Partners in UK offshore wind

MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Treatment of Birds in Flight Data in Abundance Estimation

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Image of an offshore wind farm

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Glossary

Term	Meaning
Applicant	Morgan Offshore Wind Limited.
Collision risk	Risk of a bird lethally colliding with a wind turbine within a wind farm.
Collision risk model	A model that calculates collision risk for a species within a wind farm based on a set of wind farm and bird species specific parameters. Collision risk models can be run deterministically or stochastically.
Morgan Array Area	The area within which the wind turbines, foundations, inter-array cables, interconnector cables, scour protection, cable protection and offshore substation platforms (OSPs) forming part of the Morgan Offshore Wind Project: Generation Assets will be located.
Morgan Generation Assets Survey Area	The Morgan Array Area plus a 10 km buffer. The area across which site-specific baseline characterisation surveys were undertaken.
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) seasons used in this report are based on those in Furness (2015), hereafter referred to as seasons. Separate seasons are recognised in this note in order to establish the level of importance any seabird species has within the study area during any particular period of time.

Acronyms

Acronym	Description
CRM	Collision Risk Modelling
EWG	Expert Working Groups
GIS	Geographical Information Systems
HRA	Habitats Regulations Assessment
ISAA	Information to Support an Appropriate Assessment
PEIR	Preliminary Environmental Information Report

Units

Unit	Description
km	Kilometres
km^2	Kilometres squared
%	Percentage

1 INTRODUCTION

1.1 Background

1.1.1.1 This clarification note has been produced in response to comment B19 of Natural England's relevant representation (RR-026):

"Natural England do not consider it appropriate to use the proportion of birds in flight across the entire surveyed area (array+10km buffer) to estimate the proportions of birds in flight within the array area only, and thus calculate the densities of flying birds that will be considered by CRM. This is because bird behaviour over the whole survey area may not be representative of that in the array area. Especially when considering a 10km buffer it is possible that certain species may utilise different areas of the site for different behaviours, e.g., foraging, transiting, loafing. We do not consider the sample size of birds in the array area to be an issue, or justification for the Applicants approach.

Natural England's Recommendations to Resolve Issues. *Natural England advise that abundance and density estimates (with associated CIs) of birds on the water and in flight should be calculated separately using design-based methods. For CRM, these densities of birds in flight should be an accurate representation of the data collected within the array area specifically.*

Thus, given the uncertainties around the proportions of birds in flight from the model-based density estimates, we advise design-based density estimates of flying birds within the array area should be used in preference.

However, in the first instance we recommend a basic analysis to determine if the proportion of birds in flight in the array only is broadly comparable to that across the entire survey area. This may give some comfort that the Applicants approach is appropriate, or alternatively, that further investigation or use of design-based estimates is required."

1.1.1.2 In this report, the Applicant has therefore followed Natural England's recommendation and in the first instance applied a basic analysis comparing the proportions of birds in flight in the array area with those in the survey area.

1.1.1.3 The Applicant considers the approach applied for the Morgan Generation Assets appropriate to estimate the abundance of birds in flight within the Morgan Array Area.

1.1.1.4 The aerial survey data collected to support the Morgan Generation Assets application provides a snapshot of behaviour. A bird may be flying or sitting at any point in time. If flying birds were considered as a separate statistical model when estimating abundance metrics, there is a much higher likelihood for random chance to occur and create anomalies, leading to a reduction in statistical robustness. For example, a disturbance in the survey area could cause sitting birds to flush and be in flight in one location, but that would be a poor reflection of their average behaviour in that location. Thus, modelling all behaviours of a species together and then calculating the fraction of all individuals of that species that were in flight for that survey leads to more robust estimates.

1.1.1.5 This approach was presented as part of the Preliminary Environmental Information Report (PEIR). Feedback was received on the PEIR and no issues were raised with regards to this approach from any stakeholder. It is not uncommon for similar rates to

be applied for other aspects of abundance estimation (e.g. availability bias), where the same argument about using different areas for different behaviours could apply.

1.2 Purpose of this report

1.2.1.1 This report provides a comparison between the proportions of birds in flight calculated using data from the Morgan Generation Assets survey area (as presented in the application) and the Morgan Array Area as requested by Natural England in their Relevant Representation (see above). This will determine if there is a material difference between the proportions of birds in flight between these two areas. Discussion is provided on whether there are any differences, whether the datasets are representative of bird behaviour and, if differences exist, the affect this may have on the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

2 METHODOLOGY

2.1 Analysis approach

2.1.1.1 Raw data for the entire survey area (representing the Morgan Array Area plus a 10 km buffer) and the Morgan Array Area only have been extracted using GIS. From these data the proportions of birds in flight have been calculated for each individual survey (April 2021 to March 2023) for both the survey area and the Morgan Array Area, with these calculated based on the proportion of birds in flight versus the proportion of birds sitting on the water (data for all other behaviours were excluded from this calculation). Data have been extracted for all species incorporated into collision risk modelling in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055), namely, kittiwake *Rissa tridactyla*, great black-backed gull *Larus marinus*, herring gull *Larus argentatus*, lesser black-backed gull *Larus fuscus*, Manx shearwater *Puffinus puffinus* and gannet *Morus bassanus*. The proportions calculated from these data are presented graphically in section 3 with a discussion provided describing the trends evident for each species.

2.1.1.2 In addition, the proportions of birds in flight calculated from the Morgan Array Area have then been applied to the design-based densities for birds in flight within the Morgan Array Area for each species. These are compared to the design-based densities for each species calculated using the original proportions of birds in flight from the whole survey area.

2.1.1.3 Further discussion is then provided as to the likely implications for the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

2.2 Representativeness of data

2.2.1.1 When calculating the proportion of birds at collision risk height from site-specific survey data for use in collision risk modelling, a 100 record threshold has been recommended by Natural England (Natural England, 2013), Johnston and Cook (2016) and Cook *et al.* (2018) as being required in order to calculate a representative value. The same threshold has also been used when calculating the proportion of immature birds at a project (Ørsted, 2018a; Volume 4, Annex 5.5: Offshore ornithology apportioning technical report (APP-057)) and where analysing flight directions of birds (Ørsted, 2018b; Volume 4, Annex 5.1: Offshore ornithology baseline characterisation (APP-053)). It is considered appropriate to also apply this threshold to the proportions of birds in flight in the analysis undertaken in this report, in order to also identify when the proportion of birds in flight may be representative of the behaviour of birds.

3 RESULTS

3.1 Kittiwake

3.1.1 Analysis

3.1.1.1 The proportion of kittiwake in flight in the Morgan Array Area and survey area relative to the sample size of kittiwake in both the Morgan Array Area and survey area are presented in Figure 3.1. December 2021 was the only month that had a sample size of over 100 birds in the Morgan Array Area. In this month the difference in the proportion of kittiwake in flight in the Morgan Array Area and the survey area was ≤0.003. In all other months the sample size of kittiwake in the Morgan Array Area was less than 100 birds, which based on the previous application of this threshold would suggest that these data are not sufficient to be considered representative of the proportion of birds in flight. However, across the majority of surveys, there appears to be a good level of correspondence between the proportions of birds in flight in the Morgan Array Area and the survey area.

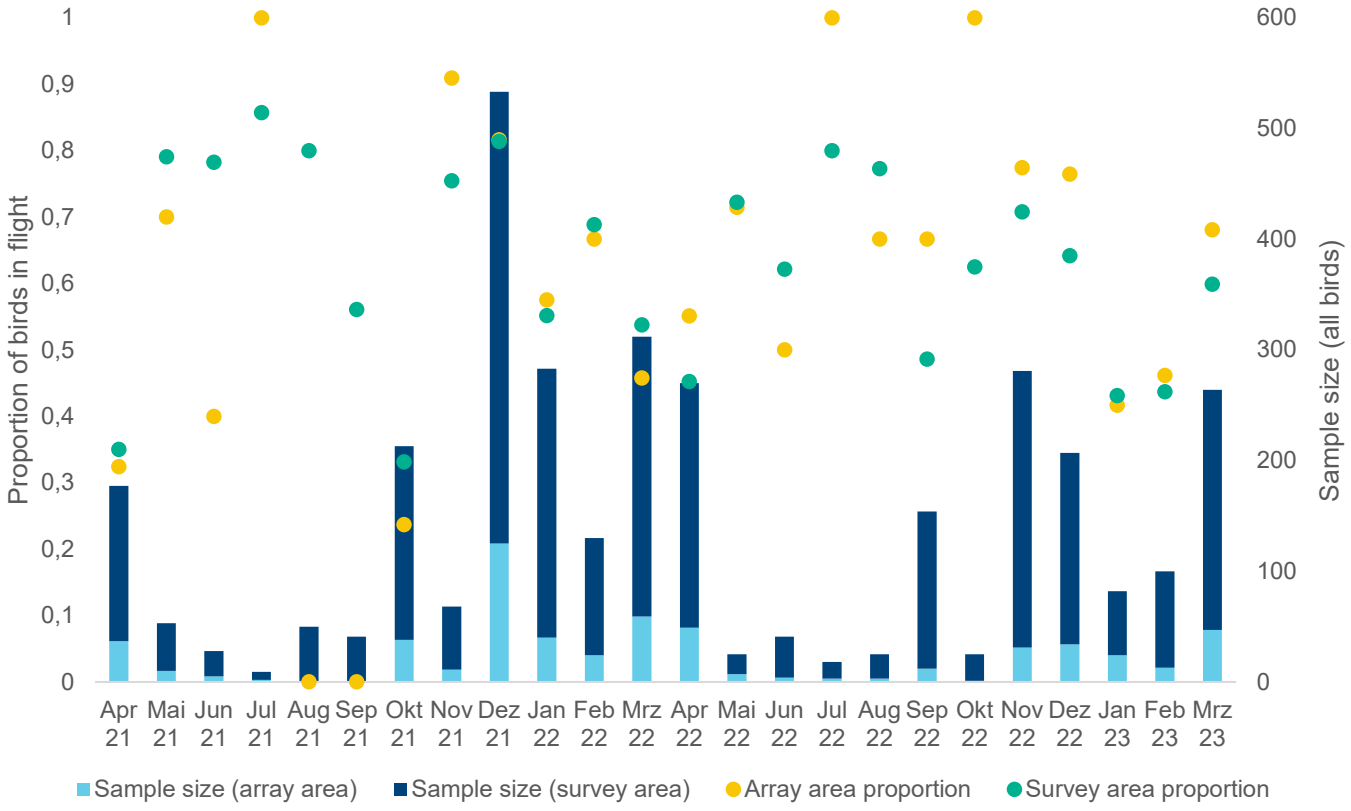

Figure 3.1: Proportion of kittiwake in flight in the Morgan Array Area and survey area relative to the sample size of kittiwake in the Morgan Array Area and survey area (note that where data points in a given month are only present for the Morgan Array Area proportion dataset, data points for the survey area dataset are beneath).

3.1.1.2 Figure 3.2 and Appendix A present design-based densities for kittiwake calculated using the proportions of birds in flight from the survey area and densities calculated using proportions of birds in flight calculated using raw data from the Morgan Array Area only. Across the 24 months of survey, densities in ten months are higher using the proportions of birds in flight from the survey area, and densities in twelve months are higher when using the proportions of birds in flight from the Morgan Array Area.

Densities in the remaining two months were zero in both survey areas. It is considered that the difference in the majority of months is will not lead to a material difference in assessment terms. The highest differences were in the April 2022 survey (0.14 birds/km^2), October 2021 survey (0.11 birds/km^2) and the March 2023 survey (0.1 birds/km^2). The difference in all other surveys was below 0.1 birds/km^2. Across all surveys the total difference represents only a 1.9% increase in densities if the proportions of birds in flight from the Morgan Array Area were to be used.

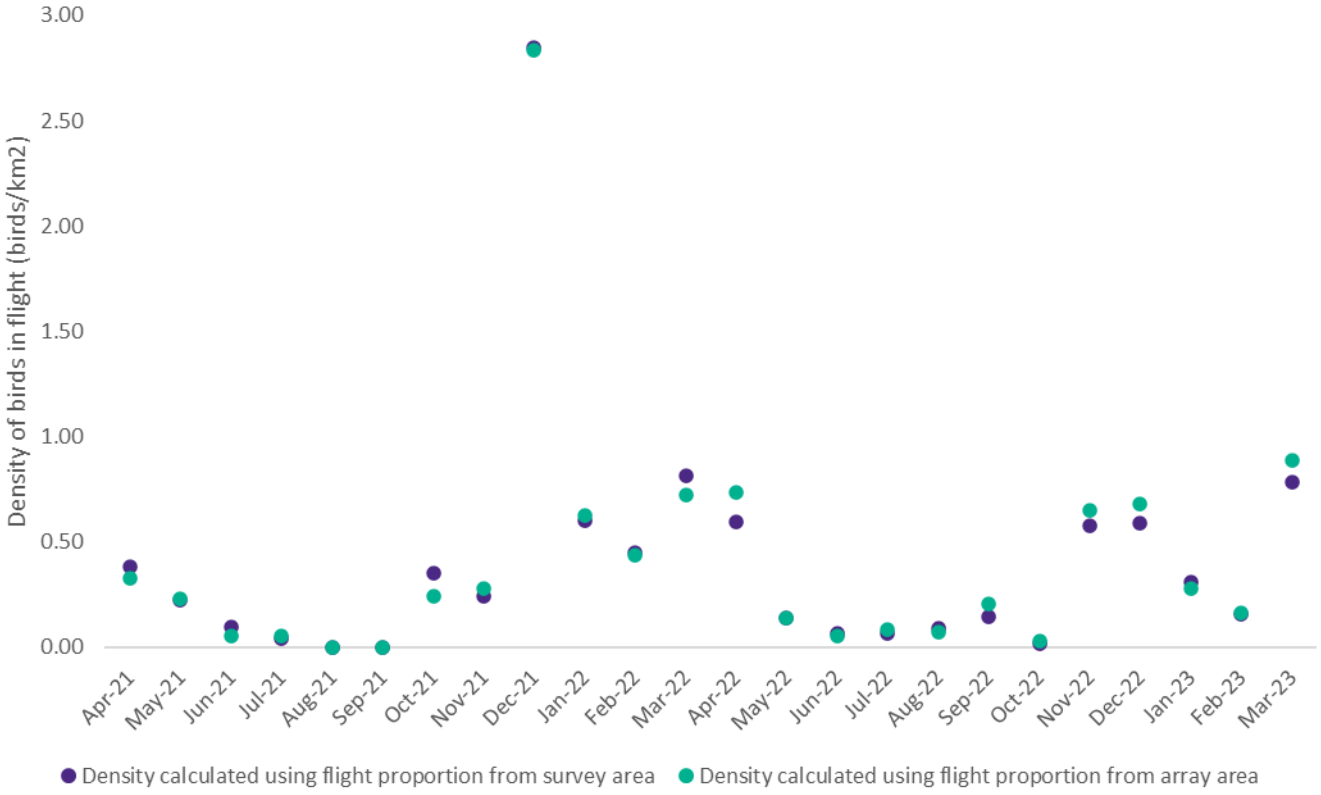

Figure 3.2: Design-based densities of flying kittiwake calculated using different proportions for birds in flight (note that where data points in a given month are only present for the updated flying density dataset, the data points for the original flying density dataset are beneath).

3.1.2 Conclusion

3.1.2.1 Sample sizes of kittiwake in the Morgan Array Area in all but one month (December 2021) were lower than the 100 bird threshold previously used as an indicator of how representative data are. In the survey area, the sample size was above 100 birds in eleven months. The lowest sample sizes in both areas were generally recorded in the breeding season for kittiwake (April to August). The low sample sizes observed in the breeding season suggests that the area in which the Morgan Generation Assets are located is not an important area for kittiwake, when compared to other sea areas in the UK (see Volume 4, Annex 5.1: Offshore ornithology baseline characterisation (APP-053) for further detail), and therefore any differences in the proportion of birds in flight between the Morgan Array Area and survey area will have a limited effect on the conclusions reached in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

3.1.2.2 The highest collision risk estimate at the Morgan Generation Assets for kittiwake, calculated using parameters advocated by the EWG and presented in Volume 4,

Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) was 40.0 collisions/annum. An increase in density of 1.9% has been calculated above with this representing a guide for the potential change in collision risk estimates. This magnitude of change would not materially alter the conclusions of the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

3.2 Great black-backed gull

3.2.1 Analysis

3.2.1.1 The proportion of great black-backed gull in flight in the Morgan Array Area and survey area relative to the sample size of great black-backed gull in the Morgan Array Area and survey area are presented in Figure 3.3. Of the 24 months surveyed, none had a sample size greater than 100 birds. It is therefore difficult to draw conclusions based on the data presented in Figure 3.3 as the data may not be representative of the actual proportion of birds in flight. However, two of the months with the highest correspondence between the proportions of birds in flight in the Morgan Array Area and survey area were two of the months with the highest sample sizes (December 2022 and January 2023). Whereas two of the months with the lowest sample size exhibited the greatest difference between the proportions of birds in flight in the Morgan Array Area and survey area (March 2022 and February 2023). There are however, months with high correspondence between the proportions of birds in flight and low sample sizes (e.g. March 2023).

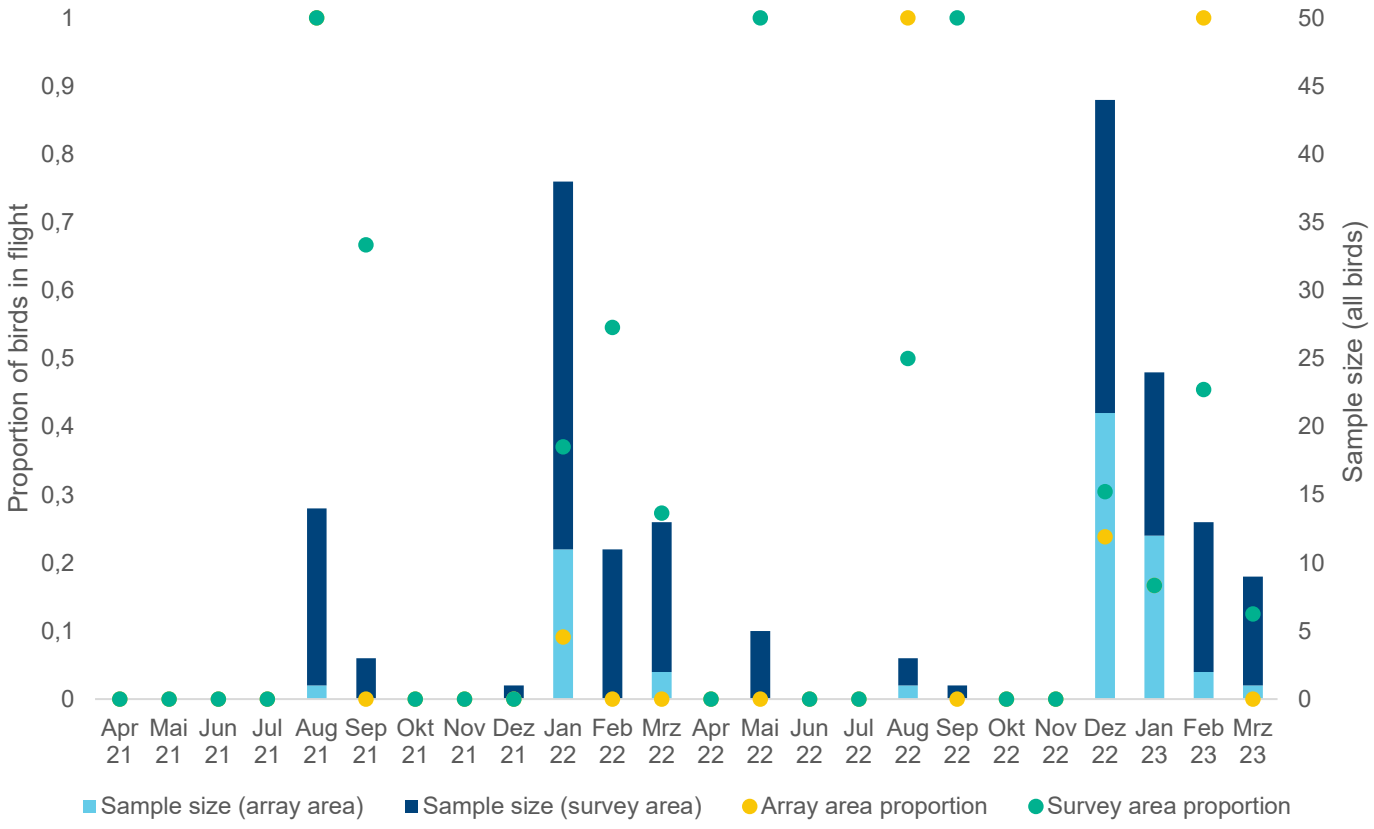

Figure 3.3: Proportion of great black-backed gull in flight in the Morgan Array Area and survey area relative to the sample size of great black-backed gull in the Morgan Array Area and survey area (note that where data points in a given month are only present for the Morgan Array Area proportion dataset, data points for the survey area dataset are beneath).

3.2.1.2 Figure 3.4 and Appendix A present design-based densities for great black-backed gull calculated using the proportions of birds in flight from the survey area and densities calculated using proportions of birds in flight calculated using raw data from the Morgan Array Area only. Across the 24 months of survey, densities in six months are higher using the proportions of birds in flight from the survey area, and densities in

only two months are higher when using the proportions of birds in flight from the Morgan Array Area. No great black-backed gulls were recorded in flight in the survey area or Morgan Array Area in twelve months with none in the Morgan Array Area in the remaining four months. In these months (August 2022 and February 2023) it is considered that the difference between densities will not lead to a material difference in assessment terms, with the largest difference being 0.04 birds/km^2 in the February 2023 survey. Across all surveys the total difference represents a 20% decrease in densities if the proportions of birds in flight from the Morgan Array Area were to be used.

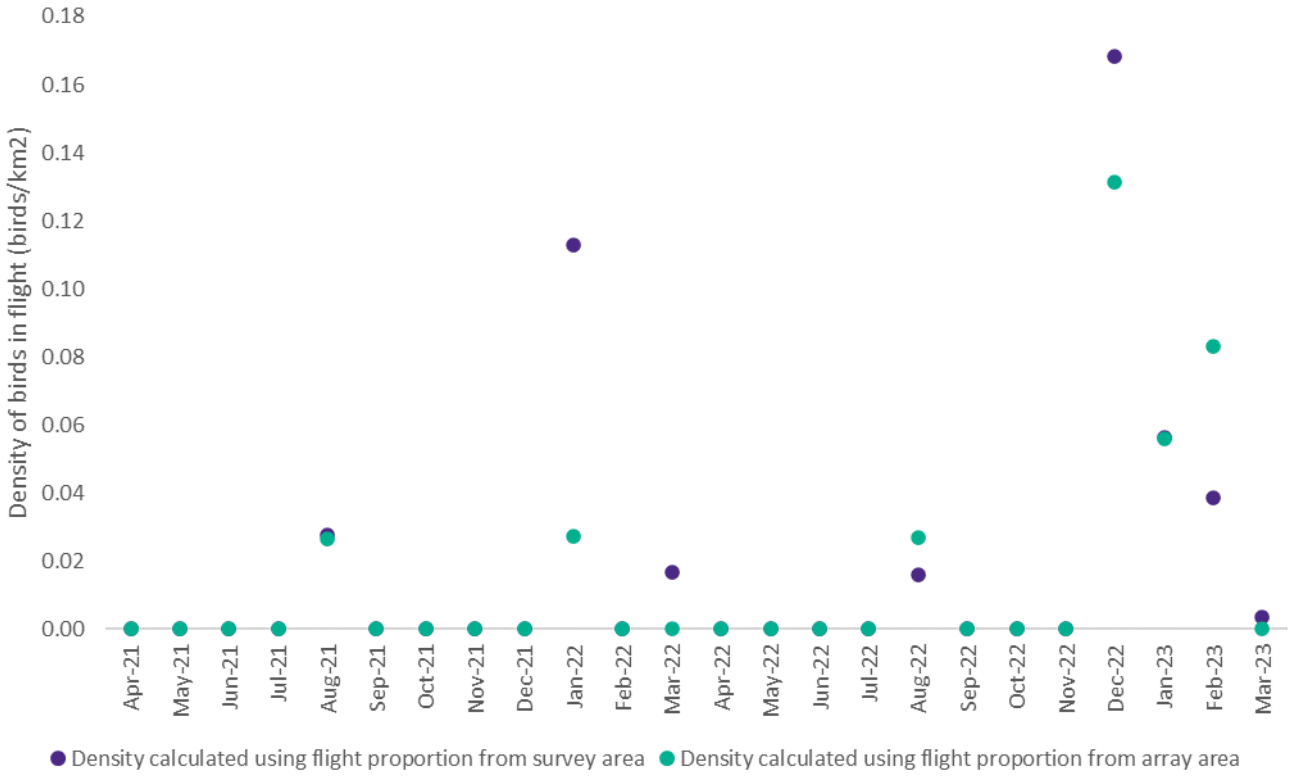

Figure 3.4: Design-based densities of flying great black-backed gull calculated using different proportions for birds in flight (note that where data points in a given month are only present for the updated flying density dataset, the data points for the original flying density dataset are beneath).

3.2.2 Conclusion

3.2.2.1 Great black-backed gulls were not abundant in the Morgan Array Area, being observed in only eight of the twenty-four site-specific baseline characterisation surveys. The sample sizes in both the Morgan Array Area and survey area did not surpass the 100 bird threshold discussed in section 2.2 in any month. As illustrated in Figure 3.3, the limited number of birds observed can lead to large differences in the proportions of birds in flight. As discussed in section 1.1.1.3, the aerial survey data collected to support the Morgan Generation Assets application provides a snapshot of behaviour. Thus, modelling all behaviours and then calculating the fraction of all birds of that species in flight for that survey leads to more robust estimates.

3.2.2.2 The highest collision risk estimate at the Morgan Generation Assets for great black-backed gull, calculated using parameters advocated by the EWG and presented in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) was 5.7 collisions/annum. A decrease in density of 20% has been

calculated above with this representing a guide for the potential change in collision risk estimates if the proportions of birds in flight from the Morgan Array Area were to be used. However, because the collision risk estimate calculated in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) is very low, this magnitude of change would not materially alter the conclusions of the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

3.2.2.3 Both datasets have monthly sample sizes that fall below the 100 bird threshold. The use of raw data from the survey area provides a larger sample size with more months over the 100 bird threshold than if the raw data from the Morgan Array Area were to be used. This ensures resulting analyses utilising these data are as robust as possible.

3.3 Herring gull

3.3.1 Analysis

3.3.1.1 The proportion of herring gull in flight in the Morgan Array Area and survey area relative to the sample size of herring gull in the Morgan Array Area and survey area are presented in Figure 3.5. Of the 24 months surveyed, none had a sample size greater than 100 birds. It is therefore difficult to draw conclusions based on the data presented in Figure 3.5.

3.3.1.2 Excluding those months with really small sample sizes, the month with the highest level of correspondence between the proportions of birds in flight (January 2022) also had the largest sample size. In addition, the month with the second largest sample size (March 2023) also had relatively little difference between the proportions of birds in flight.

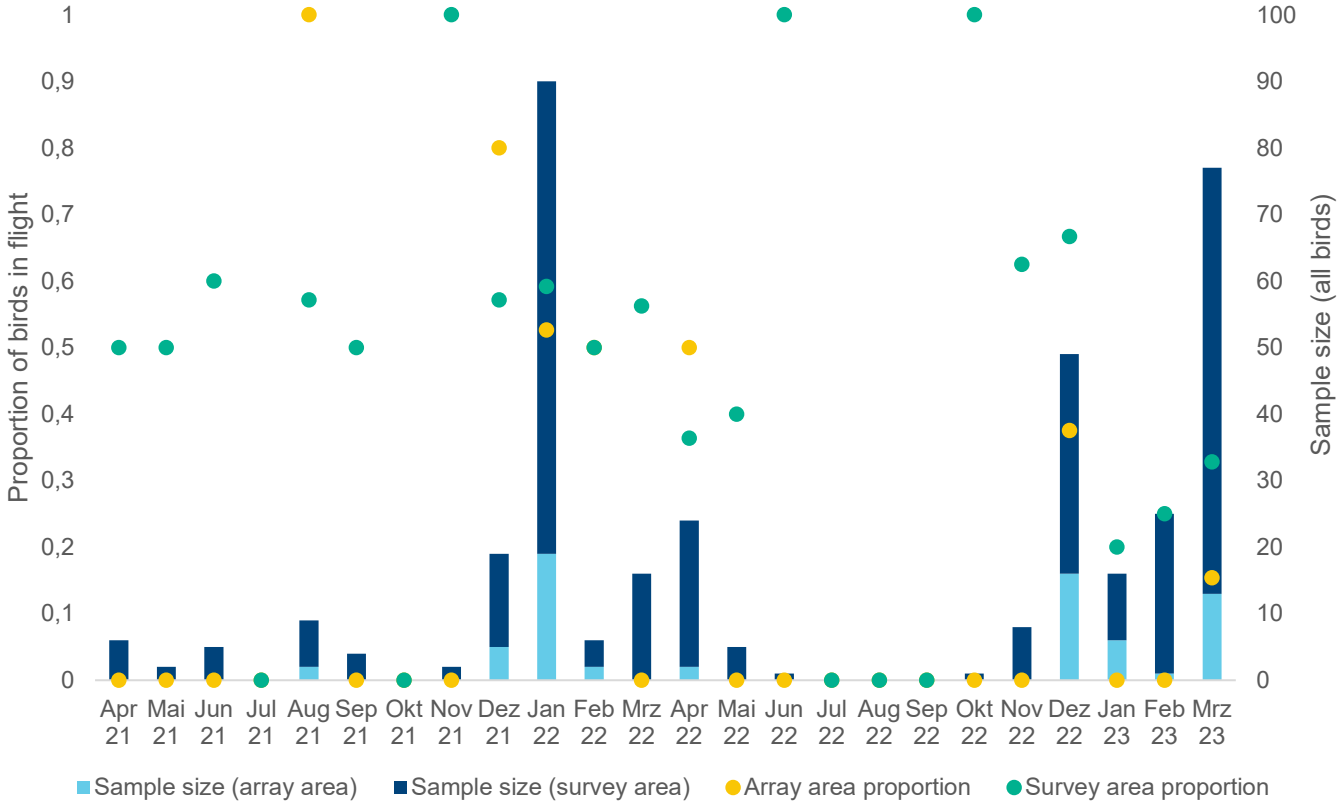

Figure 3.5: Proportion of herring gull in flight in the Morgan Array Area and survey area relative to the sample size of herring gull in the Morgan Array Area and survey area (note that where data points in a given month are only present for the array proportion dataset, data points for the survey area dataset are beneath).

3.3.1.3 Figure 3.6 and Appendix A present design-based densities for herring gull calculated using the proportions of birds in flight from the survey area and densities calculated using proportions of birds in flight calculated using raw data from the Morgan Array Area only. Across the 24 months of survey, densities in six months are higher using the proportions of birds in flight from the survey area, and densities in only three months are higher when using the proportions of birds in flight from the Morgan Array Area. In these months (August and December 2021 and April 2022) it is considered that the difference between densities will not lead to a material difference in assessment terms, with the largest difference being 0.03 birds/km^2 in the August 2021 survey. Across all surveys the total difference represents nearly a 25% decrease in

densities if the proportions of birds in flight from the Morgan Array Area were to be used.

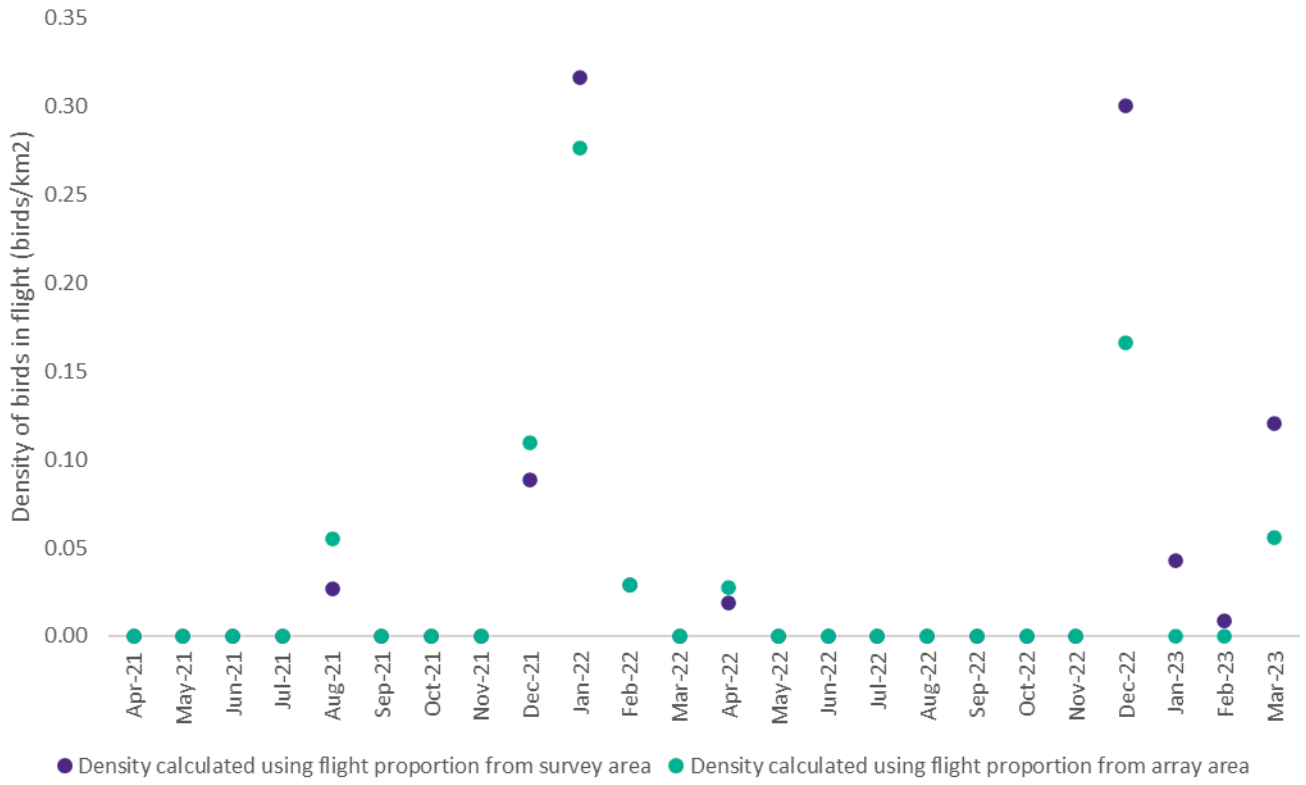

Figure 3.6: Design-based densities of flying herring gull calculated using different proportions for birds in flight (note that where data points in a given month are only present for the updated flying density dataset, the data points for the original flying density dataset are beneath).

3.3.2 Conclusion

3.3.2.1 Herring gulls were not abundant in the Morgan Array Area, being observed in only nine of the twenty-four site-specific baseline characterisation surveys. The sample sizes in both the Morgan Array Area and survey area did not surpass the 100 bird threshold discussed in section 2.2 in any month. As is illustrated in Figure 3.5, the limited number of birds observed can lead to large differences in the proportions of birds in flight. As discussed in section 1.1.1.3, the aerial survey data collected to support the Morgan Generation Assets application provides a snapshot of behaviour. Thus, modelling all behaviours and then calculating the fraction of all birds of that species in flight for that survey leads to more robust estimates.

3.3.2.2 The highest collision risk estimate at the Morgan Generation Assets for herring gull, calculated using parameters advocated by the EWG and presented in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) was 10.1 collisions/annum. A decrease in density of 25% has been calculated above with this representing a guide for the potential change in collision risk estimates if the proportions of birds in flight from the Morgan Array Area were to be used. This magnitude of change would not materially alter the conclusions of the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

3.3.2.3 Both datasets have monthly sample sizes that fall below the 100 bird threshold. The use of raw data from the survey area provides a larger sample size with more months over the 100 bird threshold than if the raw data from the Morgan Array Area were to be used. This ensures resulting analyses utilising these data are as robust as possible.

3.4 Lesser black-backed gull

3.4.1 Analysis

3.4.1.1 The proportion of lesser black-backed gull in flight in the Morgan Array Area and survey area relative to the sample size of lesser black-backed gull in the Morgan Array Area and survey area are presented in Figure 3.7. Of the 24 months surveyed, none had a sample size greater than 100 birds. It is therefore difficult to draw conclusions based on the data presented in Figure 3.7, as the data may not be representative of the actual proportion of birds in flight.

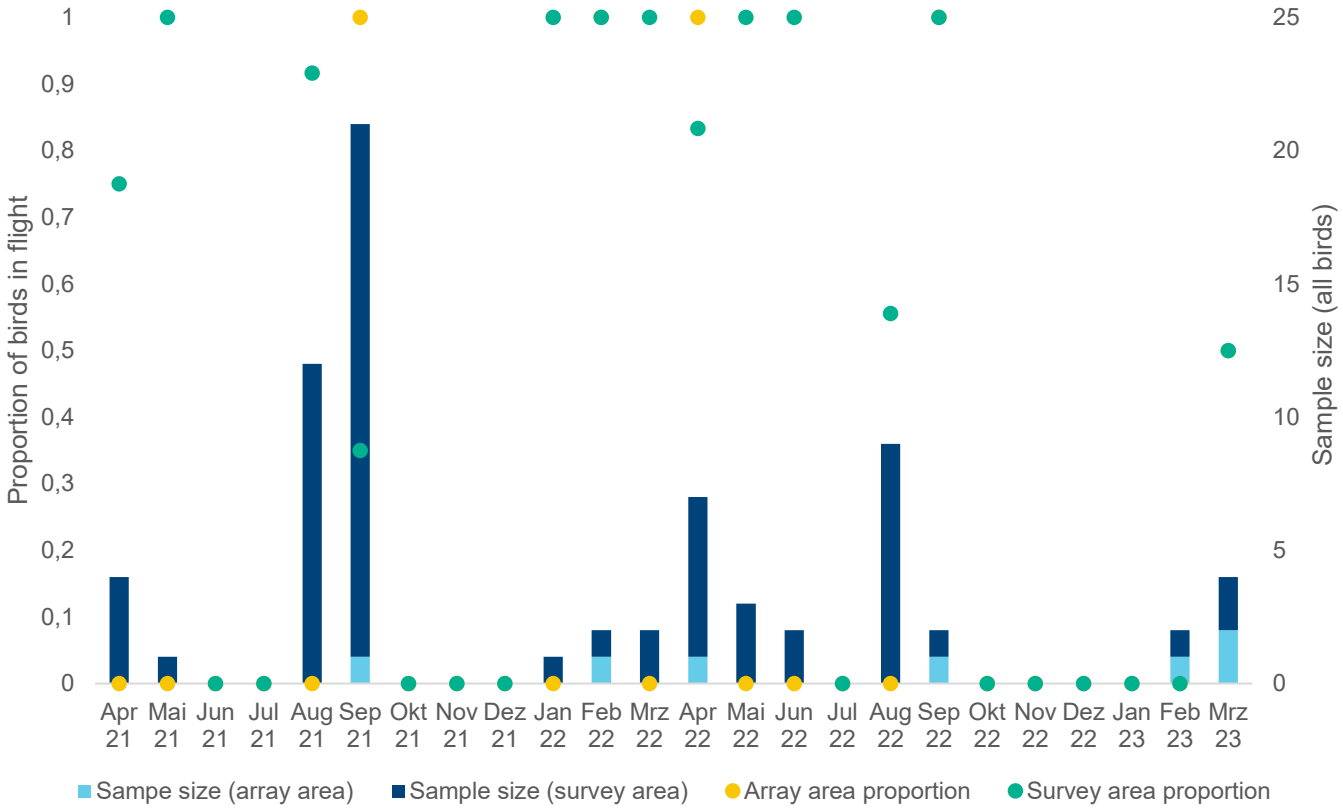

Figure 3.7: Proportion of lesser black-backed gull in flight in the Morgan Array Area and survey area relative to the sample size of lesser black-backed gull in the Morgan Array Area and survey area (note that where data points in a given month are only present for the Morgan Array Area proportion dataset, data points for the survey area dataset are beneath).

3.4.1.2 Figure 3.8 and Appendix A present design-based densities for lesser black-backed gull calculated using the proportions of birds in flight from the survey area and densities calculated using proportions of birds in flight calculated using raw data from the Morgan Array Area only. Across the 24 months of survey, densities in two months are higher using the proportions of birds in flight from the survey area, and densities in two months are higher when using the proportions of birds in flight from the Morgan Array Area (September 2021 and April 2022). It is considered that the difference between densities for these months will not lead to a material difference in assessment terms, with both falling below 0.02 birds/km^2. Across all surveys the total difference represents more than a 20% increase in densities if the proportions of birds in flight from the Morgan Array Area were to be used.

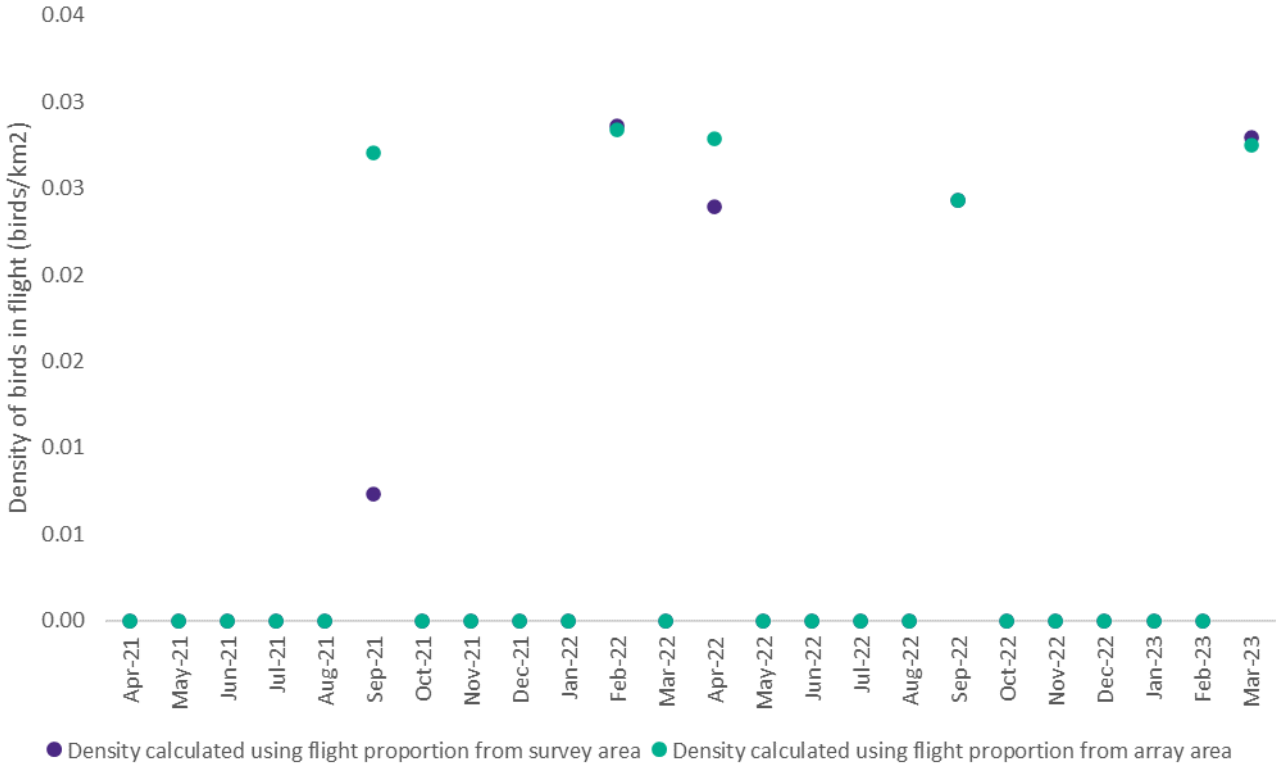

Figure 3.8: Design-based densities of flying lesser black-backed gull calculated using different proportions for birds in flight (note that where data points in a given month are only present for the updated flying density dataset, the data points for the original flying density dataset are beneath).

3.4.2 Conclusion

3.4.2.1 Lesser black-backed gulls were not abundant in the Morgan Array Area, being observed in only five of the twenty-four site-specific baseline characterisation surveys. The sample sizes in both the Morgan Array Area and survey area did not surpass the 100 bird threshold discussed in section 2.2 in any month. As is illustrated in Figure 3.7, the limited number of birds observed can lead to large differences in the proportions of birds in flight. As discussed in section 1.1.1.3, the aerial survey data collected to support the Morgan Generation Assets application provides a quick snapshot of behaviour. Thus, modelling all behaviours and then calculating the fraction of all birds of that species in flight for that survey leads to more robust estimates.

3.4.2.2 The highest collision risk estimate at the Morgan Generation Assets for lesser black-backed gull, calculated using parameters advocated by the EWG and presented in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) was 1.2 collisions/annum. An increase in density of 20% has been calculated above with this representing a guide for the potential change in collision risk estimates if the proportions of birds in flight from the Morgan Array Area were to be used. However, because the collision estimate calculated in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) is very low, this magnitude of change would not materially alter the conclusions of the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

3.4.2.3 Both datasets have monthly sample sizes that fall below the 100 bird threshold. The use of raw data from the survey area provides a larger sample size with more months

over the 100 bird threshold than if the raw data from the Morgan Array Area were to be used. This ensures resulting analyses utilising these data are as robust as possible.

3.5 Manx shearwater

3.5.1 Analysis

3.5.1.1 The proportion of Manx shearwater in flight in the Morgan Array Area and survey area relative to the sample size of Manx shearwater in the Morgan Array Area and survey area are presented in Figure 3.9. Of the 24 months surveyed, Manx shearwater were recorded in 12 surveys in the survey area and 10 surveys in the Morgan Array Area. A sample size of 100 birds was recorded in five surveys but only in the survey area.

3.5.1.2 September 2022 was the month with the largest sample size in both areas with the proportions of birds in flight showing good correspondence between the two areas (difference of less than 0.05). However, there is a larger difference between the proportions of birds in flight in the month with the second largest sample size (August 2022) (difference over 0.2).

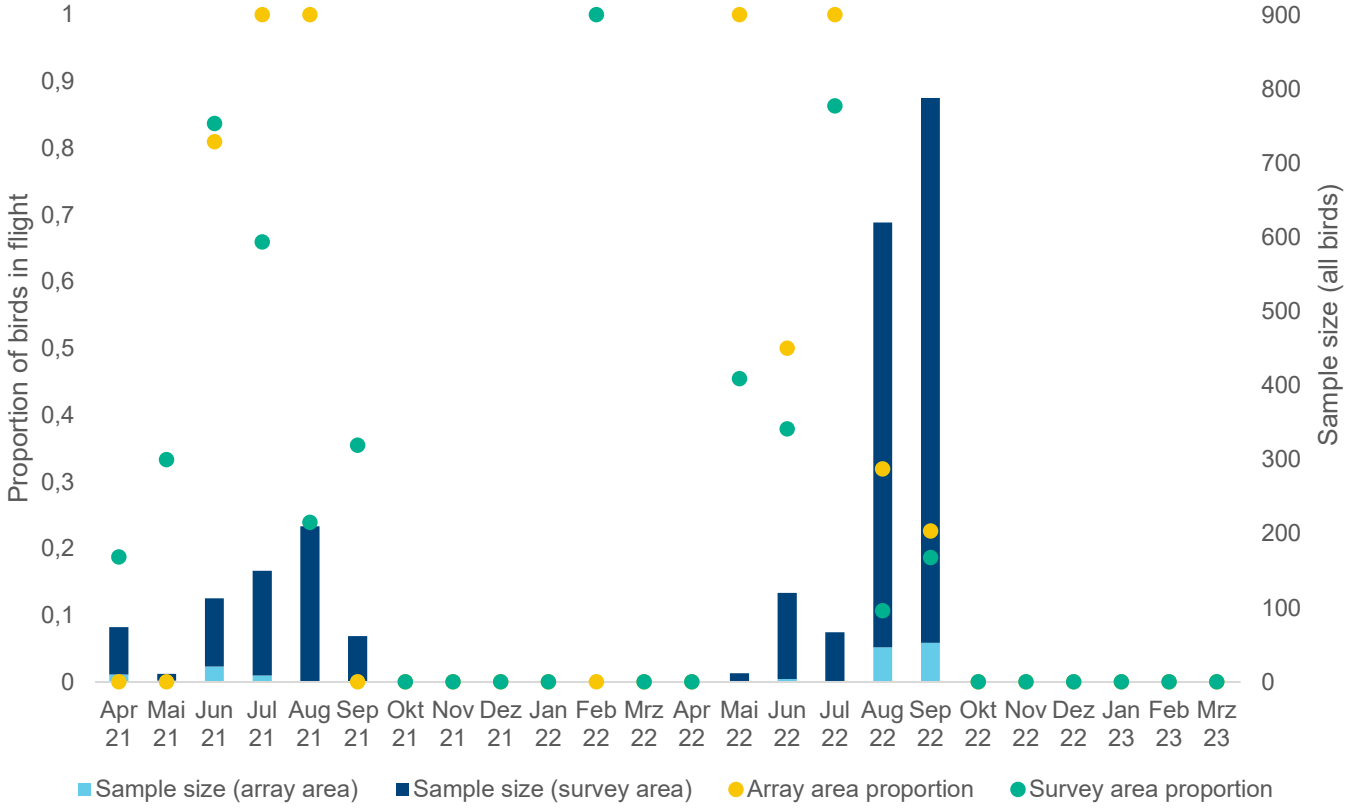

Figure 3.9: Proportion of Manx shearwater in flight in the Morgan Array Area and survey area relative to the sample size of Manx shearwater in the Morgan Array Area and survey area (note that where data points in a given month are only present for the Morgan Array Area proportion dataset, data points for the survey area dataset are beneath).

3.5.1.3 Figure 3.10 and Appendix A present design-based densities for Manx shearwater calculated using the proportions of birds in flight from the survey area and densities calculated using proportions of birds in flight calculated using raw data from the Morgan Array Area only. Across the 24 months of survey, densities in three months are higher using the proportions of birds in flight from the survey area, and seven months are higher when using the proportions of birds in flight from the Morgan Array Area (July and August 2021 and May to September 2022). It is considered that the difference between densities for these months will not lead to a material difference in assessment terms with the highest being 0.4 birds/km^2. Across all surveys the total

difference represents more than a 37% increase in densities if the proportions of birds in flight from the Morgan Array Area were to be used.

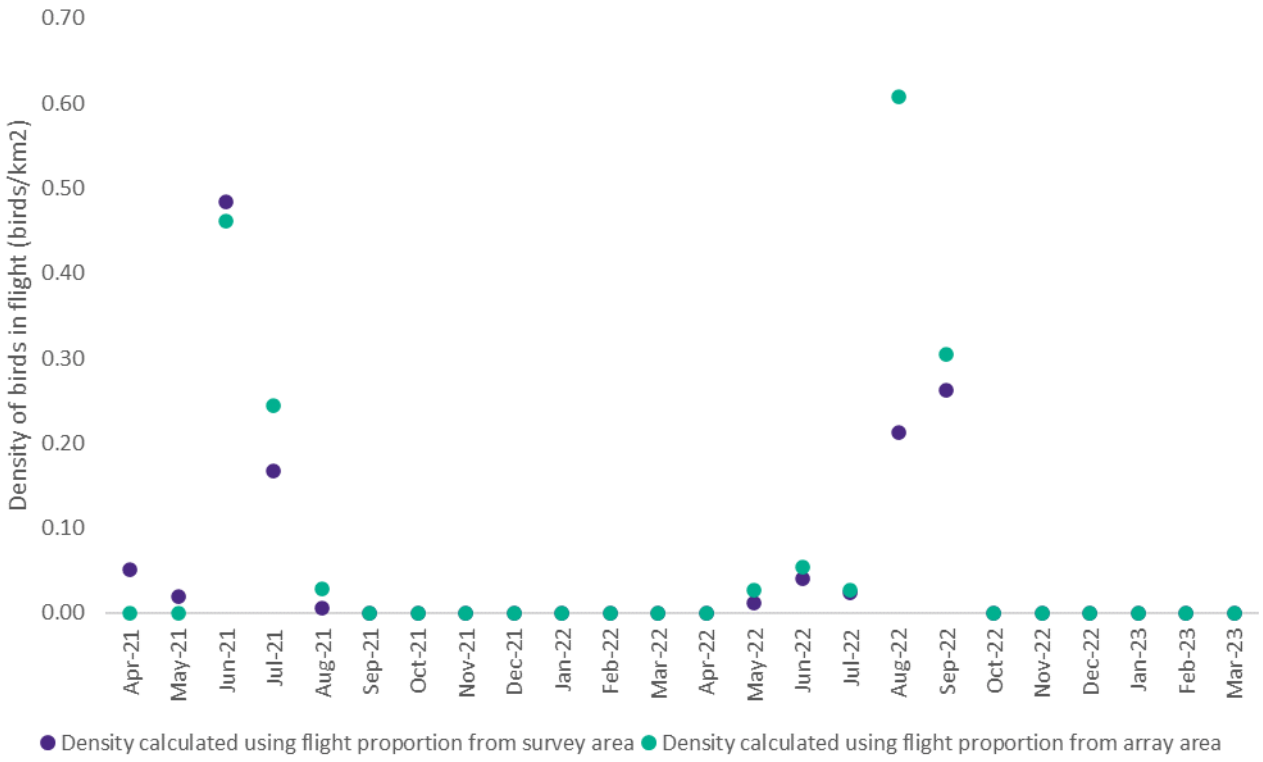

Figure 3.10: Design-based densities of flying Manx shearwater calculated using different proportions for birds in flight (note that where data points in a given month are only present for the updated flying density dataset, the data points for the original flying density dataset are beneath).

3.5.2 Conclusion

3.5.2.1 Due to the strong migratory nature of Manx shearwater, the species was recorded in only twelve of the twenty-four site-specific baseline characterisation surveys. The sample sizes in the Morgan Array Area did not surpass the 100 bird threshold discussed in section 2.2 in any month.

3.5.2.2 The highest collision risk estimate at the Morgan Generation Assets for Manx shearwater, calculated using parameters advocated by the EWG and presented in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) was <0.1 collisions/annum. An increase in density of 37% has been calculated above with this representing a guide for the potential change in collision risk estimates if the proportions of birds in flight from the Morgan Array Area were to be used. However, because the collision estimate calculated in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) is very low, this magnitude of change would not materially alter the conclusions of the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

3.5.2.3 Both datasets have monthly sample sizes that fall below the 100 bird threshold. The use of raw data from the survey area provides a larger sample size with more months over the 100 bird threshold than if the raw data from the Morgan Array Area were to be used. This ensures resulting analyses utilising these data are as robust as possible.

3.6 Gannet

3.6.1 Analysis

3.6.1.1 The proportion of gannet in flight in the Morgan Array Area and survey area relative to the sample sizes of gannet in the Morgan Array Area and survey area are presented in Figure 3.11. Of the 24 months surveyed, none had a sample size greater than 100 birds. It is therefore difficult to draw conclusions based on the data presented in Figure 3.11 as the data may not be representative of the actual proportion of birds in flight. However, in the months with the largest sample size in the Morgan Array Area (August 2021, October 2021 and August 2022) there was good correspondence between the proportions of birds in flight calculated for the Morgan Array Area and the survey area.

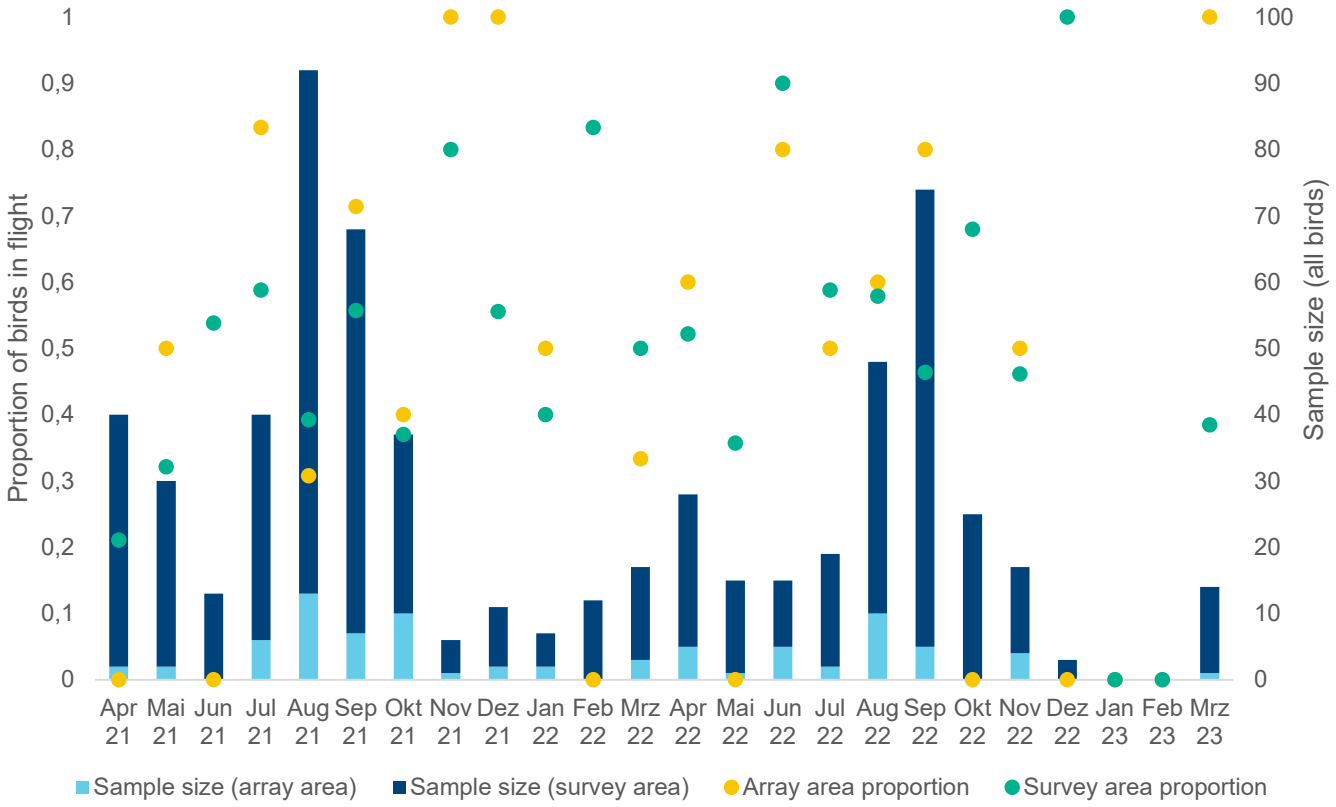

Figure 3.11: Proportion of gannet in flight in the Morgan Array Area and survey area relative to the sample size of gannet in the Morgan Array Area and survey area (note that where data points in a given month are only present for the Morgan Array Area proportion dataset, data points for the survey area dataset are beneath).

3.6.1.2 Figure 3.12 and Appendix A present design-based densities for gannet calculated using the proportions of birds in flight from the survey area and densities calculated using proportions of birds in flight calculated using raw data from the Morgan Array Area only. Across the 24 months of survey, densities in six months are higher using the proportions of birds in flight from the survey area, and densities in eleven months are higher when using the proportions of birds in flight from the Morgan Array Area. In these months (May, July, September, October, November and December 2021, January, April, September and November 2022 and March 2023) it is considered that the difference in densities will not lead to a material difference in assessment terms, with the largest difference being 0.04 birds/km^2 in the September 2022 survey. Across all surveys the total difference represents just over a 10% increase in densities if the proportions of birds in flight from the Morgan Array Area were to be used.

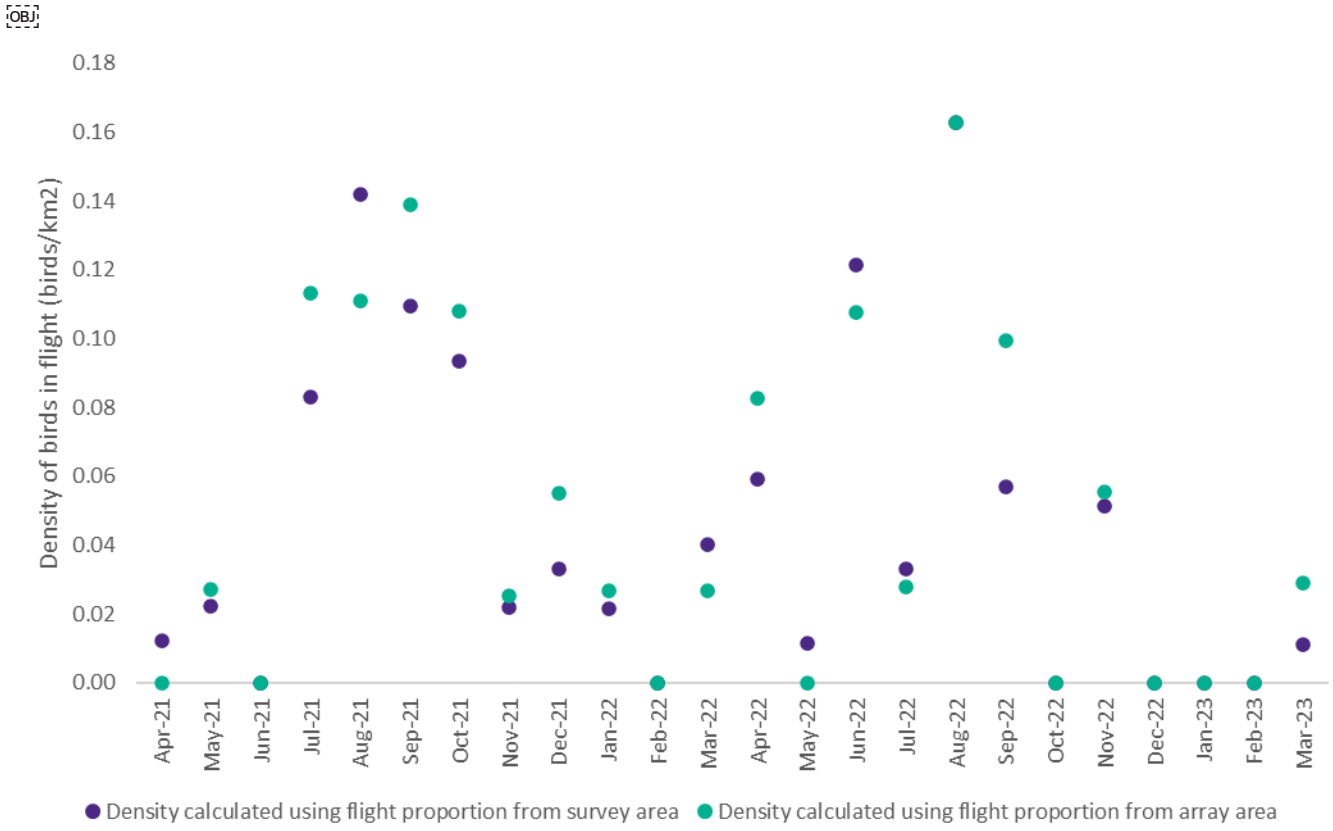

Figure 3.12: Design-based densities of flying gannet calculated using different proportions for birds in flight (note that where data points in a given month are only present for the updated flying density dataset, the data points for the original flying density dataset are beneath).

3.6.2 Conclusion

3.6.2.1 Gannets were observed in the survey area in 22 of the 24 surveys and in the Morgan Array Area in 18 of the 24 surveys. However, the 100 bird threshold discussed in section 2.2 was not surpassed in any month.

3.6.2.2 The highest collision risk estimate at the Morgan Generation Assets for gannet, calculated using parameters advocated by the EWG and presented in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) was 1.5 collisions/annum. An increase in density of 10% has been calculated above with this representing a guide for the potential change in collision risk estimates if the proportions of birds in flight from the Morgan Array Area were to be used. However, because the collision estimate calculated in Volume 4, Annex 5.3: Offshore ornithology collision risk modelling technical report (APP-055) is very low, this magnitude of change would not materially alter the conclusions of the assessments presented in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

3.6.2.3 Both datasets have monthly sample sizes that fall below the 100 bird threshold. The use of raw data from the survey area provides a larger sample size with more months over the 100 bird threshold than if the raw data from the Morgan Array Area were to be used. This ensures resulting analyses utilising these data are as robust as possible.

4 SUMMARY

4.1.1.1 The Applicant has considered Natural England's recommendation detailed in section 1.1 and has undertaken a comparison of the proportions of birds in flight recorded in the array area and the survey area. A summary of the analyses presented and conclusions reached in this report is provided in Table 4.1.

Table 4.1: Summary of analyses presented in this report.

Species	Abundance	Collision risk	Conclusion
Kittiwake	Generally good correspondence between the proportions of birds in the Morgan Array Area and survey area. However, sample size of kittiwake in the Morgan Array Area in all but one month was below 100 birds. In the one month where sample size was over 100 birds there was good correspondence between the proportions of birds in flight calculated in the Morgan Array Area and survey area.	Design-based densities for kittiwake show limited change when applying the proportions of birds in flight calculated using the raw data from the Morgan Array Area or survey area. Increase in total density is only 1.9%.	The use of raw data from the survey area provides a larger sample size with more months over the 100 bird threshold than if the raw data from the Morgan Array Area were to be used. This ensures resulting analyses utilising these data are as robust as possible. It is considered that the potential changes in densities will not materially affect the conclusions of the EIA and ISAA assessments.
Great black-backed gull	No months had a sample size greater than 100 birds in any month in both the Morgan Array Area and survey area. This complicates comparisons between the proportions of birds in flight.	Densities calculated using the proportions of birds in flight from the survey area are generally higher than those calculated using the proportions of birds in flight from the Morgan Array Area. If densities from the Morgan Array Area were to be used it would therefore lead to lower collision risk estimates. However, as collision risk estimates are low, it is considered that any changes will not be material in assessment terms.	All months in both the Morgan Array Area and survey area have associated sample sizes below the 100 bird threshold. The use of the raw data from the survey area provides as large a sample size as possible to ensure resulting analyses are as robust as possible. It is considered that the potential changes in densities will not materially affect the conclusions of the EIA and ISAA assessments.
Herring gull	No months had a sample size greater than 100 birds in any month in both the Morgan Array Area and survey area. This complicates comparisons between the proportions of birds in flight.	Densities calculated using the proportions of birds in flight from the survey area are generally higher than those calculated using the proportions of birds in flight from the Morgan Array Area. However, as collision risk estimates are low, it is considered that any changes will not be material in assessment terms.	All months in both the Morgan Array Area and survey area have associated sample sizes below the 100 bird threshold. The use of the raw data from the survey area provides as large a sample size as possible to ensure resulting analyses are as robust as possible. It is considered that the potential changes in densities will not materially affect the conclusions of the EIA and ISAA assessments.

Species	Abundance	Collision risk	Conclusion
Lesser black-backed gull	No months had a sample size greater than 100 birds in any month in both the Morgan Array Area and survey area. This complicates comparisons between the proportions of birds in flight.	Densities calculated using the proportions of birds in flight from the survey area are generally lower than those calculated using the proportions of birds in flight from the Morgan Array Area. However, as collision risk estimates are low, it is considered that any changes will not be material in assessment terms.	All months in both the Morgan Array Area and survey area have associated sample sizes below the 100 bird threshold. The use of the raw data from the survey area provides as large a sample size as possible to ensure resulting analyses are as robust as possible. It is considered that the potential changes in densities will not materially affect the conclusions of the EIA and ISAA assessments.
Manx shearwater	Sample size of Manx shearwater in the Morgan Array Area was below 100 birds but did surpass this threshold in five surveys in the survey area. This complicates comparisons between the proportions of birds in flight.	Densities calculated using the proportions of birds in flight from the survey area are generally lower than those calculated using the proportions of birds in flight from the Morgan Array Area. However, as collision risk estimates for Manx shearwater are very low, it is considered that any changes will not be material in assessment terms.	All months in the Morgan Array Area have associated sample sizes below the 100 bird threshold. The use of the raw data from the survey area provides as large a sample size as possible, including a number of surveys where sample size was above the 100 bird threshold, to ensure resulting analyses are as robust as possible. It is considered that the potential changes in densities will not to materially affect the conclusions of the EIA and ISAA assessments.
Gannet	No months had a sample size greater than 100 birds in any month in both the Morgan Array Area and survey area. This complicates comparisons between the proportions of birds in flight.	Densities calculated using the proportions of birds in flight from the survey area are generally lower than those calculated using the proportions of birds in flight from the Morgan Array Area. However, as collision risk estimates are low, it is considered that any changes will not be material in assessment terms.	All months in both the Morgan Array Area and survey area have associated sample sizes below the 100 bird threshold. The use of the raw data from the survey area provides as large a sample size as possible to ensure resulting analyses are as robust as possible. It is considered that the potential changes in densities will not materially affect the conclusions of the EIA and ISAA assessments.

4.1.1.2 In conclusion, the use of raw data from the survey area to calculate the proportion of birds in flight is considered to provide a robust approach that reduces the influence of random anomalies which, due to the low sample sizes recorded in the Morgan Array Area, could lead to unreliable estimates of collision risk. The use of the proportions of birds in flight calculated using data from the survey area represents the most robust approach for all species due to the larger sample size available and in many cases, limited differences between the two datasets where meaningful comparisons could be drawn.

4.1.1.3 The Applicant is therefore confident that the approach applied in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098) is appropriate for the dataset. It is considered that any differences that may exist between the Morgan Array Area and survey area will not materially affect the conclusions reached in Volume 2, Chapter 5: Offshore ornithology (APP-023) and HRA Stage 2 information to support an appropriate assessment Part Three: Special Protection Areas and Ramsar Site assessments (APP-098).

5 REFERENCES

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Appendix A: Densities of birds in flight

Table A.1: Design-based densities of birds in flight calculated using proportions of birds in flight from the survey area and Morgan Array Area.

Survey	Kittiwake		Great black-backed gull		Herring gull		Lesser black-backed gull		Manx shearwater		Gannet	
Apr-21	0.38	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.01	0.00
May-21	0.22	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.03
Jun-21	0.10	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.46	0.00	0.00
Jul-21	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.24	0.08	0.11
Aug-21	0.00	0.00	0.03	0.03	0.03	0.06	0.00	0.00	0.01	0.03	0.14	0.11
Sep-21	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.11	0.14
Oct-21	0.35	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.11
Nov-21	0.24	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03
Dec-21	2.85	2.84	0.00	0.00	0.09	0.11	0.00	0.00	0.00	0.00	0.03	0.06
Jan-22	0.60	0.62	0.11	0.03	0.32	0.28	0.00	0.00	0.00	0.00	0.02	0.03
Feb-22	0.45	0.44	0.00	0.00	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00
Mar-22	0.82	0.72	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03
Apr-22	0.60	0.74	0.00	0.00	0.02	0.03	0.02	0.03	0.00	0.00	0.06	0.08
May-22	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.00
Jun-22	0.07	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.12	0.11
Jul-22	0.07	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.03
Aug-22	0.09	0.08	0.02	0.03	0.00	0.00	0.00	0.00	0.21	0.61	0.16	0.16
Sep-22	0.14	0.20	0.00	0.00	0.00	0.00	0.02	0.02	0.26	0.30	0.06	0.10
Oct-22	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov-22	0.58	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.06
Dec-22	0.59	0.68	0.17	0.13	0.30	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Jan-23	0.31	0.28	0.06	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb-23	0.16	0.16	0.04	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar-23	0.78	0.89	0.00	0.00	0.12	0.06	0.03	0.03	0.00	0.00	0.01	0.03