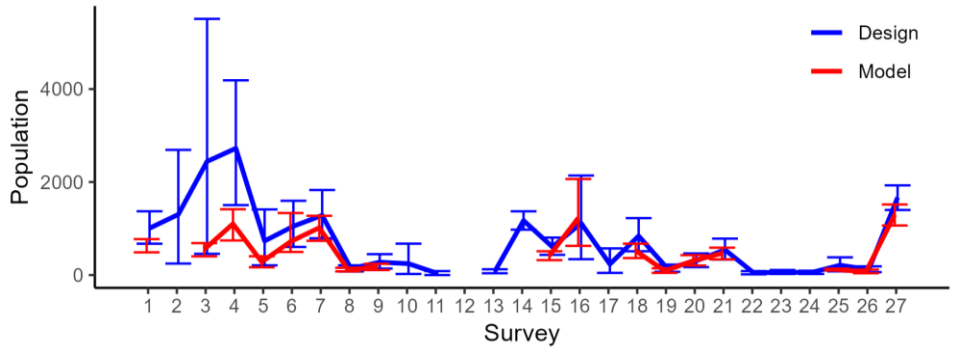

Figure 1-15 Fulmar abundance (population) of birds recorded on the sea in the OAA plus 4 km. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

1.6 Gannet

1.6.1 Design v Model-based comparison – Abundance tables

Table 1-16 Gannet design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight and on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	1032.18	449.18	304.78	2005.32	NM	NM	NM	NM	**N/A**
Aug-2020	2	2170.67	1306.54	445.66	5238.79	NM	NM	NM	NM	**N/A**
Sep-2020	3	1525.13	176.70	1200.83	1913.77	1355.05	129.72	1146.42	1619.37	**170.09**
Oct-2020	4	1079.51	139.19	821.92	1356.94	751.63	66.75	608.63	864.73	**327.88**
Nov-2020	5	31.38	16.84	7.56	69.80	NM	NM	NM	NM	**N/A**
Dec-2020	6	69.70	26.47	23.25	123.99	NM	NM	NM	NM	**N/A**
Jan-2021	7	30.56	16.09	7.75	62.18	NM	NM	NM	NM	**N/A**
Feb-2021	8	92.35	24.16	46.47	139.41	107.02	40.36	51.34	189.62	**14.67**
Mar-2021	9	92.70	26.86	46.47	147.16	64.78	17.61	33.96	96.76	**27.92**
Apr-2021	10	512.22	78.21	364.53	674.77	316.12	41.23	238.53	397.81	**196.10**
May-2021	11	634.84	112.58	418.52	868.05	508.09	58.10	391.08	607.33	**126.75**
Jun-2021	12	294.83	48.57	209.10	387.58	303.65	55.69	218.48	414.85	**8.82**
Jul-2021	13	450.98	80.93	294.57	620.14	289.36	37.94	211.09	359.75	**161.62**
Aug-2021	14	1225.91	376.91	696.93	2052.64	863.08	130.90	616.09	1110.97	**362.84**
Sep-2021	15	1457.93	227.57	1069.24	1960.46	987.33	94.34	799.64	1174.83	**470.60**
Oct-2021	16	1739.20	164.46	1426.74	2039.50	1559.15	108.63	1346.12	1761.48	**180.04**
Nov-2021	17	62.11	19.50	23.22	100.62	NM	NM	NM	NM	**N/A**
Dec-2021	18	23.14	12.50	0.00	46.50	NM	NM	NM	NM	**N/A**
Feb18-2022	19	85.96	36.63	23.25	162.75	44.49	9.07	28.49	69.05	**41.47**
Feb26-2022	20	93.55	24.63	46.48	139.62	80.93	17.09	48.98	116.66	**12.62**
Mar-2022	21	239.80	41.67	155.10	325.70	196.66	29.95	140.62	259.17	**43.14**
Apr-2022	22	966.17	113.93	750.42	1199.13	791.38	66.85	657.68	909.86	**174.79**
May-2022	23	452.03	95.77	279.30	636.63	328.12	46.95	236.68	416.84	**123.92**
Jun-2022	24	517.22	96.24	340.69	720.30	457.95	68.50	319.55	595.16	**59.27**
Jul-2022	25	511.03	70.15	372.78	650.38	355.63	60.66	232.84	472.77	**155.40**
Aug-2022	26	344.12	53.18	249.71	452.59	242.03	33.69	177.29	311.49	**102.09**
Sep-2022	27	868.89	122.52	640.08	1114.56	605.28	119.16	430.63	963.96	**263.61**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-17 Gannet design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded in flight in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	524.07	166.96	248.63	890.27	NM	NM	NM	NM	**N/A**
Aug-2020	2	391.42	67.91	270.70	517.71	292.00	67.76	186.47	468.07	**99.42**
Sep-2020	3	894.14	128.81	658.52	1162.09	823.17	87.42	670.82	1007.83	**70.98**
Oct-2020	4	456.64	83.18	302.40	643.58	419.81	50.35	316.35	505.94	**36.83**
Nov-2020	5	30.71	16.48	0.00	62.04	NM	NM	NM	NM	**N/A**
Dec-2020	6	30.99	13.60	7.75	61.99	NM	NM	NM	NM	**N/A**
Jan-2021	7	8.28	7.69	0.00	23.24	NM	NM	NM	NM	**N/A**
Feb-2021	8	86.54	23.49	38.73	131.67	91.21	21.32	49.45	129.16	**4.67**
Mar-2021	9	77.99	24.69	38.73	131.67	54.62	11.36	33.65	74.71	**23.38**
Apr-2021	10	326.98	57.71	224.73	449.85	231.22	37.94	164.54	298.34	**95.76**
May-2021	11	411.48	87.79	247.82	596.79	395.21	52.86	288.93	501.00	**16.27**
Jun-2021	12	254.52	43.86	170.53	341.07	248.44	31.26	188.90	303.75	**6.08**
Jul-2021	13	320.14	57.68	217.05	449.60	200.75	28.60	148.12	258.83	**119.39**
Aug-2021	14	1075.87	379.73	557.35	1959.33	717.24	122.85	502.37	976.81	**358.64**
Sep-2021	15	872.29	110.40	674.08	1092.48	685.47	79.73	553.89	846.50	**186.82**
Oct-2021	16	602.29	74.82	457.49	744.58	544.05	55.21	429.70	653.70	**58.24**
Nov-2021	17	31.21	14.54	7.74	61.92	NM	NM	NM	NM	**N/A**
Dec-2021	18	23.93	12.25	0.00	46.50	NM	NM	NM	NM	**N/A**
Feb18-2022	19	78.05	34.19	23.25	147.25	42.92	9.29	27.40	70.01	**35.13**
Feb26-2022	20	77.08	22.17	38.73	123.94	62.31	20.09	34.71	94.18	**14.77**
Mar-2022	21	240.85	42.46	162.85	325.70	196.66	29.95	140.62	259.17	**44.19**
Apr-2022	22	347.95	57.11	247.37	464.18	NM	NM	NM	NM	**N/A**
May-2022	23	228.80	68.86	116.46	380.43	NM	NM	NM	NM	**N/A**
Jun-2022	24	115.22	34.33	46.46	185.83	121.61	25.21	73.62	163.63	**6.39**
Jul-2022	25	317.30	54.61	214.15	428.30	262.92	47.30	168.10	349.25	**54.39**
Aug-2022	26	148.52	40.33	78.03	234.10	118.03	22.78	74.69	167.09	**30.49**
Sep-2022	27	538.95	81.67	387.33	703.52	441.42	48.87	346.86	540.95	**97.53**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

Table 1-18 Gannet design-based (blue) and model-based (red) mean abundance estimates, SD, l.c.i. & u.c.i. of all birds recorded on the sea in each survey in the OAA plus 4 km buffer. Means, SD and c.i were calculated using the 'bootstrap method'. The difference between design-based and model-based means (Diff. in means) are presented: bold blue values = design-based mean is higher than model-based mean, bold red values = model-based mean is higher than design-based mean.

Survey		Design-based				Model-based				Diff. in means
Date	No.	Mean	SD	l.c.i.	u.c.i.	Mean	SD	l.c.i.	u.c.i.	
Jul-2020	1	486.03	300.03	40.10	1203.27	NM	NM	NM	NM	**N/A**
Aug-2020	2	1749.34	1260.87	127.39	4642.4	NM	NM	NM	NM	**N/A**
Sep-2020	3	638.66	97.21	457.09	836.70	594.96	73.38	465.99	778.63	**43.70**
Oct-2020	4	602.69	102.44	418.71	814.36	383.90	42.43	301.77	467.87	**218.79**
Nov-2020	5	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Dec-2020	6	39.01	17.63	7.75	77.49	NM	NM	NM	NM	**N/A**
Jan-2021	7	23.28	14.73	0.00	54.24	NM	NM	NM	NM	**N/A**
Feb-2021	8	8.04	7.28	0.00	23.24	NM	NM	NM	NM	**N/A**
Mar-2021	9	15.93	9.40	0.00	38.73	NM	NM	NM	NM	**N/A**
Apr-2021	10	184.90	40.08	108.58	263.70	90.72	12.83	66.46	116.42	**94.18**
May-2021	11	224.31	63.85	116.06	356.52	151.35	36.62	88.01	219.26	**72.97**
Jun-2021	12	36.66	15.86	7.75	69.76	NM	NM	NM	NM	**N/A**
Jul-2021	13	135.27	42.60	62.01	217.05	71.53	22.19	37.17	120.45	**63.74**
Aug-2021	14	146.56	33.21	85.18	216.82	120.40	20.33	79.41	171.21	**26.16**
Sep-2021	15	591.65	186.03	325.42	1022.75	341.21	62.38	220.99	482.72	**250.44**
Oct-2021	16	1141.81	140.52	883.77	1434.6	1040.5	85.06	865.80	1196.25	**101.25**
Nov-2021	17	30.71	14.01	7.74	61.92	NM	NM	NM	NM	**N/A**
Dec-2021	18	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Feb18-2022	19	7.35	7.07	0.00	23.25	NM	NM	NM	NM	**N/A**
Feb26-2022	20	15.62	10.09	0.00	38.73	NM	NM	NM	NM	**N/A**
Mar-2022	21	NM	NM	NM	NM	NM	NM	NM	NM	**N/A**
Apr-2022	22	620.58	83.75	456.44	781.56	526.54	55.23	415.42	624.15	**94.04**
May-2022	23	235.85	54.14	139.75	357.14	NM	NM	NM	NM	**N/A**
Jun-2022	24	405.05	76.45	263.26	557.50	356.23	58.72	235.74	471.84	**48.82**
Jul-2022	25	190.52	36.55	126.90	269.67	100.16	62.16	53.26	323.31	**90.36**
Aug-2022	26	193.97	34.84	124.85	257.51	109.59	19.72	71.34	146.85	**84.39**
Sep-2022	27	323.92	63.93	205.52	450.57	128.69	41.74	82.51	209.87	**195.23**

N/A: Comparison between design-based and model-based estimates is not possible.
NM No Model - Abundance was too low to generate model-based estimate or no birds recorded in a survey month.

1.6.2 Design v Model-based comparison – Abundance figures

All Birds

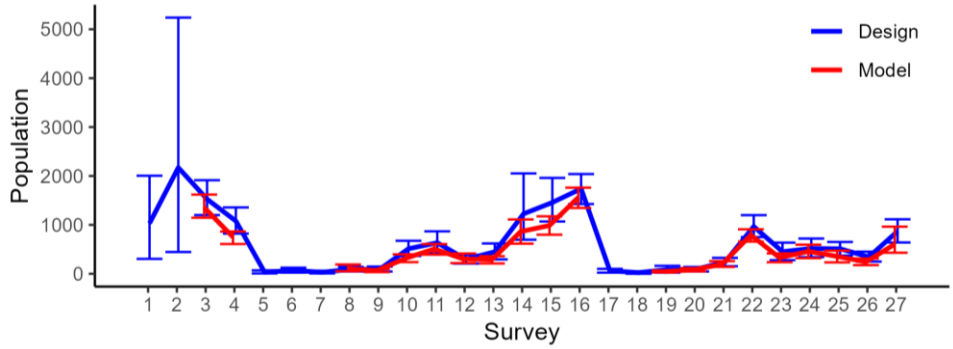

Figure 1-16 Gannet abundance (population) of all birds recorded in flight and on the sea in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Flying Birds

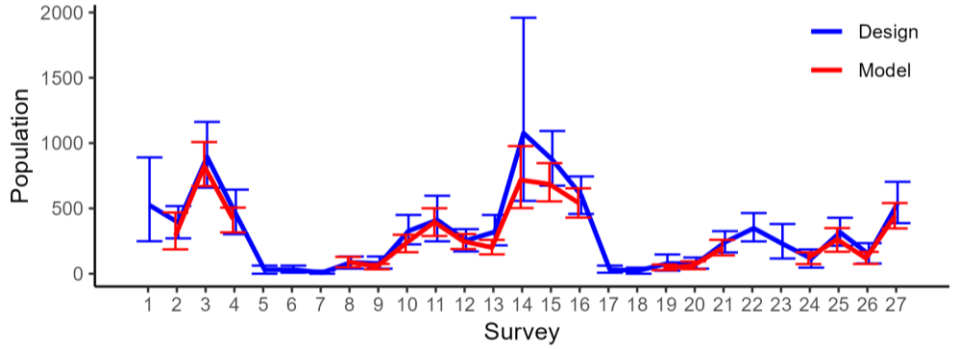

Figure 1-17 Gannet abundance (population) of birds recorded in flight in the OAA plus 4 km buffer. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

Sitting Birds

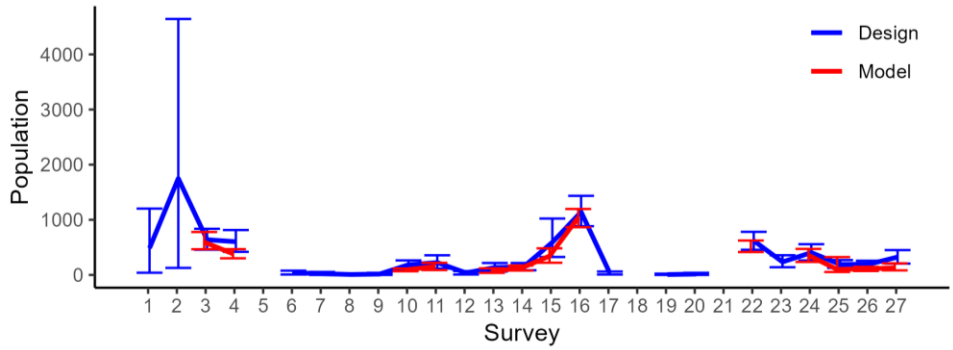

Figure 1-18 Gannet abundance (population) of birds recorded on the sea in the OAA plus 4 km. Comparison of design-based (blue line) and model-based (red-line) population estimates (mean and 95% confidence intervals).

REFERENCES

Scott-Hayward, L.A.S., Walker, C.G. and M.L. Mackenzie. 2021. Vignette for the MRSea Package v1.3: Statistical Modelling of bird and cetacean distributions in offshore renewables development areas. Centre for Research into Ecological and Environmental Modelling, University of St Andrews.