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Subject:	Hornsea Project Three (UK) Ltd response to Deadline 4 (Part 7)
Date:	15 January 2019 23:06:22
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Dear Kay, K-J

Please find attached the 7th instalment of documents.

Best regards,
Dr Dominika Chalder PIEMA
Environment and Consent Manager

[redacted]

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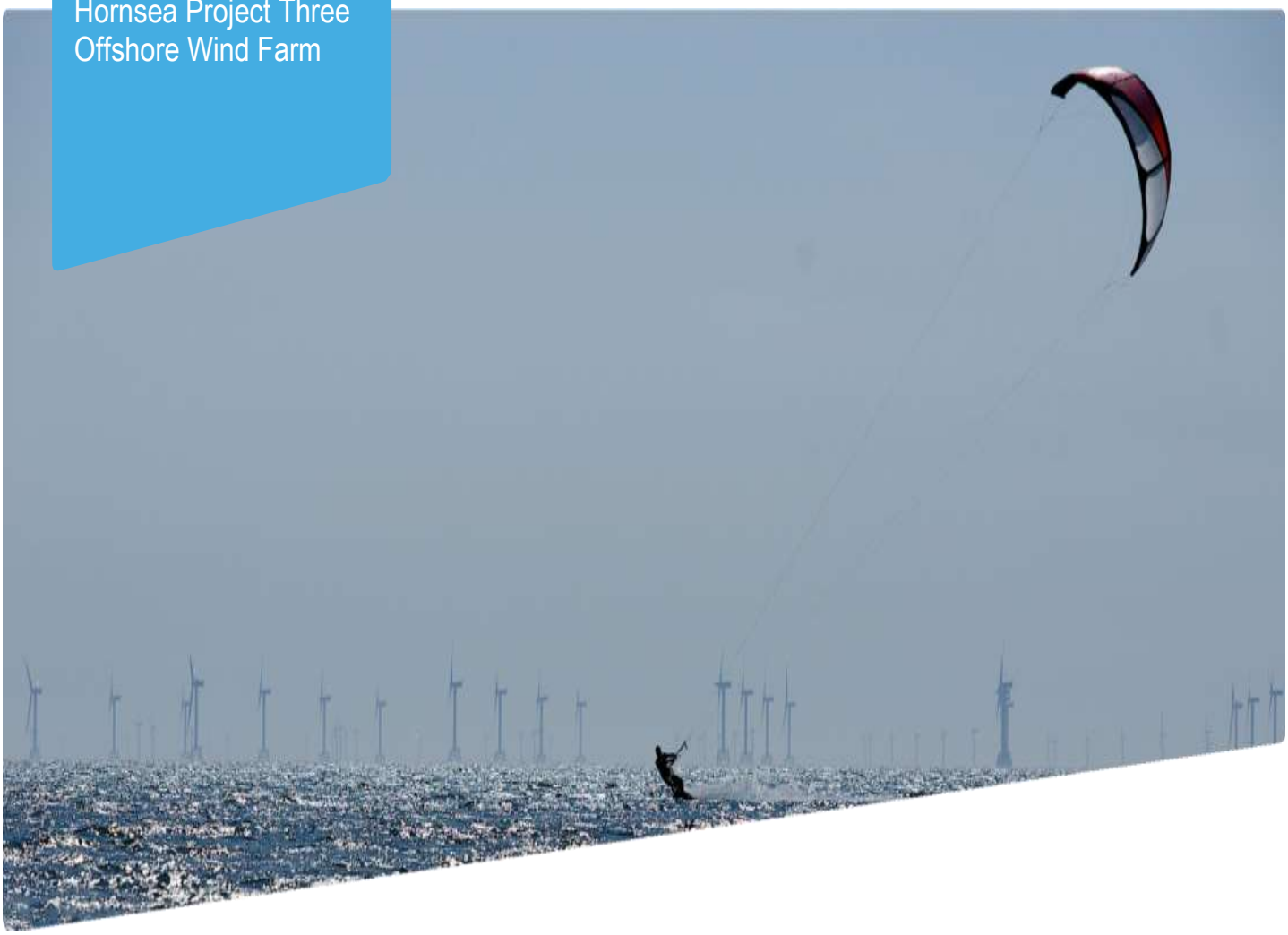
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Appendix 28 to Deadline 4 submission -Summary of positions in relation to collision mortality for the SPA populations of gannet and kittiwake

Date: 15th January 2019

Hornsea 3
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Front cover picture: Kite surfer near a UK offshore wind farm © Orsted Hornsea Project Three (UK) Ltd., 2019.

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1. Summary of positions

Introduction

1.1 This note summarises the difference between the Applicant's position and the alternative analysis set out in Annex C to this report which presents updated risk assessments using the most precautionary assumptions proposed by Natural England in their submissions at Deadline 1, 2 and 3.

1.2 It is intended that the note will assist the Examining Authority to understand the different assumptions made by the Applicant and Natural England and the implications that these differences have for the predicted collision rates for key species.

1.3 This note is set out in two parts. First the collision rates for key species are presented for Hornsea Three alone and for other plans and projects to be considered in-combination. The second part provides information on the refinements proposed. In addition, Annex C provides displacement analysis and collision risk modelling that addresses Q2.2.9 of the Examining Authority's second questions.

Part 1: summary of collision rates for Hornsea Three alone and in-combination

Overview

1.4 For gannet (Table 1.1) and kittiwake (Table 1.2) the information is summarised in the following way:

- The Applicant's position as presented in the application (RIAA – APP-051).
- The alternative analysis undertaken in Annex C which takes account of the assumptions proposed by Natural England in their submissions at Deadline 1, 2 and 3.
- Refinements of the alternative analysis that are considered reasonable in light of available evidence but which Natural England do not currently support. These comprise:
  - Application of the up-to-date evidence on flight speeds as presented in Skov et al. (2018) (see note A).
  - Application of Nocturnal Activity Factors proposed by Furness *et al.* (2018) and Furness *et al.* (unpub) (see note B).
  - The apportioning values proposed by the Applicant as presented in RIAA Annex 3: Phenology, connectivity and apportioning for features of FFC pSPA (APP-054) (see note C).
  - The seasonal definitions proposed by the Applicant based on the likely presence of breeding adult birds at Hornsea Three (see note D).

1.5 Further background information and the rationale for applying each of these refinements is provided in the notes following the table.

1.6 In the tables these refinements are applied progressively and cumulatively to the values presented (reading left to right). Once all refinements are applied the resulting collision rate is similar to that proposed by the Applicant.

1.7 All rates presented for these species relate to the qualifying FFC SPA breeding populations.

1.8 For all species, two sets of baseline data have been used for the calculations for the months December – March:

- The mean estimate density scenario obtained from the single year of Digital Aerial Surveys
- The mean estimate + UCL density scenario as used in Annex C.

1.9 Collision rates have been calculated for all model options and their relevant associated avoidance rates (or a range where there is uncertainty). It should be noted that JNCC have just revised their advice on avoidance rates in light of the ORJIP study (Bowgen and Cook (2018), report included in Appendix 14) and the rates recommended in this report have also been presented.

1.10 To facilitate an understanding of the in-combination collision risk, the predicted collision rates for other relevant plans and projects are also provided in a separate table for both species.

1.11 In these tables the predicted rates are provided based on the use of both the basic and extended versions of the model. It is also possible to refine these predictions, including with respect to:

- Adjustment to the predicted collision rates to account for differences in the design parameters of projects compared to the design that was assessed for the purposes of consent (see note E).
- Nocturnal activity factors (see note B).
- Flight speeds (see note A).

Gannet

Table 1.1: Summary of predicted collision risk estimates for the gannet population of the FFC SPA from Hornsea Three alone

Baseline data assumption	Band model Option	Avoidance rate (%)	Predicted annual collision mortality rate apportioned to FFC SPA					
			Applicant's position as at APP-051	Alternative analysis (Annex C)	Proposed refinement of alternative analysis (applied cumulatively left to right)			
					A. Flight speed	B. Nocturnal activity factor	C. Apportioning	D. Seasonality
Mean estimate	1	98.9	4	1-9	1-9	1-8	4	4
		99.5	-	1-4	1-4	1-3	2	2
	2	98.9	8	13-20	3-19	3-17	10	8
		99.5	-	1-9	1-9	1-8	2	4
	3	98	3	1-8	1-8	1-7	4	4
Mean estimate + UCL	1	98.9	4	2-10	1-9	2-8	5	4
		99.5	-	1-4	1-4	1-4	4	2
	2	98.9	8	3-22	3-20	3-18	10	8
		99.5	-	2-10	1-9	2-8	5	4
	3	98	3	1-9	1-9	1-8	5	4

Table 1.2: Summary of predicted collision risk estimates for the gannet population of the FFC SPA from other plans and projects

Model version	Project	Predicted annual collision mortality rate				
		Applicant's position as presented in REP1-005	Options for further refinement			
			E. Updated project designs – Neart na Gaoithe	E. Updated project designs – other projects	B. Nocturnal activity factors	A. Flight speeds
Basic	Tier 1	124	111	95	79	124
	Tier 1+2	160	157	131	112	106
Extended	Tier 1	116	111	78	67	60
	Tier 1+2	195	191	158	139	125

Kittiwake

Table 1.3: Summary of collision risk estimates for the kittiwake population of the FFC SPA

Baseline data assumption	Band model Option	Avoidance rate (%)	Predicted annual collision mortality rate apportioned to FFC SPA					
			Applicant's position as at APP-051	Alternative analysis (REF##)	Proposed refinement of alternative analysis (applied cumulatively left to right)			
					A. Flight speed	B. Nocturnal activity factor	C. Apportioning	D. Seasonality
Mean estimate	1	98.9	11	4-35	3-26	3-22	10	8
		99.0	-	4-32				
		99.2	8	3-26	2-19	2-16	7	6
	2	98.9	58	21-185	16-136	15-116	52	42
		99.0	-	19-168				
		99.2	42	16-134	12-99	11-84	38	30
	3	98	20	7-64	6-55	6-47	21	17
Mean estimate + UCL	1	98.9	11	5-40	3-29	3-25	11	8
		99.0	-	4-36				
		99.2	8	3-29	3-21	2-18	8	6
	2	98.9	58	25-211	18-154	17-130	59	44
		99.0	-	23-191				

Baseline data assumption	Band model Option	Avoidance rate	Predicted annual collision mortality rate apportioned to FFC SPA					
		99.2	42	18-153	14-112	13-95	43	32
	3	98	20	9-73	7-62	7-53	24	18

Table 1.4: Summary of predicted collision risk estimates for the kittiwake population of the FFC SPA from other plans and projects

Model version	Project	Predicted annual collision mortality rate				
		Applicant's position as presented in REP1-005	Options for further refinement			
			E. Updated project designs – Neart na Gaoithe	E. Updated project designs – other projects	B. Nocturnal activity factors	A. Flight speeds
Basic	Tier 1	87	86	55	50	43
	Tier 1+2	250	249	218	200	170
Extended	Tier 1	38	37	22	20	14
	Tier 1+2	107	106	91	83	58

Part 2: Notes on refinements

A. Flight speed

1.12 As set out in Appendix 10 to the Applicant's submission at Deadline 1 (REP1-188), Skov *et al.* (2018) presents flight speed data for the species considered for collision risk modelling at Hornsea Three. Skov *et al.* (2018) provides flight speed data collected at an operational wind farm in UK waters with large associated sample sizes. Table 1.5 provides a comparison between the flight speeds from Alerstam *et al.* (2007)/Pennycuick (1987) and those recorded by Skov *et al.* (2018).

Table 1.5: Species-specific mean flight speeds (m/s) often used in CRM, and those measured from single rangefinder segments recorded at Thanet

Species	Flight speed commonly used (m/s) (no. of tracks)	Flight speed estimated by the study (m/s) (SD)
Gannet	14.9[a] (n=32)	13.33 (4.24) [n=683]
Kittiwake	13.1[b] (n=2)	8.71 (3.16) [n= 287]

a Pennycuick (1987)
b Alerstam *et al.* (2007)

1.13 The sample sizes associated with the flight speed data from Skov *et al.* (2018) are significantly higher than those from Alerstam *et al.* (2007)/Pennycuick (1987). The flight speeds presented in these studies are based on very small sample sizes ranging from 32 individuals (gannet) down to as few as 2 (kittiwake). In addition, the following issues exist in relation to the flight speeds from these paper that indicate that these data are not representative of the behaviour of birds at Hornsea Three:

- The flight speed data for kittiwake was restricted to radar recordings from migration flight which are expected to be birds flying at an airspeed close to that associated with maximum lift-drag ratio (Alerstam *et al*., 2007);
- The flight speed for gannet calculated in Pennycuick (1987) is based on a small sample size with these data having been collected from birds flying at a breeding colony (Foula, Shetland). It is therefore possible that the flight speeds recorded are not representative of the flight speeds of birds that may occur at Hornsea Three due to the proximity of birds to the breeding colony; and
- The birds observed by Alerstam *et al*. (2007) were located either in southern Sweden or within the Arctic circle and no determination is given between migratory or foraging birds from colonies. Indeed, the large range of species included in Alerstam *et al*. (2007) suggests that non-breeding and/or migratory flights comprised a significant component of the data set.

1.14 The percentage reductions for each species for both unapportioned and apportioned (gannet and kittiwake only) for collision risk estimates calculated using Options 1 and 2 are:

- Gannet = 7.4%;
- Kittiwake = 26.7%;

1.15 It should be noted that Scottish Natural Heritage (SNH) have now accepted the use of the flight speed data presented in Skov et al. (2018) for collision risk modelling[1].

Application to other projects

1.16 The Applicant considers that the flight speed data presented in Skov *et al.* (2018) certainly represents the best available evidence on flight speed available for use in collision risk modelling. Projects considered in-combination will have used the flight speed data from either Pennycuick (1987) or Alerstam *et al.* (2007) and will therefore have calculated collision risk estimates that are over-estimates. It is therefore considered appropriate to consider this within the cumulative and in-combination assessments presented for Hornsea Three to account for the increased knowledge in bird flight behaviour.

1.17 The relationship between bird flight speed and resultant collision risk estimates varies depending on the turbine being used. Collision risk estimates for Hornsea Three reduced by 7.4-26.7% when the flight speed data from Skov *et al.* (2018) when gannet or kittiwake were considered. However, collision risk modelling conducted for Hornsea Three was based on a turbine with a relatively large capacity (8 MW). The effect changes to flight speed may have on smaller turbines (e.g. 3.6 MW), as have been constructed at many projects incorporated into the cumulative and in-combination assessments for Hornsea Three may potentially be lower. The Applicant has therefore modelled a range of turbine scenarios and has identified the differences presented in Table 1.6 for each species. Using this range a suitable correction factor has also been identified to apply to all projects for which the application of updated flight speed data is required.

Table 1.6: Percentage reductions in collision risk estimates when applying the flight speed data from Skov *et al.* (2018)

Turbine scenario (MW)	Gannet		Kittiwake	
	Basic	Extended	Basic	Extended
3.6	5	11	16	34
5	6	11	25	34
6	7	12	21	34
7	6	11	25	34

[1] See SNH consultation responses to Moray West Application

B. Nocturnal activity factors

1.18 As discussed in Appendix 10 to the Applicant's submission at Deadline 1 (REP1-188), the quantification of nocturnal activity factors by Band (2012) represents an over-estimate of the amount of nocturnal activity exhibited by seabird species. The Applicant has used information presented in Furness *et al.* (2018) and information associated with Furness (unpub) provided in MacArthur Green (2018) to reduce the over-estimation and uncertainty inherent in collision risk estimates as a result of the use of the nocturnal activity factors as quantified by Band (2012). The following species-specific sections therefore update collision risk estimates utilising the nocturnal activity rates provided in Furness *et al.* (2018) and MacArthur Green (2018).

Gannet

1.19 In general the reduction in annual collision risk estimates is approximately 17-18% when using Options 1 and 2 with a reduction of 11-12% for collision risk estimates apportioned to FFC SPA when using the approach to deriving nocturnal activity factors advocated by Band (2012).

Kittiwake

1.20 In general the reduction in annual collision risk estimates is 19-21% for Options 1 and 2 with a reduction of 15-16% for collision risk estimates apportioned to FFC SPA when using the approach to deriving nocturnal activity factors advocated by Band (2012).

Application to other projects

1.21 Collision risk modelling conducted for projects considered in-combination are considered to have most certainly used the nocturnal activity factors from Garthe and Hüppop (2004) and therefore it is necessary to correct the collision risk estimates to account for this over-estimation.

An analysis was conducted in Volume 5, Annex 5.3: Collision Risk Modelling (APP-109) that calculated correction factors for four geographic areas into which each of the projects considered in-combination have been assigned (

1.22 Table 1.7). This analysis was considered qualitatively in the assessments presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051). For the purposes of the analysis presented here the minimum correction factor, representing the minimum monthly change that can be applied across all months, has been used. This is almost certainly precautionary however, it is difficult to provide a more precise correction factor without increasing the potential for this correction factor to potentially under-estimate the in-combination collision risk total. The application of the 'minimum' correction factor is considered to be precautionary as this represents the minimum change that would occur across all months.

Table 1.7: Reductions to apply to collision risk estimates for projects in each geographic region

Geographic region	Projects within region	% reduction in collision risk estimates
East Anglia and English Channel	East Anglia One East Anglia Three Galloper Greater Gabbard Kentish Flats Extension London Array Thanet	Gannet = 10.1% Kittiwake = 9.2%
Southern North Sea	Dogger Bank Creyke Beck A & B Dogger Bank Teesside A & B Dudgeon Hornsea Project One Hornsea Project Two Humber Gateway Lincs Race Bank Sheringham Shoal Teesside Triton Knoll Westermost Rough	Gannet = 9.3% Kittiwake = 8.5%
Firth of Forth	Aberdeen (EOWDC) Inch Cape Kincardine Methil Neart na Gaoithe Seagreen Alpha Seagreen Bravo	Gannet = 8.4% Kittiwake = 7.8%

Geographic region	Projects within region	% reduction in collision risk estimates
Moray Firth	Beatrice Hywind Moray East	Gannet = 7.6% Kittiwake = 7.1%

C. Apportioning

1.23 The apportioning values applied in the breeding season by the Applicant for relevant species are supported by a substantial body of scientific evidence with this presented and discussed in RIAA Annex 3: Phenology, Connectivity and Apportioning (APP-054), specifically for gannet and kittiwake respectively by the results of Langston *et al.* (2013) and Cleasby *et al.* (2018), which show limited usage of Hornsea Three by either of these species (see also the Applicant's response to Q2.2.25 of the Examining Authority's second questions). Table 1.8 identifies the apportioning values used for each species. A brief summary of the evidence supporting apportioning values applied by the Applicant in the breeding season is presented in the following species-specific sections.

Table 1.8: Breeding adult apportioning values for relevant features of FFC SPA.

Season	Gannet	Kittiwake
Breeding	40.4	41.7
Post-breeding	4.8	5.4
Pre-breeding	6.2	7.2

Gannet

1.24 The apportioning approach used in the breeding season for gannet utilised age class data collected as part of boat-based surveys that covered Hornsea Three. These were considered to provide a more accurate representation of the age structure of gannet at Hornsea Three for the following reasons:

- Inability to age birds sitting on the water during aerial surveys with such birds representing a large proportion of the birds present and Hornsea Three;
- Larger sample size associated with age class data from boat-based surveys;
- Larger spatial scale associated with data from boat-based surveys allowing for comparisons between different areas;
- Surveyors are able to observe birds for longer during boat-based surveys enabling different features (plumage, behaviour) to be observed; and
- Kernel Density Estimation of gannet (Langston *et al.,* 2013) from FFC SPA indicates that Hornsea Three is not a well utilised area with up to 5% of foraging trips from the colony occurring at Hornsea Three in some years.

1.25 The Applicant would also re-iterate that the apportioning approach applied for gannet in the breeding season was previously accepted by Natural England during the examination of Hornsea Project Two (Natural England, 2015a). Natural England are yet to provide any new information that would lead to this approach being considered invalid.

Kittiwake

1.26 The apportioning approach used in the breeding season for kittiwake utilised age class data collected as part of boat-based surveys that covered Hornsea Three. These were considered to provide a more accurate representation of the age structure of gannet at Hornsea Three for the following reasons:

- Inability to age birds sitting on the water during aerial surveys with such birds representing a large proportion of the birds present and Hornsea Three;
- Larger sample size associated with age class data from boat-based surveys;
- Larger spatial scale associated with data from boat-based surveys allowing for comparisons between different areas;
- Surveyors are able to observe birds for longer during boat-based surveys enabling different features (plumage, behaviour) to be observed; and

1.27 In addition the apportioning value calculated for the breeding season is considered to be precautionary for the following reasons:

- The apportioning value does not account for adults in the population not breeding in a given year (i.e. sabbaticals) – this could account for a further reduction of c5-10% (Coulson, 2011; Marine Scotland Licensing Operations Team, 2017);
- A smaller proportion of one year old birds are likely to be present in natal waters with a much greater proportion of older age classes of immature birds showing affinity with natal waters. Such an assumption is precautionary as the population of older immature birds returning to natal waters is likely to be much larger than predicted by the apportioning approach applied by the Applicant;
- FAME data indicates that the majority of foraging flights are close to the colony and data given by BirdLife (see Section 1.3.3) suggests that only up to 5% of birds are likely to travel as far as Hornsea Three;

- Immature birds are not likely to be evenly distributed within the North Sea and will show aggregations near to foraging resources. If the area within which Hornsea Three lies is seen to be notable for kittiwake foraging; immatures may be present in large numbers;
- Foraging hotspots presented in Cleasby *et al.* (2018) indicate no connectivity between foraging birds from FFC SPA and Hornsea Three;
- Cumulative foraging range data (Figure 1.14) indicates that very few foraging trips (if any) would occur at a distance beyond 120 km (the maximum foraging distance reported by Thaxter et al. (2012) (Hornsea Three is 149 km from FFC pSPA), with this consistent with the results presented in Cleasby *et al.* (2018);
- When breeding productivity is high, foraging ranges are short (Hamer et al., 1993; Lewis et al., 2006; Riou et al., 2011; Thaxter et al., 2012). Breeding productivity at FFC pSPA is comparatively high suggesting that foraging ranges will be short;
- At sea utilisation maps presented in Wakefield et al. (2017) derived utilising the tracking data used to inform the basis for connectivity between FFC pSPA and Hornsea Three suggest that the area in which Hornsea Three is located is beyond the 95% utilisation contour; and
- Site-specific flight direction data does not indicate movements of birds to and from the colony at FFC pSPA into Hornsea Three.

1.28 The Applicant would also re-iterate that the apportioning approach applied for kittiwake in the breeding season was previously accepted by Natural England during the examination of Hornsea Project Two (Natural England 2015b).

D. Seasonality

1.29 The seasonal definitions defined by the Applicant have been defined in order to reflect the population structure of birds at Hornsea Three, not at the FFC SPA breeding colony located 150 km from Hornsea Three. It should be noted that the Applicant does not disagree that breeding birds will be present at FFC SPA for a longer period than defined as part of the Applicant's seasonal definitions however, to use the breeding seasons as defined by Natural England (for example) would not provide an approach to assessment that is biologically representative of the occurrence of birds at Hornsea Three. The breeding seasons defined by the Applicant therefore represent the periods during which time it can be assumed that adult breeding birds present at Hornsea Three originate, solely, from FFC pSPA. The population present at Hornsea Three in those months not included in the Applicant's breeding seasons but included in Natural England's breeding seasons is very different to that that would occur in the 'core breeding season' as a high proportion of immature birds, non-breeding birds, failed breeders and migratory birds will be present. Therefore it is considered that a different apportioning methodology should be applied in those months. This is supported by a large body of published evidence (see RIAA Annex: Phenology, connectivity and apportioning for features of FFC pSPA (APP-054), and specifically for FFC SPA for gannet and kittiwake, respectively by the results of Langston *et al.* (2013) and Cleasby *et al.* (2018), which show limited usage of Hornsea Three by either of these species (see also the Applicant's response to Q2.2.25 of the Examining Authority's second questions).

1.30 The difference in the seasonal extents defined by the Applicant and Natural England (as stated in REP1-211) is provided in Table 1.9.

Table 1.9: Seasonal extents for gannet and kittiwake as defined by the Applicant and Natural England

Species	Seasonal approach	Breeding	Post-breeding	Pre-breeding
Gannet	Applicant	April to August	September to November	December to March
	Natural England	March to September	October to November	December to March
Kittiwake	Applicant	April to July	August to December	January to March
	Natural England	March to August	September to December	January to February

E. Updated project designs

Neart na Gaoithe

1.31 The collision risk estimates used for Neart na Gaoithe as part of the cumulative / in-combination assessments for Hornsea Three represented the turbine scenario used as part of the application submission for Neart na Gaoithe (127 x 3.6 MW). However, the subsequent consent decision was based on a 75 x 6 MW turbine scenario, with collision risk modelling for this scenario not presented as part of the application.

1.32 In July 2015, Neart na Gaoithe submitted a Section 36 consent variation. The documentation associated with this consent variation contains collision risk estimates for a 75 x 6 MW turbine scenario. The collision risk estimates used for Neart na Gaoithe in the cumulative/in-combination assessments for Hornsea Three have therefore been updated to use the collision risk estimates presented for Neart na Gaoithe in the Section 36 consent variation.

Other projects

1.33 The use of collision risk estimates calculated based on the assumptions applied by projects at the point of application or, at the latest, point of decision, that are subsequently used as part of cumulative or in-combination assessments for Hornsea Three has the potential to significantly over-estimate the total collision impact in terms of both EIA and RIAA assessments. This was considered as part Volume 2, Chapter 5: Offshore Ornithology (Document 6.2.5) and the RIAA (Document 5.2) using previously calculated correction factors in MacArthur Green (2017). Subsequent to this the Applicant provided a clarification note (REP1-148) which considered changes to project designs for all projects considered cumulatively-in-combination.

1.34 Appendix 4 to the Applicant's submission at Deadline 1 (REP1-148) identified differences between the assessed/consented and as-built turbine scenario for those projects listed in Annex A. Consideration was given to the potential for further development at each of these projects and, if it was concluded that further development was not possible, it was proposed that collision risk estimates for relevant projects were updated. Consideration of the use of collision risk estimates representing the as-built scenario for projects considered in the in-combination assessments for presented for Hornsea Three, is provided in Annex B, taking into account the potential for future development.

1.35 This source of over-estimation has previously been highlighted by the Examining Authority for the Hornsea Project Two offshore wind farm (see paragraph 6.4.78 of the Hornsea Project Two Examining Authority's recommendation report (Appendix 66 to the Applicant's submission at Deadline 4)).

References

Alerstam, T., Rosén, M., Bäckman, J., Ericson, P.G.P. and Hellgren, O. (2007). Flight speeds among Bird Species: Allometric and Phylogenetic Effects. PLoS Biology, 5 (8), pp. 1656-1662.

Band, B. (2012). Using a collision risk model to assess bird collision risks for offshore wind farms – with extended method. [Online]. Available at: http://www.bto.org/science/wetlandand- marine/soss/projects (Accessed 2 November 2012).

Bowgen, K. and Cook, A. (2018). *Bird Collision Avoidance: Empirical evidence and impact assessments.* JNCC Report No. 614, JNCC, Peterborough, ISSN 0963-8091.

Cleasby, I.R., Owen, E., Wilson, L.J. and Bolton, M. (2018). Combining habitat modelling and hotspot analysis to reveal the location of high density seabird areas across the UK: Technical Report. Sandy: RSPB.

Coulson, J.C., 2011. *The Kittiwake*. London: T. & A.D. Poyser.

Furness, R.W., Garthe, S., Trinder, M., Matthiopoulos, J., Wanless, S. and Jeglinski, J. (2018). Nocturnal flight activity of northern gannets *Morus bassanus* and implications for modelling collision risk at offshore wind farms. *Environmental Impact Assessment Review*. 73, pp. 1-6.

Garthe, S. and Hüppop, O., 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. *Journal of Applied Ecology*, 41, pp. 724-734.

Hamer, K.C., Monaghan, P., Uttley, J.D., Walton, P. and Burns, M.D. (1993). The influence of food supply on the breeding ecology of kittiwakes Rissa tridactyla in Shetland. Ibis, 135, pp. 255-263.

Langston, R.H.W., Teuten, E. and Butler, A., 2013. *Foraging ranges of northern gannets* Morus bassanus *in relation to proposed offshore wind farms in the North Sea: 2010-2012*. Sandy: Royal Society for the Protection of Birds.

Lewis, S., Grémillet, D., Daunt, F., Ryan, P.G., Crawford, R.J. and Wanless, S., 2006. Using behavioural and state variables to identify proximate causes of population change in a seabird. *Oecologia,* 147, pp. 606−614.

MacArthur Green (2017). *Estimates of Ornithological Headroom in Offshore Wind Farm Collision Mortality.* The Crown Estate.

MacArthur Green (2018). *Norfolk Vanguard Offshore Wind Farm Appendix 13.1 Offshore Ornithology Technical Appendix.* [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001547-Appendix%2013.01%20Ornithology%20Technical%20Appendix.pdf (Accessed July 2018).

Mainstream Renewable Power (2015). *Neart na Gaoithe Offshore Wind Farm. Electricity Act 1989 – Section 36 Consent Variation. Supporting Environmental Information*. [Online]. Available at: https://www.gov.scot/Topics/marine/Licensing/marine/scoping/Mainstream-NeartnaGaoithe/supporting-information (Accessed August 2018).

Marine Scotland, 2017. Marine Scotland - Licensing Operations Team Scoping Opinion Addendum: Ornithology. [Online]. Available at: https://www.gov.scot/Resource/0052/00521151.pdf (Accessed Oct 2018).

Natural England (2015a). Hornsea offshore wind farm project two. Written submission for deadline 3: Appendix 3. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001101-Natural%20England%20(3).pdf (Accessed January 2019).

Natural England (2015b). Written Submission For Deadline 5. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001205-Natural%20England's%20response%20for%20Deadline%205.pdf (Accessed January 2019).

Pennycuick, C.J. (1987). Flight of auks (Alcidae) and other northern seabirds compared with southern procellariformes: ornithodolite observations. Journal of Experimental Biology, 128, pp. 335-347.

Riou, S., Gray, C.M., Brooke, M.D., Quillfeldt, P., Masello, J.F., Perrins, C. and Hamer, K.C., 2011. Recent impacts of anthropogenic climate change on a higher marine predator in western Britain. *Marine Ecology Progress Series*, 422, pp. 105-112.

Skov, H., Heinanen, S., Norman, T., Ward, R.M., Mendez-Roldan, S. & Ellis, I. 2018. *ORJIP Bird Collision and Avoidance Study. Final report – April 2018*. The Carbon Trust. United Kingdom. 247 pp.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langton, R.H.W. and Burton, N.H.K. (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas.

Wakefield, E.D., Owen, E., Baer, J., Carroll, M.J., Daunt, F., Dodd, S.G., Green, J.A., Guilford, T., Mavor, R.A., Miller, P.I., Newell, M.A., Newton, S.F., Robertson, G.S., Shoji, A., Soanes, L.M., Votier, S.C., Wanless, S. and Bolton, M., 2017. Breeding density ,fine-scale tracking and large-scale modelling reveal the regional distribution of four seabird species. *Ecological Applications,* pp 1-18.

Annex A – As-built scenarios

Table 1.10: Summary of approaches applied for projects considered cumulatively/in-combination with Hornsea Three and the worst case scenario for each project.

Project	Summary of refinements to collision risk estimates in this report	Is future development possible (Approach 2 and 3)?	Do updated collision risk estimates represent the worst case scenario?
Aberdeen (European Offshore Wind Development Centre)	Approach 3 - Correction factor derived using as-built turbine scenario	No	Yes. Project is operational. No further development is possible.
Beatrice	Approach 1 - Updated collision risk estimates for the as-built scenario available As built turbine scenario uses fewer turbines	Yes	No. Collision risk estimates from (Marine Scotland, 2017) represent the as-built scenario and therefore provide an accurate representation of the likely collision risk associated with the project however, further development is possible and therefore these may represent an underestimate if further development occurs
Blyth Offshore-Demonstration Extension	Approach 4 - No updated information available	-	N/A
Dogger Bank Creyke Beck A & B	Approach 1 - Non-material amendment under consideration, consented scenario could still be constructed	-	No. Current collision risk estimates are considered to reflect the worst case scenario at the project. The developer is however, considering different turbine scenarios that would reduce collision risk
Dogger Bank Teesside A and Sofia	Approach 1 - Non-material amendment under consideration, consented scenario could still be constructed	-	No. Current collision risk estimates are considered to reflect the worst case scenario at the project. The developer is however, considering different turbine scenarios that would reduce collision risk

Project	Summary of refinements to collision risk estimates in this report	Is future development possible (Approach 2 and 3)?	Do updated collision risk estimates represent the worst case scenario?
Dudgeon	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, higher capacity turbines	Yes, however future development considered unlikely as operational capacity equals CfD award and project is restricted by Sandwich tern mortality	Yes. Project is operational and updated collision risk estimates represent the as-built scenario and therefore provide an accurate representation of the likely collision risk associated with the project. Further development is considered to be unlikely.
East Anglia One	Approach 3 - Correction factor derived using as-built turbine scenario As built turbine scenario uses fewer, higher capacity turbines	Yes, however future development considered unlikely as operational capacity equals CfD award	Yes. Project is operational and updated collision risk estimates represent the as-built scenario and therefore provide an accurate representation of the likely collision risk associated with the project. Further development is considered to be unlikely.
East Anglia Three	Approach 4 - No change to consented turbine scenario	-	N/A
Seagreen Alpha	Approach 1 - None	-	New application submitted in 2018, however original consent still valid and therefore any changes in the new application should only be considered qualitatively
Seagreen Bravo	Approach 1 - None	-	New application submitted in 2018, however original consent still valid and therefore any changes in the new application should only be considered qualitatively
Galloper Wind Farm	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, higher capacity turbines	Yes	No. Updated collision risk estimates derived using the correction factor are considered to provide an accurate representation of the as-built scenario however, further development is possible

Project	Summary of refinements to collision risk estimates in this report	Is future development possible (Approach 2 and 3)?	Do updated collision risk estimates represent the worst case scenario?
Greater Gabbard Wind Farm	Approach 3 - Correction factor derived using as-built turbine scenario As-built turbine scenario has different parameters	No	Yes. Project is operational. No further development is possible.
Hornsea 1	Approach 4 - None	-	N/A
Hornsea 2	Approach 4 - No updated information available	-	N/A
Humber Gateway	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, lower capacity turbines	Yes	No. Updated collision risk estimates derived using the correction factor are considered to provide an accurate representation of the as-built scenario however, further development is possible
Hywind	Approach 4 - None	-	N/A
Inch Cape	Approach 1 - None	-	New application submitted in 2018, however original consent still valid and therefore any changes in the new application should only be considered qualitatively
Kentish Flats Extension	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, higher capacity turbines	No	Yes. Project is operational. No further development is possible.
Kincardine	Approach 4 - None	-	N/A

Project	Summary of refinements to collision risk estimates in this report	Is future development possible (Approach 2 and 3)?	Do updated collision risk estimates represent the worst case scenario?
Lincs	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, higher capacity turbines	No	Yes. Project is operational. No further development is possible.
London Array	Approach 3 - Correction factor derived using as-built turbine scenario As built turbine scenario uses fewer, higher capacity turbines	No	Yes. Project is operational. No further development is possible.
Methil	Approach 4 - None	-	N/A
Moray East	Approach 1 - Updated collision risk estimates for the as-built scenario available	Yes, however future development considered unlikely as operational capacity equals CfD award	Yes. Collision risk estimates from (Marine Scotland, 2017) represent the as-built scenario and therefore provide an accurate representation of the likely collision risk associated with the project. Further development is considered to be unlikely.
Neart na Gaoithe	Approach 1 - Updated collision risk estimates for the as-built scenario available	No	Yes. Collision risk estimates from (Mainstream Renewable Power, 2015) represent the proposed as-built scenario and therefore provide an accurate representation of the likely collision risk associated with the project.
	Approach 3 - Correction factor derived using as-built turbine scenario As built turbine scenario uses fewer, higher capacity turbines	No	Yes. Collision risk estimates derived using the correction factor are considered to provide an accurate representation of the likely collision risk associated with the project.

Project	Summary of refinements to collision risk estimates in this report	Is future development possible (Approach 2 and 3)?	Do updated collision risk estimates represent the worst case scenario?
Race Bank	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, higher capacity turbines	Considered to be highly unlikely as operational capacity (573.3 MW) is close to consented capacity (580 MW)	Yes. Project is operational. No further development is possible.
Sheringham Shoal	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, higher capacity turbines	No	Yes. Project is operational. No further development is possible.
Teesside Offshore Wind Farm	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer turbines	Yes	No. Updated collision risk estimates derived using the correction factor are considered to provide an accurate representation of the as-built scenario however, further development is possible
Thanet	Approach 1 - None	--	N/A
Triton Knoll	Approach 3 - Correction factor derived using as-built turbine scenario As built turbine scenario uses fewer, higher capacity turbines	No	Yes. Collision risk estimates derived using the correction factor are considered to provide an accurate representation of the likely collision risk associated with the project. No further development is possible with proposed as-built scenario
Westermost Rough	Approach 2 - Correction factor from MacArthur Green (2017) applied As built turbine scenario uses fewer, higher capacity turbines	Yes	No. Updated collision risk estimates derived using the correction factor are considered to provide an accurate representation of the as-built scenario however, further development is possible

Annex B – Collision risk estimates for individual projects considered in-combination

Table 1.11: Details of predicted collision rates for **gannet** for each project included in the in-combination assessment using the **Basic** model. Blue cells indicate those values that are affected by the respective refinement

Project	Predicted annual collision mortality rate				
	Applicant's position as presented in REP1-139	Proposed refinement of alternative analysis			
		E. Updated project designs – Neart na Gaoithe	E. Updated project designs – other projects	B. Nocturnal activity factors	A. Flight speeds
Tier 1					
Aberdeen European Offshore Wind Deployment Centre	0	0	0	0	0
Beatrice	3	3	3	3	2
Blyth Demonstration Project	4	4	4	3	3
Dudgeon	12	12	12	11	10
East Anglia One	6	6	4	3	3
Galloper	2	2	2	2	2
Greater Gabbard	1	1	1	1	1
Hornsea Project One	1	1	1	1	1

Project	Predicted annual collision mortality rate				
Hornsea Project Two	6	6	6	6	6
Humber Gateway	2	2	2	2	1
Hywind	0	0	0	0	0
Kentish Flats Extension	0	0	0	0	0
Lincs	2	2	2	2	2
London Array	0	0	0	0	0
Moray Firth Project One (MORL)	1	1	2	2	2
Neart na Gaoithe	7	4	4	3	3
Race Bank	35	35	18	17	16
Sheringham Shoal	14	14	14	13	12
Teesside	5	5	5	4	4
Thanet	0	0	0	0	0
Triton Knoll	22	22	7	7	6
Westermost Rough	0	0	0	0	0
Tier 1 total	124	121	87	79	75
Tier 2					
Dogger Bank Creyke Beck A and B	3	3	3	3	3

Project	Predicted annual collision mortality rate				
Dogger Bank Teesside A and B	9	9	9	8	7
East Anglia Three	3	3	3	2	2
Inch Cape	2	2	2	2	2
Kincardine	0	0	0	0	0
Methil	0	0	0	0	0
Moray West	0	0	0	0	0
Norfolk Vanguard	5	5	5	4	4
Seagreen Alpha	7	7	7	7	6
Seagreen Bravo	6	6	6	5	5
Thanet Extension	1	1	1	1	1
Tier 2 total	**36**	**36**	**36**	**33**	**31**
Overall total	**160**	**157**	**123**	**112**	**106**

Table 1.12: Details of predicted collision rates for **gannet** for each project included in the in-combination assessment using the **Extended** model. Blue cells indicate those values that are affected by the respective refinement

Project	Predicted annual collision mortality rate				
	Applicant's position as presented in REP1-139	Proposed refinement of alternative analysis			
		E. Updated project designs – Neart na Gaoithe	E. Updated project designs – other projects	B. Nocturnal activity factors	A. Flight speeds
Tier 1					
Aberdeen European Offshore Wind Deployment Centre	0	0	0	0	0
Beatrice	1	1	1	1	1
Blyth Demonstration Project	4	4	4	3	3
Dudgeon	12	12	12	11	10
East Anglia One	3	3	2	2	2
Galloper	2	2	2	2	2
Greater Gabbard	1	1	1	1	1
Hornsea Project One	1	1	1	1	1
Hornsea Project Two	4	4	4	4	4

Project	Predicted annual collision mortality rate				
Humber Gateway	2	2	2	2	1
Hywind	0	0	0	2	0
Kentish Flats Extension	0	0	0	0	0
Lincs	2	2	2	2	2
London Array	0	0	0	0	0
Moray Firth Project One (MORL)	0	0	1	1	0
Neart na Gaoithe	7	2	2	2	2
Race Bank	35	35	18	17	15
Sheringham Shoal	14	14	14	13	11
Teesside	5	5	5	0	0
Thanet	0	0	0	0	0
Triton Knoll	22	22	7	7	6
Westermost Rough	0	0	0	0	0
Tier 1 total	**116**	**111**	**78**	**67**	**60**
Tier 2					
Dogger Bank Creyke Beck A and B	25	25	25	22	20

Project	Predicted annual collision mortality rate				
Dogger Bank Teesside A and B	33	33	33	30	27
East Anglia Three	2	2	2	2	2
Inch Cape	2	2	2	2	1
Kincardine	1	1	1	1	1
Methil	0	0	0	0	0
Moray West	0	0	0	0	0
Norfolk Vanguard	5	5	5	0	4
Seagreen Alpha	6	6	6	6	5
Seagreen Bravo	5	5	5	5	4
Thanet Extension	1	1	1	0	1
Tier 2 total	**80**	**80**	**80**	**72**	**65**
Overall total	**195**	**191**	**158**	**139**	**125**

Table 1.13: Details of predicted collision rates for **kittiwake** for each project included in the in-combination assessment using the **Basic** model. Blue cells indicate those values that are affected by the respective refinement

Project	Predicted annual collision mortality rate				
	Applicant's position as presented in REP1-139	Proposed refinement of alternative analysis			
		E. Updated project designs – Neart na Gaoithe	E. Updated project designs – other projects	B. Nocturnal activity factors	A. Flight speeds
Tier 1					
Aberdeen European Offshore Wind Deployment Centre	0	0	0	0	0
Beatrice	1	1	1	0	1
Blyth Demonstration Project	0	0	0	0	0
East Anglia One	24	24	13	2	10
Galloper	3	3	3	0	3
Greater Gabbard	2	2	2	0	1
Hornsea Project One	3	3	3	2	2
Hornsea Project Two	14	14	14	13	11
Humber Gateway	3	3	4	2	2

Project	Predicted annual collision mortality rate				
Hywind	0	0	0	0	0
Kentish Flats Extension	0	0	0	0	0
Lincs	1	1	1	1	1
London Array	0	0	0	0	0
Moray Firth Project One (MORL)	1	1	1	1	1
Neart na Gaoithe	2	2	2	1	1
Race Bank	3	3	2	2	2
Teesside	2	2	2	1	1
Thanet	0	0	0	0	0
Triton Knoll	28	28	8	8	6
Westermost Rough	0	0	0	0	0
Tier 1 total	**87**	**86**	**55**	**50**	**43**
Tier 2					
Dogger Bank Creyke Beck A and B	77	77	77	70	60
Dogger Bank Teesside A and B	21	21	21	19	16
East Anglia Three	6	6	6	5	4

Project	Predicted annual collision mortality rate				
Inch Cape	17	17	17	15	13
Kincardine	1	1	1	0	0
Methil	0	0	0	0	0
Moray West	2	2	2	2	2
Norfolk Vanguard	8	8	8	8	7
Seagreen Alpha	17	17	17	16	14
Seagreen Bravo	14	14	14	13	11
Thanet Extension	1	1	1	1	1
Tier 2 total	**163**	**163**	**163**	**150**	**127**
Overall total	**250**	**249**	**218**	**200**	**170**

Table 1.14: Details of predicted collision rates for **kittiwake** for each project included in the in-combination assessment using the **Extended** model. Blue cells indicate those values that are affected by the respective refinement

Project	Predicted annual collision mortality rate				
	Applicant's position as presented in REP1-139	Proposed refinement of alternative analysis			
		E. Updated project designs – Neart na Gaoithe	E. Updated project designs – other projects	B. Nocturnal activity factors	A. Flight speeds
Tier 1					
Aberdeen European Offshore Wind Deployment Centre	0	0	0	0	0
Beatrice	0	0	0	0	0
Blyth Demonstration Project	0	0	0	0	0
East Anglia One	1	1	1	1	0
Galloper	3	3	3	2	2
Greater Gabbard	1	1	1	1	1
Hornsea Project One	1	1	1	1	0
Hornsea Project Two	2	2	2	2	1
Humber Gateway	2	2	2	2	1

Project	Predicted annual collision mortality rate				
Hywind	0	0	0	0	0
Kentish Flats Extension	0	0	0	0	0
Lincs	1	1	1	1	0
London Array	0	0	0	0	0
Moray Firth Project One (MORL)	1	1	1	1	1
Neart na Gaoithe	2	0	0	0	0
Race Bank	3	3	2	1	1
Teesside	1	1	1	1	1
Thanet	0	0	0	0	0
Triton Knoll	20	20	6	6	4
Westermost Rough	0	0	0	0	0
Tier 1 total	**38**	**37**	**22**	**20**	**14**
Tier 2					
Dogger Bank Creyke Beck A and B	23	23	23	21	15
Dogger Bank Teesside A and B	6	6	6	6	4
East Anglia Three	5	5	5	4	3

Project	Predicted annual collision mortality rate				
Inch Cape	12	12	12	11	8
Kincardine	2	2	2	2	1
Methil	0	0	0	0	0
Moray West	1	1	1	0	0
Norfolk Vanguard	6	6	6	0	0
Seagreen Alpha	8	8	8	7	5
Seagreen Bravo	5	5	5	5	3
Thanet Extension	1	1	1	0	0
Tier 2 total	**69**	**69**	**69**	**63**	**44**
Overall total	**107**	**106**	**91**	**83**	**58**

Annex C - Alternative Analysis for Ornithology

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1. Alternative analysis

Introduction

1.1 This note presents an alternative analysis applying the Applicant's understanding of Natural England's approach as submitted as part of their submissions made during the examination of Hornsea Three. This information is provided to assist the Examining Authority to understand the difference in position of Natural England and the Applicant. This information is presented without prejudice to the Applicant's position which remains as set out in the application and in subsequent submissions during the examination phase. Throughout this document the results of the alternative analysis are referred to, for convenience, as the 'alternative analysis'.

1.2 Following the presentation of the collision risk estimates and displacement analyses using the alternative analysis the Applicant has presented a comparison between the alternative analysis and the results presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) for relevant species as requested in Q2.2.9 of the Examining Authority's second questions.

Background

Displacement analysis

1.3 The approach to displacement analysis in the Hornsea Three application (Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108)) followed the guidance presented in JNCC *et al.* (2017). In addition the Applicant undertook a literature review to identify displacement and mortality rates supported by empirical evidence.

1.4 The position of Natural England as described in Natural England's written submission for Hornsea Three differs from the Applicant's approach. The differences in Natural England's position are identified in Table 1.1 alongside the methodology applied by the Applicant for the alternative analysis in this report to address each issue.

Table 1.1: Differences between the approach to displacement analysis advocated by Natural England and that applied by the Applicant

Difference	Reference	Methodology
Density data – Natural England suggest that the upper confidence limits associated with those population estimates derived for the months December to March should be incorporated in to the calculation of mean-peak populations	Paragraph 4.4 of Annex C of Natural England's Written Representation (REP1-211)	The Applicant has incorporated the population estimates associated with the upper confidence limits into the calculation of mean-peak populations (see the methodology presented in paragraph 1.8
Natural England do not agree with the seasonal extents defined for gannet or puffin	Paragraph 4.5 of Annex C of Natural England's Written Representation (REP1-211)	The Applicant has calculated mean-peak populations using the seasonal definitions advocated by Natural England

Difference	Reference	Methodology
Natural England disagree with the empirically derived displacement rates applied by the Applicant	Paragraph 4.10 of Annex C of Natural England's Written Representation (REP1-211)	In the absence of recommended rates from Natural England in their written submissions for Hornsea Three the Applicant has applied displacement and mortality rates previously used by Natural England at other offshore wind farm projects
Natural England do not agree with the apportioning approach applied for gannet or puffin	Paragraph 4.6 and Section 7 of Annex C of Natural England's Written Representation (REP1-211)	For those seasons of relevance (i.e. the breeding season) the Applicant has presented displacement mortality across a range of apportioning values as suggested by Natural England (Paragraph 7.19 of Annex C of Natural England's Written Representation (REP1-211))
Natural England consider that impacts should be apportioned to immature auks	Paragraph 4.6 of Annex C of Natural England's Written Representation (REP1-211)	For those seasons of relevance (i.e. the breeding season) the Applicant has presented displacement mortality across a range of apportioning values

Collision risk modelling

1.5 The position of Natural England in relation to collision risk modelling as described in Natural England's written submission for Hornsea Three differs from the Applicant's approach. The differences in Natural England's position are identified in Table 1.2 alongside the methodology applied by the Applicant for the alternative analysis in this report to address each issue.

Table 1.2: Differences between the approach to collision risk modelling advocated by Natural England and that applied by the Applicant

Difference	Reference	Methodology
Density data – Natural England suggest that the density data associated with the upper confidence limits for the months of December to March are used in collision risk modelling	Paragraph 3.16 of Annex C of Natural England's Written Representation (REP1-211)	The Applicant has incorporated the density values associated with upper confidence limits into collision risk modelling
Flight speed data – Natural England do not agree with the application of flight speed data from Skov *et al.* (2018)	Appendix 1 of Natural England's Written Submission for Deadline 3 (REP3-075)	The Applicant has used flight speed data from Alerstam (2007) and Pennycuick *et al.* (1987)

Difference	Reference	Methodology
Nocturnal activity factors – Natural England suggest that collision risk estimates calculated using a range of nocturnal activity factors are presented	Paragraph 3.13 of Annex C of Natural England's Written Representation (REP1-211)	The Applicant has applied the nocturnal activity factors advocated by Natural England in collision risk modelling
Band model – Natural England advocate the use of collision risk estimates calculated using Option 2 of the Band (2012) CRM	Paragraph 3.8 of Annex C of Natural England's Written Representation (REP1-211)	The Applicant has presented collision risk estimates calculated using all Band model Options
Avoidance rates – Natural England advocate the use of collision risk estimates calculated using the avoidance rates recommended in JNCC *et al.* (2014)	Paragraph 3.26 of Annex C of Natural England's Written Representation (REP1-211)	The Applicant has presented collision risk estimates calculated using a range of avoidance rates including those recommended by JNCC *et al.* (2014)
Apportioning – Natural England do not agree with the apportioning approach applied by the Applicant for gannet or kittiwake	Section 7 of Annex C of Natural England's Written Representation (REP1-211)	For those seasons of relevance (i.e. the breeding season) the Applicant has presented displacement mortality across a range of apportioning values as suggested by Natural England (Paragraph 7.19 of Annex C of Natural England's Written Representation (REP1-211))
Seasonality – Natural England do not agree with the seasonal extents defined for gannet and kittiwake	Section 7 of Annex C of Natural England's Written Representation (REP1-211)	The Applicant has calculated seasonal collision risk estimates using the seasons advocated by Natural England (Table 7.1 in Annex C of Natural England's Written Representation (REP1-211)

Displacement

Methodology

1.6 The methodology used for displacement analysis is consistent with that described in Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108) which is consistent with the guidance provided by JNCC *et al.* (2017).

1.7 Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108) identifies those species considered for displacement impacts in both Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051):

- Fulmar;
- Gannet;
- Guillemot;
- Razorbill; and
- Puffin.

1.8 The upper confidence limits associated with population estimates for December to March have been incorporated into the alternative analysis assuming that they represent the abundance of species in the four months for which surveys were not conducted. This therefore means that for December 2016 to March 2017 the mean population estimates calculated from aerial surveys are used and for December 2017 to March 2018, the upper confidence limits associated with the population estimates calculated for December 2016 to March 2017 are used. This provides a precautionary and biologically meaningful analysis as it uses known abundance estimates for December 2016 to March 2017 (as derived from aerial surveys) and assumes a precautionary population for December 2017 to March 2018.

1.9 The following species-specific sections provide the results of displacement analysis when applying the alternative analysis. This analysis uses the displacement and mortality rates advised by JNCC *et al.* (2017) and recommended and applied by Natural England as part of their assessments for other offshore wind projects. Seasonal displacement matrices are presented in Appendix A for all species with these presenting displacement rates in 10% increments (10-100%) and mortality rates in 10% increments in addition to 1, 2 and 5%.

Table 1.3: Calculation of seasonal mean-peak populations for use in the alternative analysis for relevant species

Survey year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Fulmar												
Year 1	642	91	1,146	**1,375**	0	**1,096**	262	**273**	**778**	211	69	242
Year 2	87	438	196	46	**1,470**	394	**857**	**432**	***1,002***	*378*	*123*	*462*
Mean-peak	1,423					977		352	890			
Gannet												
Year 1	**928**	240	307	799	159	180	**277**	146	**936**	22	147	113
Year 2	58	179	103	881	**1,738**	1,215	**1,691**	143	***1,366***	*50*	*319*	*209*
Mean-peak	1,333						984		1,151			
Guillemot												
Year 1	5,120	5,838	**15,017**	14,657	10,096	12,312	5,492	14,228	**16,655**	926	3,315	7,630
Year 2	5,633	7,652	1,281	**11,731**	13,531	15,981	17,517	18,888	***21,692***	*1,629*	*4,265*	*10,119*
Mean-peak	13,374				19,174							
Razorbill												
Year 1	563	336	**678**	281	0	54	**466**	**4,382**	3,080	237	677	**1,442**
Year 2	**582**	198	93	383	276	185	**3,575**	2,916	***5,665***	*536*	*1,155*	***2,066***
Mean-peak	630				2,020			5,024		1,754		
Puffin												

Survey year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Year 1	214	**288**	14	14	0	13	0	0	13	0	0	**52**
Year 2	0	**219**	0	38	0	39	40	26	*35*	*0*	*0*	***102***
Mean-peak	253				77							
Breeding season			Post-breeding season		Non-breeding season				Pre-breeding season			

Species accounts

Fulmar

Mean-peak populations

1.10 The seasonal mean-peak populations for the alternative analysis for fulmar calculated in Table 1.3 are presented alongside the seasonal mean-peak populations used to inform the assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) in Table 1.4.

Table 1.4: Seasonal mean-peak populations for fulmar

Approach to seasonality and data used	Season			
	Breeding	Post-breeding	Non-breeding	Pre-breeding
Application	1,423	977	352	525
Alternative analysis	1,423	977	352	890

1.11 The seasonal mean-peak populations are identical in all seasons defined for fulmar with the exception of the pre-breeding season with this difference occurring due to the use of population estimates associated with the upper confidence limit.

Displacement mortality

1.12 Natural England have not provided any guidance in relation to the displacement and mortality rates to use for fulmar in their examination submissions that can be used to inform the alternative analysis. Guidance in relation to displacement provided by JNCC *et al.* (2017) suggests that for species with a disturbance sensitivity of 1 in Bradbury *et al.* (2014) may not be displaced or hardly displaced. However, if assessment of these species is recommended a displacement rate of 10% or less would be assumed. No modification was provided to this score in Wade *et al.* (2016) and therefore a displacement rate of 10% has been applied in the alternative analysis. A mortality rate range of 1-10% is applied for fulmar in the alternative analysis. For the assessments presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) the Applicant undertook a literature review to identify evidence based displacement and mortality rates. Based on this review the Applicant applied a displacement rate range of 10-30% and a mortality rate of 2% in the breeding season and 1% in all other seasons.

1.13 The seasonal displacement mortalities for fulmar calculated using the mean-peak populations presented in Table 1.4 are presented in Table 1.5 using the respective displacement and mortality rates assumed for the alternative analysis and applied by the Applicant in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051). Seasonal displacement matrices for fulmar using the density and seasonality approach applied in the alternative analysis are presented in Table 1.32 to Table 1.35 of Appendix A. Displacement matrices for the Applicant's approach to density and seasonality are presented in Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108).

Table 1.5: Displacement mortality for fulmar using the alternative analysis and as presented in APP-065

Season	Density data and seasonality approach	
	Alternative analysis	Applicant
Breeding	1-14	3-9
Post-breeding	1-10	1-3
Non-breeding	0-4	0-1
Pre-breeding	1-9	1-2

Apportioning

1.14 Apportioning of displacement mortality to FFC SPA, the Farne Islands SPA, Coquet Island and the Forth Islands SPA is presented in Table 1.6 using the approach to density data and seasonality applied in the alternative analysis and applied by the Applicant in the RIAA (APP-065). In the post-breeding and pre-breeding season, the appropriate apportioning value for each SPA has been obtained using the data presented in Furness (2015). In the breeding season the apportioning value has been calculated based on the contribution of each SPA to the total population of breeding birds that may interact with Hornsea Three based on the foraging range of fulmar from Thaxter *et al.* (2012). The respective apportioning values are also presented in Table 1.6.

Table 1.6: Apportioned displacement mortality for fulmar

SPA	Season	Apportioning value (%)	Density data	
			Alternative analysis	Applicant
FFC	Breeding	21.3	0-3	1-2
	Post-breeding	0.18	0	0
	Non-breeding	0.22	0	0
	Pre-breeding	0.18	0	0
Coquet Island	Breeding	0.72	0	0
	Post-breeding	0.009	0	0
	Non-breeding	0.01	0	0
	Pre-breeding	0.009	0	0
Farne Islands	Breeding	4.15	0-1	0
	Post-breeding	0.05	0	0
	Non-breeding	0.06	0	0
	Pre-breeding	0.05	0	0
Forth Islands	Breeding	11.5	0-2	0-1

SPA	Season	Apportioning value (%)	Density data	
	Post-breeding	0.17	0	0
	Non-breeding	0.20	0	0
	Pre-breeding	0.17	0	0

Conclusion

1.15 There is considered to be no difference in assessment terms between the displacement mortality calculated using the alternative analysis and the approach applied by the Applicant in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051).

Gannet

Mean-peak populations

1.16 The seasonal mean-peak populations for the alternative analysis for gannet calculated in Table 1.3 are presented alongside the seasonal mean-peak populations used to inform the assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) in Table 1.7.

Table 1.7: Seasonal mean-peak populations for gannet

Approach to seasonality and data used	Season		
	Breeding	Post-breeding	Pre-breeding
Application	1,333	984	406
Alternative analysis	1,333	984	1,151

1.17 Differences between the seasonal mean-peak populations calculated for gannet (Table 1.7) only occur in the pre-breeding season with this difference occurring due to the use of population estimates associated with upper confidence limits.

Displacement mortality

1.18 Natural England have not provided any guidance in relation to the displacement and mortality rates to use for gannet that can be used to inform the alternative analysis in their examination submissions for Hornsea Three. Guidance in relation to displacement provided by JNCC *et al.* (2017) suggests that for species with a disturbance sensitivity of 3 in Bradbury *et al.* (2014) the SNCBs would advise a displacement rate range of 30-70%. Gannet is assigned a disturbance susceptibility of 2 in Bradbury *et al.* (2014) and therefore a rate of 30-70% would be precautionary. Further modification to the disturbance susceptibility scores presented in Bradbury *et al.* (2014) was provided by Wade *et al.* (2016) with gannet assigned a 4 in this report. No guidance is provided in JNCC *et al.* (2017) on the displacement rates to use for species assigned a disturbance susceptibility level of 4 however, in previous assessments, Natural England have recommended and applied a displacement rate range of 30-70% (Natural England, 2015a) and therefore this is used here in the alternative analysis. Natural England have previously recommended and applied a mortality rate range of 1-10% (Natural England, 2015a) for gannet and this range is used here in the alternative analysis.

1.19 For the assessments presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) the Applicant undertook a literature review to identify evidence based displacement and mortality rates. Based on this review the Applicant applied a displacement rate range of 30-70% and a mortality rate of 2% in the breeding season and 1% in all other seasons.

1.20 The seasonal displacement mortalities for gannet calculated using the mean-peak populations presented in Table 1.7 are presented in Table 1.8 using the respective displacement and mortality rates previously applied in the alternative analysis and applied by the Applicant in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051). Seasonal displacement matrices for gannet using the density and seasonality approach applied in the alternative analysis are presented in Table 1.36 to Table 1.38 of Appendix A. Displacement matrices for the Applicant's approach to density and seasonality are presented in Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108).

Table 1.8: Displacement mortality for gannet using the alternative analysis and as presented in APP-065

Season	Density data and seasonality approach	
	Alternative analysis	Applicant
Breeding	4-93	8-19
Post-breeding	3-69	3-7
Pre-breeding	3-81	1-3

Apportioning

1.21 Apportioning of displacement mortality to FFC SPA is presented in Table 1.9 using the approach to density data and seasonality applied in the alternative analysis. For the post-breeding and pre-breeding season, the appropriate apportioning value has been obtained using the data presented in Furness (2015). In the breeding season, a range of apportioning values have been applied following Natural England's proposed approach, albeit for kittiwake and puffin, in their Written Representations (REP1-211). Natural England have indicated that their preference is that age class data should be used to identify adult type birds and this used to inform a range of adult apportioning values. The apportioning values applied for gannet are therefore:

- Breeding season = 0-72.8% including:
    - 40.4% - Applicant's approach (see APP-054);
    - 72.8% - the proportion of adult birds from aerial survey data using the Applicant's seasonal approach;
    - 46.5% - the proportion of adult birds from boat-based survey data using the alternative analysis seasonal approach; and
    - 63.3% - the proportion of adult birds from aerial survey data using the alternative analysis seasonal approach.
- Post-breeding season = 4.8%; and
- Pre-breeding season = 6.2%.

Table 1.9: Seasonal apportioning of displacement mortality for gannet at FFC SPA as calculated using the alternative analysis

Season	Displacement rate (%)	Mortality rate (%)	Apportioning rate (%)								
			4.8	6.2	10	20	30	40.4	46.5	63.3	72.8
Breeding	70	10			9	19	28	38	43	59	68
	30	1			0	1	1	2	2	3	3
Post-breeding	70	10	3								
	30	1	0								
Pre-breeding	70	10		5							
	30	1		0							

Comparison with the Applicant's approach

1.22 The impacts predicted by the Applicant in the RIAA (APP-051) are presented in Table 1.10 alongside those presented using the alternative analysis (i.e. Table 1.9). The Applicant derived an apportioning rate of 40.4% in the breeding season based on age class data collected at Hornsea Three in addition to scientific evidence which suggests that this apportioning rate is appropriate (see APP-054).

Table 1.10: Displacement mortality for gannet at FFC SPA as predicted in the Hornsea Three RIAA (APP-051)

Season	Apportioning rate (%)	Displacement mortality (no. of birds) as presented in the RIAA	Displacement mortality using the alternative analysis
Breeding	40.4	3-8	0-68
Post-breeding	4.8	0	0-3
Pre-breeding	6.2	0	0-5

Conclusion

1.23 When comparing the displacement mortality associated with the EIA assessment (Table 1.8) there appears to be a difference between the alternative analysis and the values used to inform assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065). However, the upper end of the impact range calculated using the alternative analysis is based on very conservative assumptions. In addition, the populations against which EIA impacts are assessed is large and therefore, in assessment terms, it is considered that there would be no difference in terms of the assessment conclusions reached.

1.24 There is also considered to be no difference in assessment terms between the apportioned displacement mortality predicted using the alternative analysis and those calculated by the Applicant in the RIAA (APP-051) (Table 1.10) with the upper end of the impact range calculated using the alternative analysis also considered to be based on very conservative assumptions including displacement and mortality rates and apportioning values.

Guillemot

Mean-peak populations

The seasonal mean-peak populations for the alternative analysis for guillemot calculated in Table 1.3 are presented alongside the seasonal mean-peak populations used to inform the assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) in

1.25 Table 1.11.

Table 1.11: Seasonal mean-peak populations for guillemot

Approach to seasonality and data used	Season	
	Breeding	Non-breeding
Application	13,374	17,772
Alternative analysis	13,374	19,174

1.26 The breeding season mean-peak population calculated for guillemot is identical for both approaches. The mean-peak populations in the non-breeding season are different due to the use of population estimates associated with upper confidence limits.

Displacement mortality

1.27 Natural England have not provided any guidance in relation to the displacement and mortality rates to use for guillemot that can be used to inform the alternative analysis in their examination submissions for Hornsea Three. Guidance in relation to displacement provided by JNCC *et al.* (2017) suggests that for species with a disturbance sensitivity of 3 in Bradbury *et al.* (2014) the SNCBs would advise a displacement rate range of 30-70%. Guillemot is assigned a disturbance susceptibility of 3 in Bradbury *et al.* (2014) and therefore a rate of 30-70% would be precautionary. No modification was provided to this score in Wade *et al.* (2016). This displacement rate range is consistent with the rates recommended and applied previously by Natural England and it is therefore used in the alternative analysis (Natural England, 2015b). Natural England have previously recommended and applied a mortality rate range of 1-10% (Natural England, 2015b) for guillemot and this range is used in the alternative analysis.

1.28 For the assessments presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) the Applicant undertook a literature review to identify evidence based displacement and mortality rates. Based on this review the Applicant applied a displacement rate of 50% and a mortality rate range of 2-10% in the breeding season and 1% in the non-breeding season.

The seasonal displacement mortalities for guillemot calculated using the mean-peak populations presented in

Table 1.11 are presented in

1.29 Table 1.12 using the respective displacement and mortality rates applied in the alternative analysis and applied by the Applicant in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051). Seasonal displacement matrices for guillemot using the density and seasonality approach applied in the alternative analysis are presented in Table 1.39 and Table 1.40 of Appendix A. Displacement matrices for the Applicant's approach to density and seasonality are presented in Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108).

Table 1.12: Displacement mortality for guillemot using the alternative analysis and as presented in APP-065

Season	Density data and seasonality approach	
	Alternative analysis	Applicant
Breeding	40-936	134-669
Non-breeding	58-1,342	89

Apportioning

1.30 Apportioning of displacement mortality to FFC SPA is presented in Table 1.13 using the approach to density data and seasonality applied in the alternative analysis. For the non-breeding season, the appropriate apportioning value has been obtained using the data presented in Furness (2015). In the breeding season there is considered to be no connectivity between breeding adult birds from FFC SPA and Hornsea Three (see APP-054). However, there is potential for immature birds that may recruit to FFC SPA to be present at Hornsea Three. Due to the uncertainty associated with the apportioning of immature birds to individual breeding colonies, a range of apportioning values are presented in Table 1.13. Natural England have provided no guidance as to where in this range they would base their assessment. The apportioning values applied for guillemot are therefore:

- Breeding season (immatures only) = 0-100%; and
- Non-breeding season = 4.4%.

Table 1.13: Seasonal apportioning of displacement mortality for guillemot at FFC SPA as calculated using the alternative analysis

Season	Displacement rate (%)	Mortality rate (%)	Apportioning rate (%)										
			4.4	10	20	30	40	50	60	70	80	90	100
Breeding (immature birds)	70	10		94	187	281	374	468	562	655	749	843	936
	30	1		4	8	12	16	20	24	28	32	36	40
Non-breeding	70	10	59										
	30	1	3										

Comparison with the Applicant's approach

1.31 The impacts predicted by the Applicant in the RIAA (APP-051) are presented in Table 1.14 alongside those presented using the alternative analysis (i.e. Table 1.13). Using equivalent displacement and mortality rates there is considered to be no difference in assessment terms between the apportioned displacement mortality predicted using the alternative analysis and the mortality presented in the RIAA (Table 1.14).

Table 1.14: Displacement mortality for guillemot at FFC SPA as predicted in the Hornsea Three RIAA (APP-051)

Season	Apportioning rate (%)	Displacement mortality (no. of birds) as presented in the RIAA	Displacement mortality using the alternative analysis
Breeding (adult birds)	-	0	0
Breeding (immature birds)	-	Not quantified	Unknown
Non-breeding	4.4	4	3-59

Conclusion

When comparing the displacement mortality associated with the EIA assessment (

1.32 Table 1.12) there appears to be a difference between the Applicant's approach and the alternative analysis. However, the upper end of the impact range calculated using the alternative analysis is based on very conservative assumptions. In addition, the populations against which these impacts are assessed is large and therefore, in assessment terms, it is considered that there would be no difference in terms of the assessment conclusions reached.

1.33 In terms of the RIAA assessment it is not known what apportioning value Natural England would apply for impacts on immature birds however, there is considered to be no difference in assessment terms between the impacts predicted in the breeding season for adult birds and in the non-breeding season with the upper end of the impact range using the alternative analysis again considered to be based on very conservative assumptions.

Razorbill

Mean-peak populations

The seasonal mean-peak populations for the alternative analysis for razorbill calculated in Table 1.3 are presented alongside the seasonal mean-peak populations used to inform the assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) in

1.34 Table 1.15.

Table 1.15: Seasonal mean-peak populations for razorbill

Approach to seasonality and data used	Season			
	Breeding	Post-breeding	Non-breeding	Pre-breeding
Application	630	2,020	3,649	1,236
Alternative analysis	630	2,020	5,024	1,754

1.35 The breeding and post-breeding season mean-peak populations calculated for razorbill are identical for both approaches. Those in the non-breeding and pre-breeding seasons are different due to the use of population estimates associated with upper confidence limits.

Displacement mortality

1.36 Natural England have not provided any guidance in relation to the displacement and mortality rates to use for razorbill that can be used to inform the alternative analysis in their examination submissions for Hornsea Three. Guidance in relation to displacement provided by JNCC *et al.* (2017) suggests that for species with a disturbance sensitivity of 3 in Bradbury *et al.* (2014) the SNCBs would advise a displacement rate range of 30-70%. Razorbill is assigned a disturbance susceptibility of 3 in Bradbury *et al.* (2014) and therefore a rate of 30-70% would be precautionary. No modification was provided to this score in Wade *et al.* (2016). This displacement rate range is consistent with the rates recommended and applied previously by Natural England (Natural England, 2015c) and it is therefore used for the alternative analysis. Natural England have previously recommended and applied a mortality rate range of 1-10% (Natural England, 2015c) for razorbill and this range is used for the alternative analysis.

1.37 For the assessments presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) the Applicant undertook a literature review to identify evidence based displacement and mortality rates. Based on this review the Applicant applied a displacement rate of 40% and a mortality rate range of 2-10% in the breeding season, 2% in the post- and pre-breeding seasons and 1% in the non-breeding season.

The seasonal displacement mortalities for razorbill calculated using the mean-peak populations presented in

Table 1.15 are presented in

1.38 Table 1.16 using the respective displacement and mortality rates applied in the alternative analysis and applied by the Applicant in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051). Seasonal displacement matrices for razorbill using the density and seasonality approach applied in the alternative analysis are presented in Table 1.41 to Table 1.44 of Appendix A. Displacement matrices for the Applicant's approach to density and seasonality are presented in Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108).

Table 1.16: Displacement mortality for razorbill using the alternative analysis and as presented in APP-065

Season	Density data and seasonality approach	
	Alternative analysis	Applicant
Breeding	2-44	5-25
Post-breeding	6-141	16
Non-breeding	15-352	15
Pre-breeding	5-123	10

Apportioning

1.39 Apportioning of displacement mortality to FFC SPA is presented in Table 1.17 using the approach to density data and seasonality applied in the alternative analysis. For the post, non- and pre-breeding seasons, the appropriate apportioning values have been obtained using the data presented in Furness (2015). In the breeding season there is considered to be no connectivity between breeding adult birds from FFC SPA and Hornsea Three (see APP-054). However, there is potential for immature birds that may recruit to FFC SPA to be present at Hornsea Three. Due to the uncertainty associated with the apportioning of immature birds to individual breeding colonies, a range of apportioning values are presented in Table 1.17. Natural England have provided no guidance as to where in this range they would base their assessment. The apportioning values applied for razorbill are therefore:

- Breeding season (immatures only) = 0-100%;
- Post-breeding season = 3.4%
- Non-breeding season = 2.7%; and
- Pre-breeding season = 3.4%

Table 1.17: Seasonal apportioning of displacement mortality for razorbill at FFC SPA as calculated using the alternative analysis

Season	Displacement rate (%)	Mortality rate (%)	Apportioning rate (%)											
			2.7	3.4	10	20	30	40	50	60	70	80	90	100
Breeding (immature birds only)	70	10			4	9	13	18	22	26	31	35	40	44
	30	1			0	0	1	1	1	1	1	2	2	2
Post-breeding	70	10		5										
	30	1		0										
Non-breeding	70	10	10											
	30	1	0											
Pre-breeding	70	10		4										
	30	1		0										

Comparison with the Applicant's approach

1.40 The impacts predicted by the Applicant in the RIAA (APP-051) are presented in Table 1.18 alongside those presented using the alternative analysis (i.e. Table 1.17). Using equivalent displacement and mortality rates there is considered to be no difference in assessment terms between the apportioned displacement mortality predicted using the alternative analysis and the mortality presented in the RIAA (Table 1.18).

Table 1.18: Displacement mortality for razorbill at FFC SPA as predicted in the Hornsea Three RIAA (APP-051)

Season	Apportioning rate (%)	Displacement mortality (no. of birds) as presented in the RIAA	Displacement mortality using the alternative analysis
Breeding (adult birds)	-	0	0
Breeding (immature birds)	-	Not quantified	Unknown
Post-breeding	3.4	1	0-5
Non-breeding	2.7	0	0-10
Pre-breeding	3.4	0	0-4

Conclusion

When comparing the displacement mortality associated with the EIA assessment (

1.41 Table 1.16) there appears to be a difference between the Applicant's position and the alternative analysis. However, the upper end of the impact range using the alternative analysis is based on very conservative assumptions. In addition, the populations against which these impacts are assessed is large and therefore, in assessment terms, it is considered that there would be no difference in terms of the assessment conclusions reached.

1.42 In terms of the RIAA assessment it is not known what apportioning value Natural England would apply for impacts on immature birds however, there is considered to be no difference in assessment terms between the impacts predicted in the breeding season for adult birds and in the non-breeding season with the upper end of the impact range using the alternative analysis again considered to be based on very conservative assumptions.

Puffin

Mean-peak populations

1.43 The seasonal mean-peak populations for the alternative analysis for puffin calculated in Table 1.3 are presented alongside the seasonal mean-peak populations used to inform the assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) in Table 1.19.

Table 1.19: Seasonal mean-peak populations for puffin

Approach to seasonality and data used	Season	
	Breeding	Non-breeding
Application	253	127
Alternative analysis	253	77

1.44 The breeding season mean-peak population calculated for puffin is identical for both approaches. In the non-breeding season the population differs due to the difference in seasonal approaches with the peak non-breeding population in the Applicant's approach occurring in a breeding month when the alternative analysis approach to seasonality is applied.

Displacement mortality

1.45 Natural England have not provided any guidance in relation to the displacement and mortality rates to use for puffin that can be used to inform the alternative analysis in their examination submissions for Hornsea Three. Guidance in relation to displacement provided by JNCC *et al.* (2017) suggests that for auk species the SNCBs would typically advise a displacement rate range of 30-70%. This range has been applied in the alternative analysis and is consistent with the rates recommended and applied previously by Natural England (Natural England, 2015d). Natural England have previously recommended and applied a mortality rate range of 1-10% (Natural England, 2015d) for puffin and this range is used for the alternative analysis.

1.46 For the assessments presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051) the Applicant undertook a literature review to identify evidence based displacement and mortality rates. Based on this review the Applicant applied a displacement rate of 50% and a mortality rate range of 2-10% in the breeding season and 1% in the non-breeding season.

1.47 The seasonal displacement mortalities for puffin calculated using the mean-peak populations presented in Table 1.19 are presented in Table 1.20 using the respective displacement and mortality rates previously applied in the alternative analysis and applied by the Applicant in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051). Seasonal displacement matrices for puffin using the density and seasonality approach applied in the alternative analysis are presented in Table 1.45 and Table 1.46 of Appendix A. Displacement matrices for the Applicant's approach to density and seasonality are presented in Volume 5, Annex 5.2: Analysis of Displacement Impacts on Seabirds (APP-108).

Table 1.20: Displacement mortality for puffin using the alternative analysis and as presented in APP-065

Season	Density data and seasonality approach	
	Alternative analysis	Applicant
Breeding	1-18	3-13
Non-breeding	0-5	1

Apportioning

1.48 Apportioning of displacement mortality to FFC SPA is presented in Table 1.21 using the approach to density data and seasonality applied in the alternative analysis. For the non-breeding seasons, the appropriate apportioning value has been obtained using the data presented in Furness (2015). In the breeding season a range of apportioning values

1.49 In the breeding season it is considered highly unlikely that breeding adult birds from FFC SPA will be present at Hornsea Three (see APP-054). However, there is potential for immature birds that may recruit to FFC SPA to be present at Hornsea Three. Due to the uncertainty associated with the apportioning of immature birds to individual breeding colonies, a range of apportioning values are presented in Table 1.21. In the breeding season a range of apportioning values have been applied following Natural England's proposed approach in their Written Representations (REP1-211). Natural England have provided no guidance as to where in this range they would base their assessment. The apportioning values applied for puffin are therefore:

- Breeding season = 0-100%;
- Post-breeding season = 0.4%

Table 1.21: Seasonal apportioning of displacement mortality for puffin at FFC SPA as calculated using the alternative analysis

Season	Displacement rate (%)	Mortality rate (%)	Apportioning rate (%)										
			0.4	10	20	30	40	50	60	70	80	90	100
Breeding	70	10		2	4	5	7	9	11	12	14	16	18
	30	1		0	0	0	0	0	0	1	1	1	1
Non-breeding	70	10	0										
	30	1	0										

Comparison with the Applicant's approach

1.50 The impacts predicted by the Applicant in the RIAA (APP-051) are presented in Table 1.22 alongside those presented using the alternative analysis (i.e. Table 1.21). Using equivalent displacement and mortality rates there is considered to be no difference in assessment terms between the apportioned displacement mortality predicted using the approach presented above (i.e. the use of aerial survey data only) and the mortality presented in Table 1.23.

Table 1.22: Displacement mortality for puffin at FFC SPA as predicted in the Hornsea Three RIAA (APP-051)

Season	Apportioning rate (%)	Displacement mortality (no. of birds) as presented in the RIAA	Displacement mortality using the alternative analysis
Breeding (adult birds)	0	0	Unknown
Breeding (immature birds)	-	Not quantified	Unknown
Non-breeding	0.4	0	0

Conclusion

1.51 There is considered to be no difference in assessment terms between the displacement mortality calculated using the alternative analysis and the approach applied by the Applicant in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051).

Collision risk modelling

Overview

1.52 This section provides collision risk estimates calculated using the approach to collision risk modelling applied as part of the alternative analysis (see Table 1.2 for an overview). Also provided is a comparison between these alternative collision risk estimates and those presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and, for relevant species, the RIAA (APP-051). The methodology used to obtain the collision risk estimates presented in Volume 2, Chapter 5: Offshore Ornithology (APP-065) and, for relevant species, the RIAA (APP-051) is presented in Volume 5, Annex 5.3: Collision Risk Modelling (APP-109).

Methodology for collision risk modelling using the alternative analysis

1.53 The underlying methodology used for collision risk modelling (i.e. the use of the Band (2012) CRM) is consistent with that described in Volume 5, Annex 5.3: Collision Risk Modelling (APP-109).

1.54 Volume 5, Annex 5.3: Collision Risk Modelling (APP-109) identifies those species considered for displacement impacts in both Volume 2, Chapter 5: Offshore Ornithology (APP-065) and the RIAA (APP-051):

- Gannet;
- Kittiwake;
- Lesser black-backed gull; and
- Great black-backed gull.

1.55 Following a request from the RSPB the Applicant also undertook collision risk modelling for herring gull (REP1-189) and this species is also included here.

1.56 The species parameters used for collision risk modelling, following the alternative analysis are presented in Table 1.23.

Table 1.23: Seabird parameters used for collision risk modelling using the alternative analysis.

Parameter	Source	Gannet	Kittiwake	Lesser black-backed gull	Herring gull	Great black-backed gull
Bird length (m)	Robinson (2017)	0.94	0.39	0.58	0.60	0.71
Wingspan (m)	Robinson (2017)	1.72	1.08	1.42	1.44	1.58
Flight speed (m/s)	Pennycuick (1987) or Alerstam (2007)	14.9	13.1	13.1	12.8	13.7
Nocturnal activity factor	Natural England's Written Representation (REP1-211)	1-2	2-3	2-3	2-3	2-3
Flight type	N/A	Flapping	Flapping	Flapping	Flapping	Flapping
Proportion of flights upwind	N/A	50	50	50	50	50
Avoidance rate (Basic model) (%)	Cook *et al.* (2014) JNCC *et al.* (2014)	98.9 (±0.2)	98.9 (±0.2) 99.2 (±0.2)	99.5 (±0.1)	99.5 (±0.1)	99.5 (±0.1)
Avoidance rate (Extended model) (%)	Cook *et al.* (2014)	98.0	98.0	98.9 (±0.2)	99.0 (±0.2)	98.9 (±0.2)

1.57 The species accounts for each species presented below present collision risk estimates using the following density data scenarios:

- Mean estimate;
- Upper confidence limit;
- Lower confidence limits; and
- Mean estimate (April to November) and upper confidence limit (December to March) (termed mean estimate + UCL).

1.58 The mean estimate and upper confidence limit density scenario (mean estimate + UCL) follows the methodology proposed by Natural England (i.e. to use the upper confidence limits for those months for which only one survey was undertaken). For the months April to November the mean estimate from the two surveys conducted in these months is used. For the months December to March the density associated with the upper confidence limit calculated from the survey data collected in these months is applied. The mean values for the months April to November are calculated by averaging the density data for each of the respective surveys undertaken in those months. Monthly confidence limits are calculated following the approach described in Volume 5, Annex 5.4: Data Hierarchy Report (APP-110).

Table 1.24: Density data used for collision risk modelling

Species	Metric	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Gannet	LCL	0.05	0.00	0.02	0.16	0.20	0.10	0.31	0.07	0.34	0.00	0	0.03
	Mean	0.09	0.02	0.05	0.25	0.34	0.16	0.43	0.12	0.59	0.02	0	0.08
	Mean+UCL	0.09	0.02	0.05	0.25	0.34	0.16	0.43	0.12	0.86	0.04	0	0.14
	UCL	0.13	0.03	0.09	0.34	0.49	0.22	0.54	0.16	0.86	0.04	0	0.14
Kittiwake	LCL	0.95	0.76	0.22	1.15	0.45	0.69	0.23	0.41	1.15	0.27	0.06	0.69
	Mean	1.47	1.15	0.34	1.91	0.60	1.17	0.31	0.51	1.95	0.47	0.18	1.34
	Mean+UCL	1.47	1.15	0.34	1.91	0.60	1.17	0.31	0.51	2.98	0.69	0.37	2.30
	UCL	2.00	1.54	0.45	2.66	0.75	1.65	0.39	0.60	2.98	0.69	0.37	2.30
Lesser black-backed gull	LCL	0.00	0.00	0.09	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.02	0.01	0.21	0.14	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean+UCL	0.02	0.01	0.21	0.14	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	UCL	0.04	0.02	0.34	0.24	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Herring gull	LCL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	Mean	0.00	0.00	0.01	0.01	0.00	0.06	0.00	0.00	0.1	0.00	0.04	0.00
	Mean+UCL	0.00	0.00	0.01	0.01	0.00	0.06	0.00	0.00	0.18	0.00	0.08	0.00
	UCL	0.00	0.00	0.04	0.03	0.00	0.12	0.00	0.00	0.18	0.00	0.08	0.00
Great black-	LCL	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.11	0.27	0.03	0.00	0.00
	Mean	0.01	0.00	0.02	0.25	0.02	0.09	0.08	0.15	0.46	0.13	0.04	0.03

Species	Metric	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
backed gull	Mean+UCL	0.01	0.00	0.02	0.25	0.02	0.09	0.08	0.15	0.69	0.26	0.08	0.07
	UCL	0.02	0.00	0.04	0.49	0.04	0.18	0.12	0.20	0.69	0.26	0.08	0.07

1.59 As shown in Table 1.24: Density data used for collision risk modelling

1.60 there is no difference between the densities presented for the mean-estimate scenario and the mean estimate + UCL scenario for lesser black-backed gull due to no lesser black-backed gulls being recorded in aerial surveys between September and March. As such, only a mean estimate scenario is presented.

1.61 The methodology applied for collision risk modelling withstanding those aspects of the methodology identified are consistent with that presented in Volume 5, Annex 5.3: Collision Risk Modelling (APP-109). This includes the turbine parameters used for Hornsea Three.

Species accounts

Gannet

Annual collision risk estimates

1.62 Annual collision risk estimates for gannet utilising all Band model Options and appropriate avoidance rates are presented in Table 1.25 with these calculated using the alternative analysis. Collision risk estimates incorporating the uncertainty associated with density data, flight height data and avoidance rates are presented in Appendix B. Also presented in Table 1.25 are those collision risk estimates used to inform assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065).

Table 1.25: Annual collision risk estimates for gannet incorporating variability around density data

Band model Option (avoidance rate)	Nocturnal activity factor	Applicant's position	Alternative analysis	
		As at application (APP-065)	Mean estimate	Mean estimate + UCL (Dec to Mar)
Option 1 (98.9%)	1	17	17	20
	2	N/A	22	25
Option 2 (98.9%)	1	37	38	43
	2	N/A	49	56
Option 3 (98%)	1	15	16	18
	2	N/A	20	23

Apportioning

1.63 Apportioning of collision risk estimates to FFC SPA calculated using the alternative analysis is presented in Table 1.26 alongside those apportioned collision risk estimates used to inform assessments presented in the RIAA (APP-051). For the post-breeding and pre-breeding season, the appropriate apportioning value has been obtained using the data presented in Furness (2015). In the breeding season a range of apportioning values have been applied following Natural England's proposed approach, albeit for kittiwake and puffin, in their Written Representations (REP1-211). Natural England have indicated that their preference is that age class data should be used to identify adult type birds and this used to inform a range of adult apportioning values. The apportioning values applied for gannet are therefore:

- Breeding season = 0-72.8% including:
    - 40.4% - Applicant's approach (see APP-054);
    - 72.8% - the proportion of adult birds from aerial survey data using the Applicant's seasonal approach;
    - 46.5% - the proportion of adult birds from boat-based survey data using the alternative analysis seasonal approach; and
    - 63.3% - the proportion of adult birds from aerial survey data using the alternative analysis seasonal approach.
- Post-breeding season = 4.8%; and
- Pre-breeding season = 6.2%.

Table 1.26: Apportioned collision risk estimates for gannet at FFC SPA applying the alternative analysis

Band model Option	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)									Total
			Post-breeding	Pre-breeding	Breeding							
			4.8	6.2	10	20	30	40.4	46.5	63.3	72.8	
Option 1	1	Application	0	0	-	-	-	3	-	-	-	4
		Mean	0	0	1	2	3	4	5	6	7	1-8
		Mean+UCL	0	0	1	2	3	4	5	7	8	2-8
	2	Mean	0	0	1	2	4	5	6	7	9	2-9
		Mean+UCL	0	0	1	2	4	5	6	8	9	2-10
Option 2	1	Application	1	0	-	-	-	7	-	-	-	8
		Mean	0	0	2	4	7	9	10	14	16	3-17
		Mean+UCL	0	1	2	5	7	10	11	15	17	3-18
	2	Mean	1	1	3	5	8	10	12	16	19	4-20
		Mean+UCL	1	1	3	5	8	11	13	17	20	4-22
Option 3	1	Application	0	0	-	-	-	3	-	-	-	3
		Mean	0	0	1	2	3	4	4	6	7	1-7
		Mean+UCL	0	0	1	2	3	4	5	6	7	1-8
	2	Mean	0	0	1	2	3	4	5	7	8	2-8
		Mean+UCL	0	0	1	2	3	5	5	7	8	2-9

Conclusion

1.64 When applying consistent nocturnal activity factors and model Options, the differences between the collision risk estimates presented in Table 1.25 and Table 1.26 are not considered to be different in assessment terms, with the exception of Option 2. However, it is considered that Option 2 does not provide representative collision risk estimates in relation to the flight behaviour of birds at Hornsea Three either when applying the Applicant's approach or the alternative analysis.

Kittiwake

Annual collision risk estimates

1.65 Annual collision risk estimates for kittiwake utilising all Band model Options and appropriate avoidance rates are presented in Table 1.27. Collision risk estimates incorporating the uncertainty associated with density data, flight height data and avoidance rates are presented in Appendix B.

Table 1.27: Annual collision risk estimates for kittiwake incorporating variability around density data

Band model Option (avoidance rate)	Nocturnal activity factor	Applicant's position	Alternative analysis	
		As at application (APP-065)	Mean estimate	Mean estimate + UCL (Dec to Mar)
Option 1 (98.9%)	2	45	48	56
	3	N/A	57	68
Option 1 (99.2%)	2	33	35	41
	3	N/A	41	49
Option 2 (98.9%)	2	238	251	296
	3	N/A	297	355
Option 2 (99.2%)	2	173	182	215
	3	N/A	216	258
Option 3 (98%)	2	83	87	103
	3	N/A	103	124

Apportioning

1.66 Apportioning of collision mortality to FFC SPA using the alternative analysis is presented in Table 1.28 alongside those apportioned collision risk estimates used to inform assessments presented in the RIAA (APP-051). For the post-breeding and pre-breeding season, the appropriate apportioning value has been obtained using the data presented in Furness (2015). In the breeding season a range of apportioning values have been applied following Natural England's proposed approach in their Written Representations (REP1-211). Natural England have indicated that their preference is that age class data should be used to identify adult type birds and this used to inform a range of adult apportioning values. The apportioning values applied for kittiwake are therefore:

- Breeding season = 0-95.3% incorporating:
    - 41.7% - the proportion of adult birds from boat-based survey data using the age structure approach and the Applicant's approach to seasonality (i.e. the Applicant's apportioning value (see APP-054));
    - 37.4% - the proportion of adult birds from boat-based survey data using the age structure approach and the alternative analysis approach to seasonality;
    - 77.5% - the proportion of adult birds from boat-based survey data using the Applicant's approach to seasonality;
    - 75.8% - the proportion of adult birds from boat-based survey data using the alternative analysis approach to seasonality;
    - 87.9% - proportion of adult birds from aerial survey data applying the age structure apportioning approach and the Applicant's approach to seasonality;
    - 82.2% - proportion of adult birds from aerial survey data applying the age structure apportioning approach and the alternative analysis approach to seasonality;
    - 95.3% - the proportion of adult birds from aerial survey data using the Applicant's approach to seasonality; and
    - 93.1% - the proportion of adult birds from aerial survey data using the alternative analysis approach to seasonality.
- Post-breeding season = 5.4%; and
- Pre-breeding season = 7.2%.

Table 1.28: Apportioned collision risk estimates for kittiwake at FFC SPA

Band model Option (avoidance rate)	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)												Total
			Post-breeding	Pre-breeding	Breeding										
			5.4	7.2	10	20	37.4	41.7	75.8	77.5	82.2	87.9	93.1	95.3	
Option 1 (98.9%)	2	Application	1	1	-	-	-	10	-	-	-	-	-	-	11
		Mean	1	0	3	6	12	13	24	24	26	28	29	30	4-31
		Mean+UCL	1	0	4	7	13	15	27	27	29	31	33	34	5-35
	3	Mean	1	0	4	7	13	15	27	28	29	31	33	34	5-35
		Mean+UCL	1	0	4	8	15	17	31	31	33	36	38	38	6-40
Option 1 (99.2%)	2	Application	1	0	-	-	-	7	-	-	-	-	-	-	8
		Mean	1	0	2	5	9	10	17	18	19	20	21	22	3-22
		Mean+UCL	1	0	3	5	10	11	19	20	21	23	24	25	3-25
	3	Mean	1	0	3	5	10	11	20	20	21	23	24	25	3-26
		Mean+UCL	1	0	3	6	11	12	22	23	24	26	27	28	4-29
Option 2 (98.9%)	2	Application	4	3	-	-	-	51	-	-	-	-	-	-	58
		Mean	5	1	19	38	70	78	142	145	154	165	175	179	21-162
		Mean+UCL	6	2	21	42	79	89	161	165	175	187	198	202	25-184
	3	Mean	4	1	17	33	62	69	125	128	136	145	154	158	25-185
		Mean+UCL	5	1	19	37	70	78	141	144	153	163	173	177	29-211

Band model	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)												Total
Option 2 (98.9%)	2	Application	3	2	-	-	-	37	-	-	-	-	-	-	42
		Mean	3	1	12	24	45	50	91	93	99	106	112	115	16-118
		Mean+UCL	4	1	14	27	51	56	103	105	111	119	126	129	18-133
	3	Mean	4	1	14	27	51	57	103	106	112	120	127	130	18-134
		Mean+UCL	5	1	15	31	58	64	117	120	127	136	144	147	21-153
Option 3 (98%)	2	Application	1	1	-	-	-	20	-	-	-	-	-	-	20
		Mean	1	0	6	12	22	24	44	45	47	51	54	55	7-57
		Mean+UCL	2	0	6	13	24	27	49	50	53	57	60	62	9-64
	3	Mean	2	0	7	13	24	27	49	51	54	57	61	62	9-64
		Mean+UCL	2	1	7	15	28	31	56	57	61	65	69	70	10-73

Conclusion

1.67 When applying consistent nocturnal activity factors, the differences between the collision risk estimates presented in Table 1.25 are not considered to be different in assessment terms, with the exception of Option 2. However, it is considered that Option 2 does not provide representative collision risk estimates in relation to the flight behaviour of birds at Hornsea Three when using either the Applicant's approach or the alternative analysis.

1.68 In Table 1.26, there is a degree of difference between the collision risk estimates presented. However, these differences occur due to the use of breeding season apportioning values that do not reflect the behaviour of birds from FFC SPA. If biologically representative apportioning values are presented then there are minimal differences between the collision risk estimates presented when using consistent nocturnal activity factors, model Options and avoidance rates.

Lesser black-backed gull

Annual collision risk estimates

1.69 Annual collision risk estimates for lesser black-backed gull utilising all Band model Options and appropriate avoidance rates are presented in Table 1.29. Collision risk estimates incorporating the uncertainty associated with density data, flight height data and avoidance rates are presented in Appendix B. Also presented in Table 1.29 are those collision risk estimates used to inform assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065).

Table 1.29: Annual collision risk estimates for lesser black-backed gull

Band model Option (avoidance rate)	Nocturnal activity factor	Applicant's position	Alternative analysis
		As at application	Mean estimate/Mean estimate + UCL
Option 1 (99.5%)	2	N/A	13
	3	14	14
Option 2 (99.5%)	2	N/A	16
	3	17	17
Option 3 (98.9%)	2	N/A	10
	3	12	12

Conclusion

1.70 There is no difference between the collision risk estimates presented in Table 1.29 when using consistent nocturnal activity factors and model Options as the density data used are identical.

Herring gull

Annual collision risk estimates

1.71 Annual collision risk estimates for herring gull utilising all Band model Options and appropriate avoidance rates are presented in Table 1.30. Collision risk estimates incorporating the uncertainty associated with density data, flight height data and avoidance rates are presented in Appendix B. Also presented in Table 1.30 are those collision risk estimates presented in Appendix 12 to the Applicant's submission at Deadline 1 (REP1-189).

Table 1.30: Annual collision risk estimates for herring gull

Band model Option (avoidance rate)	Nocturnal activity factor	Applicant's position	Alternative analysis	
		As presented in REP1-189	Mean estimate	Mean estimate + UCL (Dec to Mar)
Option 1 (99.5%)	2	N/A	5	8
	3	6	7	10
Option 2 (99.5%)	2	N/A	7	11
	3	8	9	14
Option 3 (98.9%)	2	N/A	5	7
	3	6	6	10

Conclusion

1.72 There is considered to be no difference in assessment terms between the collision risk estimates presented in Table 1.30 when using consistent nocturnal activity factors and model Options.

Great black-backed gull

Annual collision risk estimates

Annual collision risk estimates for great black-backed gull utilising all Band model Options and appropriate avoidance rates are presented in

Table 1.31. Collision risk estimates incorporating the uncertainty associated with density data, flight height data and avoidance rates are presented in Appendix B. Also presented in

1.73 Table 1.31 are those collision risk estimates used to inform assessments in Volume 2, Chapter 5: Offshore Ornithology (APP-065).

Table 1.31: Annual collision risk estimates for great black-backed gull

Band model Option (avoidance rate)	Nocturnal activity factor	Applicant's position	Alternative analysis	
		As at application	Mean estimate	Mean estimate + UCL (Dec to Mar)
Option 1 (99.5%)	2	N/A	26	33
	3	32	32	42
Option 2 (99.5%)	2	N/A	53	69
	3	66	66	87
Option 3 (98.9%)	2	N/A	42	55
	3	52	52	69

Conclusion

1.74 There is no difference between the collision risk estimates presented in Table 1.30 calculated using the mean estimate density scenario and those presented in the application when using consistent nocturnal activity factors and model Options. The collision risk estimates calculated using the mean estimate + UCL scenario are higher than other collision risk estimates presented in Table 1.30.

References

Alerstam, T., Rosén, M., Bäckman, J., Ericson, P.G.P. and Hellgren, O. (2007). Flight speeds among Bird Species: Allometric and Phylogenetic Effects. PLoS Biology, 5 (8), pp. 1656-1662.

Band, B. (2012). Using a collision risk model to assess bird collision risks for offshore wind farms – with extended method. [Online]. Available at: http://www.bto.org/science/wetlandand- marine/soss/projects (Accessed 2 November 2012).

Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G. and Hume, D. (2014). Mapping Seabird Sensitivity to Offshore Wind Farms. PLOS ONE, 12 (1), pp. 1-17.

Cook, A.S.C.P., Humphreys, E.M., Masden, E.A. and Burton, N.H.K., 2014. The avoidance rates of collision between birds and offshore turbines. Thetford: BTO.

Furness, R.W. (2015). Non-breeding season populations of seabirds in UK waters. [Online]. Available at: http://publications.naturalengland.org.uk/publication/6427568802627584 (Accessed May 2015).

JNCC, Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England and Scottish Natural Heritage, (2017). Joint SNCB Interim Displacement Advice Note. [Online]. Available at: http://jncc.defra.gov.uk/pdf/Joint_SNCB_Interim_Displacement_AdviceNote_2017.pdf (Accessed May 2017).

JNCC, Natural England, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Natural Heritage, 2014. Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review.

Natural England (2015a). Hornsea offshore wind farm project two. Written submission for deadline 3: Appendix 3. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001101-Natural%20England%20(3).pdf (Accessed January 2019).

Natural England (2015b). Hornsea offshore wind farm project two. Written submission for deadline 3: Appendix 4. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001109-Natural%20England%20(4).pdf (Accessed January 2019).

Natural England (2015c). Hornsea offshore wind farm project two. Written submission for deadline 3: Appendix 5. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001107-Natural%20England%20(5).pdf (Accessed January 2019).

Natural England (2015d). Hornsea offshore wind farm project two. Written submission for deadline 3: Appendix 6. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010053/EN010053-001110-Natural%20England%20(6).pdf (Accessed January 2019).

Pennycuick, C.J. (1987). Flight of auks (Alcidae) and other northern seabirds compared with southern procellariformes: ornithodolite observations. Journal of Experimental Biology, 128, pp. 335-347.

Robinson, R.A. (2017). Birdfacts: profiles of birds occurring in Britain and Ireland (BTO Research Report 207). Thetford: BTO.

Robinson, R.A. (2017). Birdfacts: profiles of birds occurring in Britain and Ireland (BTO Research Report 207). Thetford: BTO.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W., and Burton, N.H.K. (2012). Seabird foraging ranges as a tool for identifying candidate marine protected areas. Biological Conservation, 156, 53-61.

Appendix A – Seasonal displacement matrices

Fulmar

Table 1.32: Displacement mortality for fulmar in the breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	7	14	28	43	57	71	85	100	114	128	142
20	3	6	14	28	57	85	114	142	171	199	228	256	285
30	4	9	21	43	85	128	171	213	256	299	341	384	427
40	6	11	28	57	114	171	228	285	341	398	455	512	569
50	7	14	36	71	142	213	285	356	427	498	569	640	711
60	9	17	43	85	171	256	341	427	512	597	683	768	854
70	10	20	50	100	199	299	398	498	597	697	797	896	996
80	11	23	57	114	228	341	455	569	683	797	910	1024	1138
90	13	26	64	128	256	384	512	640	768	896	1024	1152	1280
100	14	28	71	142	285	427	569	711	854	996	1138	1280	1423

Table 1.33: Displacement mortality for fulmar in the post-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	5	10	20	29	39	49	59	68	78	88	98
20	2	4	10	20	39	59	78	98	117	137	156	176	195
30	3	6	15	29	59	88	117	146	176	205	234	264	293
40	4	8	20	39	78	117	156	195	234	273	312	352	391
50	5	10	24	49	98	146	195	244	293	342	391	439	488
60	6	12	29	59	117	176	234	293	352	410	469	527	586
70	7	14	34	68	137	205	273	342	410	479	547	615	684
80	8	16	39	78	156	234	312	391	469	547	625	703	781
90	9	18	44	88	176	264	352	439	527	615	703	791	879
100	10	20	49	98	195	293	391	488	586	684	781	879	977

Table 1.34: Displacement mortality for fulmar in the non-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	2	4	7	11	14	18	21	25	28	32	35
20	1	1	4	7	14	21	28	35	42	49	56	63	70
30	1	2	5	11	21	32	42	53	63	74	85	95	106
40	1	3	7	14	28	42	56	70	85	99	113	127	141
50	2	4	9	18	35	53	70	88	106	123	141	159	176
60	2	4	11	21	42	63	85	106	127	148	169	190	211
70	2	5	12	25	49	74	99	123	148	173	197	222	247
80	3	6	14	28	56	85	113	141	169	197	226	254	282
90	3	6	16	32	63	95	127	159	190	222	254	285	317
100	4	7	18	35	70	106	141	176	211	247	282	317	352

Table 1.35: Displacement mortality for fulmar in the pre-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	4	9	18	27	36	45	53	62	71	80	89
20	2	4	9	18	36	53	71	89	107	125	142	160	178
30	3	5	13	27	53	80	107	134	160	187	214	240	267
40	4	7	18	36	71	107	142	178	214	249	285	320	356
50	4	9	22	45	89	134	178	223	267	312	356	401	445
60	5	11	27	53	107	160	214	267	320	374	427	481	534
70	6	12	31	62	125	187	249	312	374	436	498	561	623
80	7	14	36	71	142	214	285	356	427	498	570	641	712
90	8	16	40	80	160	240	320	401	481	561	641	721	801
100	9	18	45	89	178	267	356	445	534	623	712	801	890

Gannet

Table 1.36: Displacement mortality for gannet in the breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	7	13	27	40	53	67	80	93	107	120	133
20	3	5	13	27	53	80	107	133	160	187	213	240	267
30	4	8	20	40	80	120	160	200	240	280	320	360	400
40	5	11	27	53	107	160	213	267	320	373	427	480	533
50	7	13	33	67	133	200	267	333	400	467	533	600	667
60	8	16	40	80	160	240	320	400	480	560	640	720	800
70	9	19	47	93	187	280	373	467	560	653	747	840	933
80	11	21	53	107	213	320	427	533	640	747	853	960	1066
90	12	24	60	120	240	360	480	600	720	840	960	1080	1200
100	13	27	67	133	267	400	533	667	800	933	1066	1200	1333

Table 1.37: Displacement mortality for gannet in the post-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	5	10	20	30	39	49	59	69	79	89	98
20	2	4	10	20	39	59	79	98	118	138	157	177	197
30	3	6	15	30	59	89	118	148	177	207	236	266	295
40	4	8	20	39	79	118	157	197	236	276	315	354	394
50	5	10	25	49	98	148	197	246	295	344	394	443	492
60	6	12	30	59	118	177	236	295	354	413	472	531	591
70	7	14	34	69	138	207	276	344	413	482	551	620	689
80	8	16	39	79	157	236	315	394	472	551	630	709	787
90	9	18	44	89	177	266	354	443	531	620	709	797	886
100	10	20	49	98	197	295	394	492	591	689	787	886	984

Table 1.38: Displacement mortality for gannet in the pre-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	6	12	23	35	46	58	69	81	92	104	115
20	2	5	12	23	46	69	92	115	138	161	184	207	230
30	3	7	17	35	69	104	138	173	207	242	276	311	345
40	5	9	23	46	92	138	184	230	276	322	368	414	461
50	6	12	29	58	115	173	230	288	345	403	461	518	576
60	7	14	35	69	138	207	276	345	414	484	553	622	691
70	8	16	40	81	161	242	322	403	484	564	645	725	806
80	9	18	46	92	184	276	368	461	553	645	737	829	921
90	10	21	52	104	207	311	414	518	622	725	829	933	1036
100	12	23	58	115	230	345	461	576	691	806	921	1036	1151

Guillemot

Table 1.39: Displacement mortality for guillemot in the breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	13	27	67	134	267	401	535	669	802	936	1070	1204	1337
20	27	53	134	267	535	802	1070	1337	1605	1872	2140	2407	2675
30	40	80	201	401	802	1204	1605	2006	2407	2809	3210	3611	4012
40	53	107	267	535	1070	1605	2140	2675	3210	3745	4280	4815	5350
50	67	134	334	669	1337	2006	2675	3344	4012	4681	5350	6018	6687
60	80	160	401	802	1605	2407	3210	4012	4815	5617	6420	7222	8024
70	94	187	468	936	1872	2809	3745	4681	5617	6553	7489	8426	9362
80	107	214	535	1070	2140	3210	4280	5350	6420	7489	8559	9629	10699
90	120	241	602	1204	2407	3611	4815	6018	7222	8426	9629	10833	12037
100	134	267	669	1337	2675	4012	5350	6687	8024	9362	10699	12037	13374

Table 1.40: Displacement mortality for guillemot in the non-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	19	38	96	192	383	575	767	959	1150	1342	1534	1726	1917
20	38	77	192	383	767	1150	1534	1917	2301	2684	3068	3451	3835
30	58	115	288	575	1150	1726	2301	2876	3451	4026	4602	5177	5752
40	77	153	383	767	1534	2301	3068	3835	4602	5369	6136	6903	7669
50	96	192	479	959	1917	2876	3835	4793	5752	6711	7669	8628	9587
60	115	230	575	1150	2301	3451	4602	5752	6903	8053	9203	10354	11504
70	134	268	671	1342	2684	4026	5369	6711	8053	9395	10737	12079	13422
80	153	307	767	1534	3068	4602	6136	7669	9203	10737	12271	13805	15339
90	173	345	863	1726	3451	5177	6903	8628	10354	12079	13805	15531	17256
100	192	383	959	1917	3835	5752	7669	9587	11504	13422	15339	17256	19174

Razorbill

Table 1.41: Displacement mortality for razorbill in the breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	1	3	6	13	19	25	32	38	44	50	57	63
20	1	3	6	13	25	38	50	63	76	88	101	113	126
30	2	4	9	19	38	57	76	95	113	132	151	170	189
40	3	5	13	25	50	76	101	126	151	176	202	227	252
50	3	6	16	32	63	95	126	158	189	221	252	284	315
60	4	8	19	38	76	113	151	189	227	265	303	340	378
70	4	9	22	44	88	132	176	221	265	309	353	397	441
80	5	10	25	50	101	151	202	252	303	353	403	454	504
90	6	11	28	57	113	170	227	284	340	397	454	511	567
100	6	13	32	63	126	189	252	315	378	441	504	567	630

Table 1.42: Displacement mortality for razorbill in the post-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	4	10	20	40	61	81	101	121	141	162	182	202
20	4	8	20	40	81	121	162	202	242	283	323	364	404
30	6	12	30	61	121	182	242	303	364	424	485	546	606
40	8	16	40	81	162	242	323	404	485	566	647	727	808
50	10	20	51	101	202	303	404	505	606	707	808	909	1010
60	12	24	61	121	242	364	485	606	727	849	970	1091	1212
70	14	28	71	141	283	424	566	707	849	990	1131	1273	1414
80	16	32	81	162	323	485	647	808	970	1131	1293	1455	1616
90	18	36	91	182	364	546	727	909	1091	1273	1455	1637	1818
100	20	40	101	202	404	606	808	1010	1212	1414	1616	1818	2020

Table 1.43: Displacement mortality for razorbill in the non-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	5	10	25	50	100	151	201	251	301	352	402	452	502
20	10	20	50	100	201	301	402	502	603	703	804	904	1005
30	15	30	75	151	301	452	603	754	904	1055	1206	1356	1507
40	20	40	100	201	402	603	804	1005	1206	1407	1608	1809	2009
50	25	50	126	251	502	754	1005	1256	1507	1758	2009	2261	2512
60	30	60	151	301	603	904	1206	1507	1809	2110	2411	2713	3014
70	35	70	176	352	703	1055	1407	1758	2110	2462	2813	3165	3517
80	40	80	201	402	804	1206	1608	2009	2411	2813	3215	3617	4019
90	45	90	226	452	904	1356	1809	2261	2713	3165	3617	4069	4521
100	50	100	251	502	1005	1507	2009	2512	3014	3517	4019	4521	5024

Table 1.44: Displacement mortality for razorbill in the pre-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	2	4	9	18	35	53	70	88	105	123	140	158	175
20	4	7	18	35	70	105	140	175	211	246	281	316	351
30	5	11	26	53	105	158	211	263	316	368	421	474	526
40	7	14	35	70	140	211	281	351	421	491	561	632	702
50	9	18	44	88	175	263	351	439	526	614	702	789	877
60	11	21	53	105	211	316	421	526	632	737	842	947	1053
70	12	25	61	123	246	368	491	614	737	860	982	1105	1228
80	14	28	70	140	281	421	561	702	842	982	1123	1263	1403
90	16	32	79	158	316	474	632	789	947	1105	1263	1421	1579
100	18	35	88	175	351	526	702	877	1053	1228	1403	1579	1754

Puffin

Table 1.45: Displacement mortality for puffin in the breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	3	5	8	10	13	15	18	20	23	25
20	1	1	3	5	10	15	20	25	30	35	41	46	51
30	1	2	4	8	15	23	30	38	46	53	61	68	76
40	1	2	5	10	20	30	41	51	61	71	81	91	101
50	1	3	6	13	25	38	51	63	76	89	101	114	127
60	2	3	8	15	30	46	61	76	91	106	122	137	152
70	2	4	9	18	35	53	71	89	106	124	142	160	177
80	2	4	10	20	41	61	81	101	122	142	162	182	203
90	2	5	11	23	46	68	91	114	137	160	182	205	228
100	3	5	13	25	51	76	101	127	152	177	203	228	253

Table 1.46: Displacement mortality for puffin in the non-breeding season calculated applying the alternative analysis

	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	1	2	2	3	4	5	5	6	7	8
20	0	0	1	2	3	5	6	8	9	11	12	14	15
30	0	0	1	2	5	7	9	12	14	16	19	21	23
40	0	1	2	3	6	9	12	15	19	22	25	28	31
50	0	1	2	4	8	12	15	19	23	27	31	35	39
60	0	1	2	5	9	14	19	23	28	32	37	42	46
70	1	1	3	5	11	16	22	27	32	38	43	49	54
80	1	1	3	6	12	19	25	31	37	43	49	56	62
90	1	1	3	7	14	21	28	35	42	49	56	62	69
100	1	2	4	8	15	23	31	39	46	54	62	69	77

Appendix B – Monthly collision risk results the alternative analysis

Gannet

Table 1.47: Monthly collision risk estimates for gannet calculated using Option 1 of Band (2012) using confidence intervals associated with density and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	0.11	0.00	0.83	1.05	0.22	0.73	3.39	4.23	1.64	3.84	0.82	3.77
98.9	0.10	0.00	0.70	0.89	0.19	0.62	2.86	3.58	1.39	3.25	0.70	3.19
99.1	0.08	0.00	0.57	0.73	0.15	0.51	2.34	2.93	1.14	2.66	0.57	2.61
Density = Mean estimate + UCL												
98.7	0.29	0.00	1.43	1.05	0.22	0.73	3.39	4.23	1.64	3.84	0.82	5.50
98.9	0.25	0.00	1.21	0.89	0.19	0.62	2.86	3.58	1.39	3.25	0.70	4.65
99.1	0.20	0.00	0.99	0.73	0.15	0.51	2.34	2.93	1.14	2.66	0.57	3.81
Density = Upper confidence limit												
98.7	0.29	0.00	1.43	1.49	0.40	1.19	4.54	6.00	2.25	4.85	1.15	5.50
98.9	0.25	0.00	1.21	1.26	0.34	1.01	3.84	5.08	1.90	4.10	0.98	4.65
99.1	0.20	0.00	0.99	1.03	0.28	0.82	3.14	4.15	1.56	3.36	0.80	3.81
Density = Lower confidence limit												
98.7	0.00	0.00	0.29	0.60	0.04	0.28	2.23	2.46	1.03	2.83	0.49	2.17
98.9	0.00	0.00	0.24	0.51	0.03	0.23	1.89	2.08	0.87	2.40	0.42	1.84
99.1	0.00	0.00	0.20	0.42	0.03	0.19	1.54	1.70	0.71	1.96	0.34	1.50

Table 1.48: Monthly collision risk estimates for gannet calculated using Option 2 of Band (2012) using confidence intervals associated with density and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	0.25	0.00	1.81	2.30	0.48	1.61	7.43	9.28	3.60	8.43	1.81	8.27

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
98.9	0.21	0.00	1.53	1.95	0.41	1.36	6.28	7.85	3.04	7.13	1.53	7.00
99.1	0.17	0.00	1.26	1.59	0.33	1.11	5.14	6.42	2.49	5.83	1.25	5.73
Density = Mean estimate + UCL												
98.7	0.64	0.00	3.15	2.30	0.48	1.61	7.43	9.28	3.60	8.43	1.81	12.06
98.9	0.54	0.00	2.66	1.95	0.41	1.36	6.28	7.85	3.04	7.13	1.53	10.21
99.1	0.45	0.00	2.18	1.59	0.33	1.11	5.14	6.42	2.49	5.83	1.25	8.35
Density = Upper confidence limit												
98.7	0.64	0.00	3.15	3.28	0.88	2.61	9.96	13.16	4.93	10.64	2.53	12.06
98.9	0.54	0.00	2.66	2.77	0.74	2.21	8.43	11.14	4.17	9.00	2.14	10.21
99.1	0.45	0.00	2.18	2.27	0.61	1.81	6.90	9.11	3.41	7.36	1.75	8.35
Density = Lower confidence limit												
98.7	0.00	0.00	0.63	1.32	0.08	0.61	4.89	5.40	2.27	6.22	1.08	4.77
98.9	0.00	0.00	0.53	1.12	0.07	0.51	4.14	4.57	1.92	5.26	0.92	4.03
99.1	0.00	0.00	0.44	0.92	0.06	0.42	3.38	3.74	1.57	4.30	0.75	3.30

Table 1.49: Monthly collision risk estimates for gannet calculated using Option 3 of Band (2012) using confidence intervals associated with density and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98	0.09	0.00	0.64	0.81	0.17	0.57	2.61	3.26	1.26	2.96	0.63	2.91
Density = Mean estimate + UCL												
98	0.23	0.00	1.11	0.81	0.17	0.57	2.61	3.26	1.26	2.96	0.63	4.24
Density = Upper confidence limit												
98	0.23	0.00	1.11	1.15	0.31	0.92	3.50	4.62	1.73	3.74	0.89	4.24
Density = Lower confidence limit												
98	0.00	0.00	0.22	0.46	0.03	0.21	1.72	1.90	0.80	2.18	0.38	1.68

Table 1.50: Monthly collision risk estimates for gannet calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	0.11	0.00	0.83	1.05	0.22	0.73	3.39	4.23	1.64	3.84	0.82	3.77
98.9	0.10	0.00	0.70	0.89	0.19	0.62	2.86	3.58	1.39	3.25	0.70	3.19
99.1	0.08	0.00	0.57	0.73	0.15	0.51	2.34	2.93	1.14	2.66	0.57	2.61
PCH = Upper confidence metric												
98.7	0.34	0.00	2.48	3.15	0.66	2.20	10.16	12.69	4.92	11.53	2.47	11.32
98.9	0.29	0.00	2.10	2.66	0.56	1.86	8.59	10.74	4.16	9.75	2.09	9.58
99.1	0.23	0.00	1.72	2.18	0.46	1.52	7.03	8.78	3.41	7.98	1.71	7.83

Table 1.51: Monthly collision risk estimates for gannet calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	0.29	0.00	1.43	1.05	0.22	0.73	3.39	4.23	1.64	3.84	0.82	5.50
98.9	0.25	0.00	1.21	0.89	0.19	0.62	2.86	3.58	1.39	3.25	0.70	4.65
99.1	0.20	0.00	0.99	0.73	0.15	0.51	2.34	2.93	1.14	2.66	0.57	3.81
PCH = Upper confidence metric												
98.7	0.88	0.00	4.30	3.15	0.66	2.20	10.16	12.69	4.92	11.53	2.47	16.49
98.9	0.74	0.00	3.64	2.66	0.56	1.86	8.59	10.74	4.16	9.75	2.09	13.96
99.1	0.61	0.00	2.98	2.18	0.46	1.52	7.03	8.78	3.41	7.98	1.71	11.42

Table 1.52: Monthly collision risk estimates for gannet calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	0.25	0.00	1.81	2.30	0.48	1.61	7.43	9.28	3.60	8.43	1.81	8.27
98.9	0.21	0.00	1.53	1.95	0.41	1.36	6.28	7.85	3.04	7.13	1.53	7.00
99.1	0.17	0.00	1.26	1.59	0.33	1.11	5.14	6.42	2.49	5.83	1.25	5.73
Flight height distribution = Upper confidence metric												
98.7	0.55	0.00	4.02	5.10	1.07	3.57	16.46	20.56	7.97	18.68	4.01	18.34
98.9	0.46	0.00	3.40	4.31	0.90	3.02	13.93	17.40	6.75	15.80	3.39	15.52
99.1	0.38	0.00	2.78	3.53	0.74	2.47	11.39	14.24	5.52	12.93	2.77	12.70
Flight height distribution = Lower confidence limit												
98.7	0.08	0.00	0.56	0.70	0.15	0.49	2.27	2.84	1.10	2.58	0.55	2.53
98.9	0.06	0.00	0.47	0.60	0.12	0.42	1.92	2.40	0.93	2.18	0.47	2.14
99.1	0.05	0.00	0.38	0.49	0.10	0.34	1.57	1.97	0.76	1.79	0.38	1.75

Table 1.53: Monthly collision risk estimates for gannet calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	0.64	0.00	3.15	2.30	0.48	1.61	7.43	9.28	3.60	8.43	1.81	12.06
98.9	0.54	0.00	2.66	1.95	0.41	1.36	6.28	7.85	3.04	7.13	1.53	10.21
99.1	0.45	0.00	2.18	1.59	0.33	1.11	5.14	6.42	2.49	5.83	1.25	8.35
Flight height distribution = Upper confidence metric												
98.7	1.43	0.00	6.97	5.10	1.07	3.57	16.46	20.56	7.97	18.68	4.01	26.73
98.9	1.21	0.00	5.90	4.31	0.90	3.02	13.93	17.40	6.75	15.80	3.39	22.62
99.1	0.99	0.00	4.83	3.53	0.74	2.47	11.39	14.24	5.52	12.93	2.77	18.51
Flight height distribution = Lower confidence limit												
98.7	0.20	0.00	0.96	0.70	0.15	0.49	2.27	2.84	1.10	2.58	0.55	3.69
98.9	0.17	0.00	0.81	0.60	0.12	0.42	1.92	2.40	0.93	2.18	0.47	3.12
99.1	0.14	0.00	0.67	0.49	0.10	0.34	1.57	1.97	0.76	1.79	0.38	2.56

Table 1.54: Monthly collision risk estimates for gannet calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98	0.09	0.00	0.64	0.81	0.17	0.57	2.61	3.26	1.26	2.96	0.63	2.91
Flight height distribution = Upper confidence metric												
98	0.24	0.00	1.75	2.22	0.46	1.55	7.16	8.95	3.47	8.13	1.74	7.98
Flight height distribution = Lower confidence limit												
98	0.02	0.00	0.15	0.19	0.04	0.14	0.63	0.79	0.30	0.71	0.15	0.70

Table 1.55: Monthly collision risk estimates for gannet calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 1.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98	0.23	0.00	1.11	0.81	0.17	0.57	2.61	3.26	1.26	2.96	0.63	4.24
Flight height distribution = Upper confidence metric												
98	0.62	0.00	3.03	2.22	0.46	1.55	7.16	8.95	3.47	8.13	1.74	11.63
Flight height distribution = Lower confidence limit												
98	0.05	0.00	0.27	0.19	0.04	0.14	0.63	0.79	0.30	0.71	0.15	1.02

Table 1.56: Monthly collision risk estimates for gannet calculated using Option 1 of Band (2012) using confidence intervals associated with density and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	0.17	0.00	1.04	1.24	0.25	0.81	3.77	4.88	2.00	5.05	1.19	5.84
98.9	0.14	0.00	0.88	1.05	0.21	0.68	3.19	4.13	1.69	4.28	1.01	4.94
99.1	0.12	0.00	0.72	0.86	0.17	0.56	2.61	3.38	1.39	3.50	0.82	4.04

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate + UCL												
98.7	0.44	0.00	1.80	1.24	0.25	0.81	3.77	4.88	2.00	5.05	1.19	8.51
98.9	0.37	0.00	1.53	1.05	0.21	0.68	3.19	4.13	1.69	4.28	1.01	7.20
99.1	0.30	0.00	1.25	0.86	0.17	0.56	2.61	3.38	1.39	3.50	0.82	5.89
Density = Upper confidence limit												
98.7	0.44	0.00	1.80	1.76	0.45	1.31	5.05	6.92	2.74	6.38	1.67	8.51
98.9	0.37	0.00	1.53	1.49	0.38	1.11	4.28	5.86	2.32	5.40	1.41	7.20
99.1	0.30	0.00	1.25	1.22	0.31	0.91	3.50	4.79	1.90	4.42	1.15	5.89
Density = Lower confidence limit												
98.7	0.00	0.00	0.36	0.71	0.04	0.30	2.48	2.84	1.26	3.73	0.71	3.37
98.9	0.00	0.00	0.31	0.60	0.04	0.26	2.10	2.40	1.07	3.15	0.60	2.85
99.1	0.00	0.00	0.25	0.49	0.03	0.21	1.72	1.96	0.87	2.58	0.49	2.33

Table 1.57: Monthly collision risk estimates for gannet calculated using Option 2 of Band (2012) using confidence intervals associated with density and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	0.37	0.00	2.28	2.71	0.54	1.77	8.26	10.71	4.39	11.09	2.61	12.81
98.9	0.31	0.00	1.93	2.29	0.46	1.50	6.99	9.06	3.71	9.38	2.21	10.84
99.1	0.26	0.00	1.58	1.88	0.37	1.23	5.72	7.41	3.04	7.68	1.81	8.87
Density = Mean estimate + UCL												
98.7	0.96	0.00	3.96	2.71	0.54	1.77	8.26	10.71	4.39	11.09	2.61	18.68
98.9	0.81	0.00	3.35	2.29	0.46	1.50	6.99	9.06	3.71	9.38	2.21	15.80
99.1	0.67	0.00	2.74	1.88	0.37	1.23	5.72	7.41	3.04	7.68	1.81	12.93
Density = Upper confidence limit												
98.7	0.96	0.00	3.96	3.86	0.99	2.88	11.09	15.19	6.01	13.99	3.66	18.68
98.9	0.81	0.00	3.35	3.27	0.84	2.44	9.38	12.85	5.09	11.84	3.09	15.80
99.1	0.67	0.00	2.74	2.67	0.69	1.99	7.68	10.51	4.16	9.69	2.53	12.93

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Lower confidence limit												
98.7	0.00	0.00	0.79	1.56	0.09	0.67	5.44	6.23	2.76	8.18	1.56	7.38
98.9	0.00	0.00	0.67	1.32	0.08	0.57	4.60	5.27	2.34	6.92	1.32	6.25
99.1	0.00	0.00	0.55	1.08	0.06	0.46	3.76	4.31	1.91	5.66	1.08	5.11

Table 1.58: Monthly collision risk estimates for gannet calculated using Option 3 of Band (2012) using confidence intervals associated with density and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98	0.13	0.00	0.80	0.95	0.19	0.62	2.90	3.76	1.54	3.89	0.92	4.50
Density = Mean estimate + UCL												
98	0.34	0.00	1.39	0.95	0.19	0.62	2.90	3.76	1.54	3.89	0.92	6.56
Density = Upper confidence limit												
98	0.34	0.00	1.39	1.36	0.35	1.01	3.89	5.33	2.11	4.92	1.28	6.56
Density = Lower confidence limit												
98	0.00	0.00	0.28	0.55	0.03	0.23	1.91	2.19	0.97	2.87	0.55	2.59

Table 1.59: Monthly collision risk estimates for gannet calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	0.17	0.00	1.04	1.24	0.25	0.81	3.77	4.88	2.00	5.05	1.19	5.84
98.9	0.14	0.00	0.88	1.05	0.21	0.68	3.19	4.13	1.69	4.28	1.01	4.94
99.1	0.12	0.00	0.72	0.86	0.17	0.56	2.61	3.38	1.39	3.50	0.82	4.04
PCH = Upper confidence metric												
98.7	0.50	0.00	3.12	3.71	0.74	2.43	11.30	14.64	6.00	15.16	3.57	17.52
98.9	0.43	0.00	2.64	3.14	0.63	2.05	9.56	12.39	5.08	12.83	3.02	14.83

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.1	0.35	0.00	2.16	2.57	0.51	1.68	7.82	10.14	4.16	10.50	2.47	12.13

Table 1.60: Monthly collision risk estimates for gannet calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	0.44	0.00	1.80	1.24	0.25	0.81	3.77	4.88	2.00	5.05	1.19	8.51
98.9	0.37	0.00	1.53	1.05	0.21	0.68	3.19	4.13	1.69	4.28	1.01	7.20
99.1	0.30	0.00	1.25	0.86	0.17	0.56	2.61	3.38	1.39	3.50	0.82	5.89
PCH = Upper confidence metric												
98.7	1.32	0.00	5.41	3.71	0.74	2.43	11.30	14.64	6.00	15.16	3.57	25.54
98.9	1.11	0.00	4.58	3.14	0.63	2.05	9.56	12.39	5.08	12.83	3.02	21.61
99.1	0.91	0.00	3.75	2.57	0.51	1.68	7.82	10.14	4.16	10.50	2.47	17.68

Table 1.61: Monthly collision risk estimates for gannet calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	0.37	0.00	2.28	2.71	0.54	1.77	8.26	10.71	4.39	11.09	2.61	12.81
98.9	0.31	0.00	1.93	2.29	0.46	1.50	6.99	9.06	3.71	9.38	2.21	10.84
99.1	0.26	0.00	1.58	1.88	0.37	1.23	5.72	7.41	3.04	7.68	1.81	8.87
Flight height distribution = Upper confidence metric												
98.7	0.82	0.00	5.06	6.01	1.20	3.93	18.31	23.73	9.73	24.57	5.79	28.40
98.9	0.69	0.00	4.28	5.09	1.02	3.33	15.49	20.08	8.23	20.79	4.90	24.03
99.1	0.57	0.00	3.50	4.16	0.83	2.72	12.68	16.43	6.73	17.01	4.01	19.66
Flight height distribution = Lower confidence limit												
98.7	0.11	0.00	0.70	0.83	0.17	0.54	2.53	3.28	1.34	3.39	0.80	3.92

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
98.9	0.10	0.00	0.59	0.70	0.14	0.46	2.14	2.77	1.14	2.87	0.68	3.32
99.1	0.08	0.00	0.48	0.57	0.11	0.38	1.75	2.27	0.93	2.35	0.55	2.72

Table 1.62: Monthly collision risk estimates for gannet calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	0.96	0.00	3.96	2.71	0.54	1.77	8.26	10.71	4.39	11.09	2.61	18.68
98.9	0.81	0.00	3.35	2.29	0.46	1.50	6.99	9.06	3.71	9.38	2.21	15.80
99.1	0.67	0.00	2.74	1.88	0.37	1.23	5.72	7.41	3.04	7.68	1.81	12.93
Flight height distribution = Upper confidence metric												
98.7	2.13	0.00	8.77	6.01	1.20	3.93	18.31	23.73	9.73	24.57	5.79	41.40
98.9	1.81	0.00	7.42	5.09	1.02	3.33	15.49	20.08	8.23	20.79	4.90	35.03
99.1	1.48	0.00	6.07	4.16	0.83	2.72	12.68	16.43	6.73	17.01	4.01	28.66
Flight height distribution = Lower confidence limit												
98.7	0.29	0.00	1.21	0.83	0.17	0.54	2.53	3.28	1.34	3.39	0.80	5.72
98.9	0.25	0.00	1.03	0.70	0.14	0.46	2.14	2.77	1.14	2.87	0.68	4.84
99.1	0.20	0.00	0.84	0.57	0.11	0.38	1.75	2.27	0.93	2.35	0.55	3.96

Table 1.63: Monthly collision risk estimates for gannet calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98	0.13	0.00	0.80	0.95	0.19	0.62	2.90	3.76	1.54	3.89	0.92	4.50
Flight height distribution = Upper confidence metric												
98	0.36	0.00	2.20	2.62	0.52	1.71	7.97	10.32	4.23	10.69	2.52	12.36
Flight height distribution = Lower confidence limit												

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
98	0.03	0.00	0.19	0.23	0.05	0.15	0.70	0.91	0.37	0.94	0.22	1.08

Table 1.64: Monthly collision risk estimates for gannet calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution and a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98	0.34	0.00	1.39	0.95	0.19	0.62	2.90	3.76	1.54	3.89	0.92	6.56
Flight height distribution = Upper confidence metric												
98	0.93	0.00	3.82	2.62	0.52	1.71	7.97	10.32	4.23	10.69	2.52	18.01
Flight height distribution = Lower confidence limit												
98	0.08	0.00	0.33	0.23	0.05	0.15	0.70	0.91	0.37	0.94	0.22	1.58

Kittiwake

Table 1.65: Monthly collision risk estimates for kittiwake calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	1.84	0.73	6.54	7.61	6.66	1.95	11.12	3.29	5.71	1.42	2.02	7.48
98.9	1.56	0.61	5.54	6.44	5.64	1.65	9.41	2.78	4.84	1.20	1.71	6.33
99.1	1.28	0.50	4.53	5.27	4.61	1.35	7.70	2.27	3.96	0.98	1.40	5.18
99.2	1.13	0.45	4.03	4.68	4.10	1.20	6.84	2.02	3.52	0.88	1.24	4.60
99.5	0.71	0.28	2.52	2.93	2.56	0.75	4.28	1.26	2.20	0.55	0.78	2.88
Density = Mean estimate + UCL												
98.7	2.72	1.46	11.18	7.61	6.66	1.95	11.12	3.29	5.71	1.42	2.02	11.41
98.9	2.30	1.23	9.46	6.44	5.64	1.65	9.41	2.78	4.84	1.20	1.71	9.65
99.1	1.88	1.01	7.74	5.27	4.61	1.35	7.70	2.27	3.96	0.98	1.40	7.90
99.2	1.67	0.90	6.88	4.68	4.10	1.20	6.84	2.02	3.52	0.88	1.24	7.02

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	1.04	0.56	4.30	2.93	2.56	0.75	4.28	1.26	2.20	0.55	0.78	4.39
Density = Upper confidence limit												
98.7	2.72	1.46	11.18	10.30	8.91	2.60	15.54	4.11	8.07	1.80	2.40	11.41
98.9	2.30	1.23	9.46	8.72	7.54	2.20	13.15	3.48	6.83	1.52	2.03	9.65
99.1	1.88	1.01	7.74	7.13	6.17	1.80	10.76	2.85	5.59	1.24	1.66	7.90
99.2	1.67	0.90	6.88	6.34	5.48	1.60	9.56	2.53	4.97	1.11	1.48	7.02
99.5	1.04	0.56	4.30	3.96	3.43	1.00	5.98	1.58	3.11	0.69	0.92	4.39
Density = Lower confidence limit												
98.7	1.08	0.23	3.35	4.91	4.41	1.29	6.71	2.46	3.35	1.05	1.64	4.40
98.9	0.91	0.19	2.83	4.16	3.74	1.09	5.68	2.08	2.84	0.89	1.39	3.73
99.1	0.74	0.16	2.32	3.40	3.06	0.89	4.64	1.70	2.32	0.73	1.13	3.05
99.2	0.66	0.14	2.06	3.02	2.72	0.79	4.13	1.51	2.06	0.65	1.01	2.71
99.5	0.41	0.09	1.29	1.89	1.70	0.50	2.58	0.95	1.29	0.40	0.63	1.69

Table 1.66: Monthly collision risk estimates for kittiwake calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	9.69	3.81	34.40	39.98	35.02	10.23	58.47	17.27	30.04	7.48	10.62	39.31
98.9	8.20	3.23	29.10	33.83	29.63	8.66	49.47	14.61	25.42	6.33	8.99	33.26
99.1	6.71	2.64	23.81	27.68	24.25	7.09	40.48	11.96	20.79	5.18	7.35	27.22
99.2	5.96	2.35	21.17	24.61	21.55	6.30	35.98	10.63	18.48	4.60	6.54	24.19
99.5	3.73	1.47	13.23	15.38	13.47	3.94	22.49	6.64	11.55	2.88	4.09	15.12
Density = Mean estimate + UCL												
98.7	14.28	7.65	58.76	39.98	35.02	10.23	58.47	17.27	30.04	7.48	10.62	59.98
98.9	12.08	6.48	49.72	33.83	29.63	8.66	49.47	14.61	25.42	6.33	8.99	50.75
99.1	9.89	5.30	40.68	27.68	24.25	7.09	40.48	11.96	20.79	5.18	7.35	41.52
99.2	8.79	4.71	36.16	24.61	21.55	6.30	35.98	10.63	18.48	4.60	6.54	36.91

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	5.49	2.94	22.60	15.38	13.47	3.94	22.49	6.64	11.55	2.88	4.09	23.07
Density = Upper confidence limit												
98.7	14.28	7.65	58.76	54.15	46.84	13.69	81.67	21.62	42.45	9.44	12.63	59.98
98.9	12.08	6.48	49.72	45.82	39.64	11.59	69.10	18.29	35.92	7.99	10.69	50.75
99.1	9.89	5.30	40.68	37.49	32.43	9.48	56.54	14.97	29.39	6.54	8.74	41.52
99.2	8.79	4.71	36.16	33.32	28.83	8.43	50.26	13.30	26.12	5.81	7.77	36.91
99.5	5.49	2.94	22.60	20.83	18.02	5.27	31.41	8.31	16.33	3.63	4.86	23.07
Density = Lower confidence limit												
98.7	5.65	1.19	17.60	25.82	23.20	6.78	35.27	12.92	17.63	5.51	8.62	23.15
98.9	4.78	1.01	14.89	21.85	19.63	5.74	29.84	10.93	14.91	4.66	7.29	19.59
99.1	3.91	0.83	12.19	17.88	16.06	4.69	24.42	8.95	12.20	3.81	5.96	16.02
99.2	3.48	0.73	10.83	15.89	14.28	4.17	21.70	7.95	10.85	3.39	5.30	14.24
99.5	2.17	0.46	6.77	9.93	8.92	2.61	13.56	4.97	6.78	2.12	3.31	8.90

Table 1.67: Monthly collision risk estimates for kittiwake calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98	2.85	1.12	10.13	11.77	10.31	3.01	17.22	5.09	8.85	2.20	3.13	11.58
Density = Mean estimate + UCL												
98	4.21	2.25	17.30	11.77	10.31	3.01	17.22	5.09	8.85	2.20	3.13	17.66
Density = Upper confidence limit												
98	4.21	2.25	17.30	15.95	13.79	4.03	24.05	6.37	12.50	2.78	3.72	17.66
Density = Lower confidence limit												
98	1.66	0.35	5.18	7.60	6.83	2.00	10.39	3.81	5.19	1.62	2.54	6.82

Table 1.68: Monthly collision risk estimates for kittiwake calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	1.84	0.73	6.54	7.61	6.66	1.95	11.12	3.29	5.71	1.42	2.02	7.48
98.9	1.56	0.61	5.54	6.44	5.64	1.65	9.41	2.78	4.84	1.20	1.71	6.33
99.1	1.28	0.50	4.53	5.27	4.61	1.35	7.70	2.27	3.96	0.98	1.40	5.18
99.2	1.13	0.45	4.03	4.68	4.10	1.20	6.84	2.02	3.52	0.88	1.24	4.60
99.5	0.71	0.28	2.52	2.93	2.56	0.75	4.28	1.26	2.20	0.55	0.78	2.88
PCH = Upper confidence metric												
98.7	4.15	1.63	14.72	17.11	14.99	4.38	25.03	7.39	12.86	3.20	4.55	16.83
98.9	3.51	1.38	12.46	14.48	12.68	3.71	21.18	6.25	10.88	2.71	3.85	14.24
99.1	2.87	1.13	10.19	11.85	10.38	3.03	17.33	5.12	8.90	2.22	3.15	11.65
99.2	2.55	1.00	9.06	10.53	9.23	2.70	15.40	4.55	7.91	1.97	2.80	10.35
99.5	1.59	0.63	5.66	6.58	5.77	1.68	9.63	2.84	4.94	1.23	1.75	6.47

Table 1.69: Monthly collision risk estimates for kittiwake calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	2.72	1.46	11.18	7.61	6.66	1.95	11.12	3.29	5.71	1.42	2.02	11.41
98.9	2.30	1.23	9.46	6.44	5.64	1.65	9.41	2.78	4.84	1.20	1.71	9.65
99.1	1.88	1.01	7.74	5.27	4.61	1.35	7.70	2.27	3.96	0.98	1.40	7.90
99.2	1.67	0.90	6.88	4.68	4.10	1.20	6.84	2.02	3.52	0.88	1.24	7.02
99.5	1.04	0.56	4.30	2.93	2.56	0.75	4.28	1.26	2.20	0.55	0.78	4.39
PCH = Upper confidence metric												
98.7	6.11	3.28	25.15	17.11	14.99	4.38	25.03	7.39	12.86	3.20	4.55	25.67
98.9	5.17	2.77	21.28	14.48	12.68	3.71	21.18	6.25	10.88	2.71	3.85	21.72
99.1	4.23	2.27	17.41	11.85	10.38	3.03	17.33	5.12	8.90	2.22	3.15	17.77
99.2	3.76	2.02	15.48	10.53	9.23	2.70	15.40	4.55	7.91	1.97	2.80	15.80
99.5	2.35	1.26	9.67	6.58	5.77	1.68	9.63	2.84	4.94	1.23	1.75	9.87

Table 1.70: Monthly collision risk estimates for kittiwake calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Maximum likelihood												
98.7	9.69	3.81	34.40	39.98	35.02	10.23	58.47	17.27	30.04	7.48	10.62	39.31
98.9	8.20	3.23	29.10	33.83	29.63	8.66	49.47	14.61	25.42	6.33	8.99	33.26
99.1	6.71	2.64	23.81	27.68	24.25	7.09	40.48	11.96	20.79	5.18	7.35	27.22
99.2	5.96	2.35	21.17	24.61	21.55	6.30	35.98	10.63	18.48	4.60	6.54	24.19
99.5	3.73	1.47	13.23	15.38	13.47	3.94	22.49	6.64	11.55	2.88	4.09	15.12
Flight height distribution = Upper confidence limit												
98.7	12.68	4.99	45.03	52.34	45.85	13.40	76.54	22.61	39.32	9.79	13.91	51.46
98.9	10.73	4.22	38.10	44.29	38.80	11.34	64.76	19.13	33.27	8.28	11.77	43.55
99.1	8.78	3.46	31.17	36.24	31.74	9.28	52.99	15.65	27.22	6.78	9.63	35.63
99.2	7.80	3.07	27.71	32.21	28.21	8.25	47.10	13.91	24.20	6.02	8.56	31.67
99.5	4.88	1.92	17.32	20.13	17.63	5.15	29.44	8.70	15.12	3.76	5.35	19.79
Flight height distribution = Lower confidence limit												
98.7	6.34	2.50	22.51	26.17	22.92	6.70	38.27	11.30	19.66	4.89	6.95	25.73
98.9	5.37	2.11	19.05	22.15	19.40	5.67	32.38	9.56	16.64	4.14	5.88	21.77
99.1	4.39	1.73	15.59	18.12	15.87	4.64	26.49	7.83	13.61	3.39	4.81	17.81
99.2	3.90	1.54	13.85	16.11	14.11	4.12	23.55	6.96	12.10	3.01	4.28	15.84
99.5	2.44	0.96	8.66	10.07	8.82	2.58	14.72	4.35	7.56	1.88	2.67	9.90

Table 1.71: Monthly collision risk estimates for kittiwake calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Maximum likelihood												
98.7	14.28	7.65	58.76	39.98	35.02	10.23	58.47	17.27	30.04	7.48	10.62	59.98

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
98.9	12.08	6.48	49.72	33.83	29.63	8.66	49.47	14.61	25.42	6.33	8.99	50.75
99.1	9.89	5.30	40.68	27.68	24.25	7.09	40.48	11.96	20.79	5.18	7.35	41.52
99.2	8.79	4.71	36.16	24.61	21.55	6.30	35.98	10.63	18.48	4.60	6.54	36.91
99.5	5.49	2.94	22.60	15.38	13.47	3.94	22.49	6.64	11.55	2.88	4.09	23.07
Flight height distribution = Upper confidence limit												
98.7	18.70	10.02	76.92	52.34	45.85	13.40	76.54	22.61	39.32	9.79	13.91	78.52
98.9	15.82	8.48	65.09	44.29	38.80	11.34	64.76	19.13	33.27	8.28	11.77	66.44
99.1	12.94	6.94	53.26	36.24	31.74	9.28	52.99	15.65	27.22	6.78	9.63	54.36
99.2	11.50	6.17	47.34	32.21	28.21	8.25	47.10	13.91	24.20	6.02	8.56	48.32
99.5	7.19	3.85	29.59	20.13	17.63	5.15	29.44	8.70	15.12	3.76	5.35	30.20
Flight height distribution = Lower confidence limit												
98.7	9.35	5.01	38.46	26.17	22.92	6.70	38.27	11.30	19.66	4.89	6.95	39.26
98.9	7.91	4.24	32.55	22.15	19.40	5.67	32.38	9.56	16.64	4.14	5.88	33.22
99.1	6.47	3.47	26.63	18.12	15.87	4.64	26.49	7.83	13.61	3.39	4.81	27.18
99.2	5.75	3.08	23.67	16.11	14.11	4.12	23.55	6.96	12.10	3.01	4.28	24.16
99.5	3.60	1.93	14.79	10.07	8.82	2.58	14.72	4.35	7.56	1.88	2.67	15.10

Table 1.72: Monthly collision risk estimates for kittiwake calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98	2.85	1.12	10.13	11.77	10.31	3.01	17.22	5.09	8.85	2.20	3.13	11.58
Flight height distribution = Upper confidence metric												
98	4.05	1.59	14.37	16.71	14.63	4.28	24.43	7.22	12.55	3.12	4.44	16.42
Flight height distribution = Lower confidence limit												
98	1.68	0.66	5.95	6.91	6.06	1.77	10.11	2.99	5.19	1.29	1.84	6.80

Table 1.73: Monthly collision risk estimates for kittiwake calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98	4.21	2.25	17.30	11.77	10.31	3.01	17.22	5.09	8.85	2.20	3.13	17.66
Flight height distribution = Upper confidence metric												
98	5.97	3.20	24.55	16.71	14.63	4.28	24.43	7.22	12.55	3.12	4.44	25.06
Flight height distribution = Lower confidence limit												
98	2.47	1.32	10.16	6.91	6.06	1.77	10.11	2.99	5.19	1.29	1.84	10.37

Table 1.74: Monthly collision risk estimates for kittiwake calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	2.45	0.92	7.88	8.76	7.41	2.13	12.25	3.72	6.74	1.76	2.64	10.13
98.9	2.08	0.78	6.67	7.41	6.27	1.80	10.36	3.15	5.71	1.49	2.24	8.57
99.1	1.70	0.64	5.46	6.07	5.13	1.47	8.48	2.58	4.67	1.22	1.83	7.01
99.2	1.51	0.57	4.85	5.39	4.56	1.31	7.54	2.29	4.15	1.09	1.63	6.23
99.5	0.94	0.35	3.03	3.37	2.85	0.82	4.71	1.43	2.59	0.68	1.02	3.90
Density = Mean estimate + UCL												
98.7	3.62	1.85	13.47	8.76	7.41	2.13	12.25	3.72	6.74	1.76	2.64	15.45
98.9	3.06	1.56	11.40	7.41	6.27	1.80	10.36	3.15	5.71	1.49	2.24	13.07
99.1	2.50	1.28	9.33	6.07	5.13	1.47	8.48	2.58	4.67	1.22	1.83	10.70
99.2	2.23	1.14	8.29	5.39	4.56	1.31	7.54	2.29	4.15	1.09	1.63	9.51
99.5	1.39	0.71	5.18	3.37	2.85	0.82	4.71	1.43	2.59	0.68	1.02	5.94
Density = Upper confidence limit												
98.7	3.62	1.85	13.47	11.86	9.91	2.85	17.11	4.66	9.53	2.23	3.14	15.45
98.9	3.06	1.56	11.40	10.04	8.39	2.41	14.48	3.94	8.06	1.88	2.66	13.07
99.1	2.50	1.28	9.33	8.21	6.86	1.97	11.84	3.23	6.60	1.54	2.18	10.70

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.2	2.23	1.14	8.29	7.30	6.10	1.75	10.53	2.87	5.87	1.37	1.93	9.51
99.5	1.39	0.71	5.18	4.56	3.81	1.10	6.58	1.79	3.67	0.86	1.21	5.94
Density = Lower confidence limit												
98.7	1.43	0.29	4.03	5.66	4.91	1.41	7.39	2.79	3.96	1.30	2.14	5.96
98.9	1.21	0.24	3.41	4.79	4.16	1.19	6.25	2.36	3.35	1.10	1.81	5.05
99.1	0.99	0.20	2.79	3.92	3.40	0.98	5.11	1.93	2.74	0.90	1.48	4.13
99.2	0.88	0.18	2.48	3.48	3.02	0.87	4.55	1.71	2.44	0.80	1.32	3.67
99.5	0.55	0.11	1.55	2.18	1.89	0.54	2.84	1.07	1.52	0.50	0.82	2.29

Table 1.75: Monthly collision risk estimates for kittiwake calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	12.90	4.84	41.45	46.05	38.96	11.19	64.38	19.57	35.45	9.27	13.89	53.24
98.9	10.92	4.09	35.07	38.97	32.97	9.47	54.48	16.56	30.00	7.84	11.76	45.05
99.1	8.93	3.35	28.69	31.88	26.97	7.75	44.57	13.55	24.54	6.42	9.62	36.86
99.2	7.94	2.98	25.51	28.34	23.98	6.89	39.62	12.04	21.82	5.70	8.55	32.76
99.5	4.96	1.86	15.94	17.71	14.99	4.30	24.76	7.53	13.64	3.57	5.34	20.48
Density = Mean estimate + UCL												
98.7	19.02	9.71	70.81	46.05	38.96	11.19	64.38	19.57	35.45	9.27	13.89	81.23
98.9	16.09	8.21	59.92	38.97	32.97	9.47	54.48	16.56	30.00	7.84	11.76	68.73
99.1	13.17	6.72	49.02	31.88	26.97	7.75	44.57	13.55	24.54	6.42	9.62	56.23
99.2	11.70	5.97	43.58	28.34	23.98	6.89	39.62	12.04	21.82	5.70	8.55	49.99
99.5	7.31	3.73	27.23	17.71	14.99	4.30	24.76	7.53	13.64	3.57	5.34	31.24
Density = Upper confidence limit												
98.7	19.02	9.71	70.81	62.37	52.11	14.97	89.93	24.50	50.10	11.71	16.52	81.23
98.9	16.09	8.21	59.92	52.77	44.09	12.66	76.10	20.73	42.39	9.91	13.98	68.73
99.1	13.17	6.72	49.02	43.18	36.08	10.36	62.26	16.96	34.69	8.11	11.44	56.23

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.2	11.70	5.97	43.58	38.38	32.07	9.21	55.34	15.08	30.83	7.21	10.16	49.99
99.5	7.31	3.73	27.23	23.99	20.04	5.76	34.59	9.42	19.27	4.50	6.35	31.24
Density = Lower confidence limit												
98.7	7.53	1.51	21.21	29.74	25.81	7.41	38.84	14.65	20.81	6.83	11.27	31.35
98.9	6.37	1.28	17.95	25.16	21.84	6.27	32.86	12.39	17.60	5.78	9.53	26.52
99.1	5.21	1.05	14.68	20.59	17.87	5.13	26.89	10.14	14.40	4.73	7.80	21.70
99.2	4.63	0.93	13.05	18.30	15.89	4.56	23.90	9.01	12.80	4.20	6.93	19.29
99.5	2.90	0.58	8.16	11.44	9.93	2.85	14.94	5.63	8.00	2.63	4.33	12.06

Table 1.76: Monthly collision risk estimates for kittiwake calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98	3.80	1.42	12.21	13.56	11.47	3.29	18.96	5.76	10.44	2.73	4.09	15.68
Density = Mean estimate + UCL												
98	5.60	2.86	20.85	13.56	11.47	3.29	18.96	5.76	10.44	2.73	4.09	23.92
Density = Upper confidence limit												
98	5.60	2.86	20.85	18.37	15.35	4.41	26.48	7.21	14.75	3.45	4.86	5.60
Density = Lower confidence limit												
98	2.22	0.45	6.25	8.76	7.60	2.18	11.44	4.31	6.13	2.01	3.32	9.23

Table 1.77: Monthly collision risk estimates for kittiwake calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	2.45	0.92	7.88	8.76	7.41	2.13	12.25	3.72	6.74	1.76	2.64	10.13
98.9	2.08	0.78	6.67	7.41	6.27	1.80	10.36	3.15	5.71	1.49	2.24	8.57

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.1	1.70	0.64	5.46	6.07	5.13	1.47	8.48	2.58	4.67	1.22	1.83	7.01
99.2	1.51	0.57	4.85	5.39	4.56	1.31	7.54	2.29	4.15	1.09	1.63	6.23
99.5	0.94	0.35	3.03	3.37	2.85	0.82	4.71	1.43	2.59	0.68	1.02	3.90
PCH = Upper confidence metric												
98.7	5.52	2.07	17.74	19.71	16.68	4.79	27.56	8.38	15.18	3.97	5.95	22.79
98.9	4.67	1.75	15.01	16.68	14.11	4.05	23.32	7.09	12.84	3.36	5.03	19.28
99.1	3.82	1.43	12.28	13.65	11.55	3.32	19.08	5.80	10.51	2.75	4.12	15.78
99.2	3.40	1.27	10.92	12.13	10.26	2.95	16.96	5.16	9.34	2.44	3.66	14.02
99.5	2.12	0.80	6.82	7.58	6.41	1.84	10.60	3.22	5.84	1.53	2.29	8.76

Table 1.78: Monthly collision risk estimates for kittiwake calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
98.7	3.62	1.85	13.47	8.76	7.41	2.13	12.25	3.72	6.74	1.76	2.64	15.45
98.9	3.06	1.56	11.40	7.41	6.27	1.80	10.36	3.15	5.71	1.49	2.24	13.07
99.1	2.50	1.28	9.33	6.07	5.13	1.47	8.48	2.58	4.67	1.22	1.83	10.70
99.2	2.23	1.14	8.29	5.39	4.56	1.31	7.54	2.29	4.15	1.09	1.63	9.51
99.5	1.39	0.71	5.18	3.37	2.85	0.82	4.71	1.43	2.59	0.68	1.02	5.94
PCH = Upper confidence metric												
98.7	8.14	4.15	30.31	19.71	16.68	4.79	27.56	8.38	15.18	3.97	5.95	34.77
98.9	6.89	3.52	25.65	16.68	14.11	4.05	23.32	7.09	12.84	3.36	5.03	29.42
99.1	5.64	2.88	20.98	13.65	11.55	3.32	19.08	5.80	10.51	2.75	4.12	24.07
99.2	5.01	2.56	18.65	12.13	10.26	2.95	16.96	5.16	9.34	2.44	3.66	21.40
99.5	3.13	1.60	11.66	7.58	6.41	1.84	10.60	3.22	5.84	1.53	2.29	13.37

Table 1.79: Monthly collision risk estimates for kittiwake calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	12.90	4.84	41.45	46.05	38.96	11.19	64.38	19.57	35.45	9.27	13.89	53.24
98.9	10.92	4.09	35.07	38.97	32.97	9.47	54.48	16.56	30.00	7.84	11.76	45.05
99.1	8.93	3.35	28.69	31.88	26.97	7.75	44.57	13.55	24.54	6.42	9.62	36.86
99.2	7.94	2.98	25.51	28.34	23.98	6.89	39.62	12.04	21.82	5.70	8.55	32.76
99.5	4.96	1.86	15.94	17.71	14.99	4.30	24.76	7.53	13.64	3.57	5.34	20.48
Flight height distribution = Upper confidence limit												
98.7	16.89	6.33	54.26	60.29	51.01	14.65	84.29	25.62	46.41	12.14	18.19	69.70
98.9	14.29	5.36	45.91	51.01	43.16	12.39	71.32	21.68	39.27	10.27	15.39	58.97
99.1	11.69	4.38	37.56	41.74	35.31	10.14	58.35	17.74	32.13	8.40	12.59	48.25
99.2	10.39	3.90	33.39	37.10	31.39	9.01	51.87	15.77	28.56	7.47	11.19	42.89
99.5	6.50	2.43	20.87	23.19	19.62	5.63	32.42	9.85	17.85	4.67	7.00	26.81
Flight height distribution = Lower confidence limit												
98.7	8.44	3.17	27.13	30.14	25.50	7.32	42.14	12.81	23.21	6.07	9.09	34.85
98.9	7.15	2.68	22.96	25.51	21.58	6.20	35.66	10.84	19.64	5.13	7.69	29.49
99.1	5.85	2.19	18.78	20.87	17.66	5.07	29.18	8.87	16.07	4.20	6.30	24.13
99.2	5.20	1.95	16.70	18.55	15.69	4.51	25.93	7.88	14.28	3.73	5.60	21.44
99.5	3.25	1.22	10.43	11.59	9.81	2.82	16.21	4.93	8.93	2.33	3.50	13.40

Table 1.80: Monthly collision risk estimates for kittiwake calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	19.02	9.71	70.81	46.05	38.96	11.19	64.38	19.57	35.45	9.27	13.89	81.23
98.9	16.09	8.21	59.92	38.97	32.97	9.47	54.48	16.56	30.00	7.84	11.76	68.73
99.1	13.17	6.72	49.02	31.88	26.97	7.75	44.57	13.55	24.54	6.42	9.62	56.23
99.2	11.70	5.97	43.58	28.34	23.98	6.89	39.62	12.04	21.82	5.70	8.55	49.99
99.5	7.31	3.73	27.23	17.71	14.99	4.30	24.76	7.53	13.64	3.57	5.34	31.24

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Upper confidence limit												
98.7	24.90	12.71	92.70	60.29	51.01	14.65	84.29	25.62	46.41	12.14	18.19	106.33
98.9	21.07	10.75	78.44	51.01	43.16	12.39	71.32	21.68	39.27	10.27	15.39	89.98
99.1	17.24	8.80	64.17	41.74	35.31	10.14	58.35	17.74	32.13	8.40	12.59	73.62
99.2	15.32	7.82	57.04	37.10	31.39	9.01	51.87	15.77	28.56	7.47	11.19	65.44
99.5	9.58	4.89	35.65	23.19	19.62	5.63	32.42	9.85	17.85	4.67	7.00	40.90
Flight height distribution = Lower confidence limit												
98.7	12.45	6.35	46.35	30.14	25.50	7.32	42.14	12.81	23.21	6.07	9.09	53.17
98.9	10.53	5.38	39.22	25.51	21.58	6.20	35.66	10.84	19.64	5.13	7.69	44.99
99.1	8.62	4.40	32.09	20.87	17.66	5.07	29.18	8.87	16.07	4.20	6.30	36.81
99.2	7.66	3.91	28.52	18.55	15.69	4.51	25.93	7.88	14.28	3.73	5.60	32.72
99.5	4.79	2.44	17.83	11.59	9.81	2.82	16.21	4.93	8.93	2.33	3.50	20.45

Table 1.81: Monthly collision risk estimates for kittiwake calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98	3.80	1.42	12.21	13.56	11.47	3.29	18.96	5.76	10.44	2.73	4.09	15.68
Flight height distribution = Upper confidence metric												
98	5.39	2.02	17.32	19.24	16.28	4.67	26.90	8.18	14.81	3.87	5.80	22.24
Flight height distribution = Lower confidence limit												
98	2.23	0.84	7.17	7.96	6.74	1.93	11.13	3.38	6.13	1.60	2.40	9.21

Table 1.82: Monthly collision risk estimates for kittiwake calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
98	5.60	2.86	20.85	13.56	11.47	3.29	18.96	5.76	10.44	2.73	4.09	23.92
Flight height distribution = Upper confidence metric												
98	7.95	4.05	29.58	19.24	16.28	4.67	26.90	8.18	14.81	3.87	5.80	33.94
Flight height distribution = Lower confidence limit												
98	3.29	1.68	12.25	7.96	6.74	1.93	11.13	3.38	6.13	1.60	2.40	14.05

Lesser black-backed gull

Table 1.83: Monthly collision risk estimates for lesser black-backed gull calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	0.00	0.00	0.68	0.30	7.92	5.10	1.44	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.57	0.25	6.60	4.25	1.20	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.46	0.20	5.28	3.40	0.96	0.00	0.00	0.00	0.00
Density = Upper confidence limit												
99.4	0.00	0.00	0.00	1.29	0.68	12.54	8.97	2.91	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.08	0.57	10.45	7.47	2.43	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.86	0.46	8.36	5.98	1.94	0.00	0.00	0.00	0.00
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.07	0.00	3.30	1.24	0.00	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.06	0.00	2.75	1.03	0.00	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.05	0.00	2.20	0.83	0.00	0.00	0.00	0.00	0.00

Table 1.84: Monthly collision risk estimates for lesser black-backed gull calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	0.00	0.00	0.83	0.37	9.66	6.22	1.76	0.00	0.00	0.00	0.00

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	0.00	0.00	0.00	0.69	0.31	8.05	5.19	1.47	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.56	0.25	6.44	4.15	1.17	0.00	0.00	0.00	0.00
Density = Upper confidence limit												
99.4	0.00	0.00	0.00	1.58	0.83	15.29	10.94	3.55	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.31	0.69	12.74	9.11	2.96	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	1.05	0.56	10.19	7.29	2.37	0.00	0.00	0.00	0.00
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.09	0.00	4.02	1.51	0.00	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.07	0.00	3.35	1.26	0.00	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.06	0.00	2.68	1.01	0.00	0.00	0.00	0.00	0.00

Table 1.85: Monthly collision risk estimates for lesser black-backed gull calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	0.00	0.00	0.00	0.55	0.24	6.36	4.10	1.16	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.46	0.20	5.38	3.47	0.98	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.38	0.17	4.40	2.84	0.80	0.00	0.00	0.00	0.00
Density = Upper confidence limit												
98.7	0.00	0.00	0.00	1.04	0.55	10.07	7.20	2.34	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.88	0.46	8.52	6.09	1.98	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.72	0.38	6.97	4.98	1.62	0.00	0.00	0.00	0.00
Density = Lower confidence limit												
98.7	0.00	0.00	0.00	0.06	0.00	2.65	0.99	0.00	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.05	0.00	2.24	0.84	0.00	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.04	0.00	1.83	0.69	0.00	0.00	0.00	0.00	0.00

Table 1.86: Monthly collision risk estimates for lesser black-backed gull calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	0.00	0.00	0.00	0.68	0.30	7.92	5.10	1.44	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.57	0.25	6.60	4.25	1.20	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.46	0.20	5.28	3.40	0.96	0.00	0.00	0.00	0.00
PCH = Upper confidence metric												
99.4	0.00	0.00	0.00	1.59	0.70	18.47	11.91	3.36	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.33	0.59	15.39	9.92	2.80	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	1.06	0.47	12.31	7.94	2.24	0.00	0.00	0.00	0.00

Table 1.87: Monthly collision risk estimates for lesser black-backed gull calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	0.00	0.00	0.00	0.83	0.37	9.66	6.22	1.76	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.69	0.31	8.05	5.19	1.47	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.56	0.25	6.44	4.15	1.17	0.00	0.00	0.00	0.00
Flight height distribution = Upper confidence limit												
99.4	0.00	0.00	0.00	1.76	0.78	20.43	13.17	3.72	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.47	0.65	17.03	10.98	3.10	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	1.17	0.52	13.62	8.78	2.48	0.00	0.00	0.00	0.00
Flight height distribution = Lower confidence limit												
99.4	0.00	0.00	0.00	0.47	0.21	5.49	3.54	1.00	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.39	0.17	4.58	2.95	0.83	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.32	0.14	3.66	2.36	0.67	0.00	0.00	0.00	0.00

Table 1.88: Monthly collision risk estimates for lesser black-backed gull calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	0.00	0.00	0.00	0.55	0.24	6.36	4.10	1.16	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.46	0.20	5.38	3.47	0.98	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.38	0.17	4.40	2.84	0.80	0.00	0.00	0.00	0.00
Flight height distribution = Upper confidence limit												
98.7	0.00	0.00	0.00	1.62	0.72	18.78	12.11	3.42	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	1.37	0.61	15.89	10.24	2.89	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	1.12	0.50	13.00	8.38	2.37	0.00	0.00	0.00	0.00
Flight height distribution = Lower confidence limit												
98.7	0.00	0.00	0.00	0.26	0.11	2.97	1.92	0.54	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.22	0.10	2.52	1.62	0.46	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.18	0.08	2.06	1.33	0.37	0.00	0.00	0.00	0.00

Table 1.89: Monthly collision risk estimates for lesser black-backed gull calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	0.00	0.00	0.79	0.34	8.65	5.62	1.63	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.66	0.28	7.21	4.68	1.36	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.52	0.22	5.77	3.75	1.09	0.00	0.00	0.00	0.00
Density = Upper confidence limit												
99.4	0.00	0.00	0.00	1.49	0.76	13.70	9.87	3.30	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.24	0.63	11.42	8.23	2.75	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.99	0.51	9.14	6.58	2.20	0.00	0.00	0.00	0.00
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.08	0.00	3.60	1.36	0.00	0.00	0.00	0.00	0.00

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	0.00	0.00	0.00	0.07	0.00	3.00	1.14	0.00	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.06	0.00	2.40	0.91	0.00	0.00	0.00	0.00	0.00

Table 1.90: Monthly collision risk estimates for lesser black-backed gull calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	0.00	0.00	0.96	0.41	10.56	6.85	1.99	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.80	0.34	8.80	5.71	1.66	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.64	0.27	7.04	4.57	1.33	0.00	0.00	0.00	0.00
Density = Upper confidence limit												
99.4	0.00	0.00	0.00	1.82	0.93	16.72	12.04	4.03	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.51	0.77	13.93	10.04	3.36	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	1.21	0.62	11.14	8.03	2.68	0.00	0.00	0.00	0.00
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.10	0.00	4.39	1.66	0.00	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.08	0.00	3.66	1.39	0.00	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.07	0.00	2.93	1.11	0.00	0.00	0.00	0.00	0.00

Table 1.91: Monthly collision risk estimates for lesser black-backed gull calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	0.00	0.00	0.00	0.63	0.27	6.95	4.51	1.31	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.53	0.23	5.88	3.82	1.11	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.44	0.19	4.81	3.12	0.91	0.00	0.00	0.00	0.00
Density = Upper confidence limit												
98.7	0.00	0.00	0.00	1.20	0.61	11.01	7.93	2.65	0.00	0.00	0.00	0.00

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
98.9	0.00	0.00	0.00	1.01	0.52	9.31	6.71	2.24	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.83	0.42	7.62	5.49	1.84	0.00	0.00	0.00	0.00
Density = Lower confidence limit												
98.7	0.00	0.00	0.00	0.07	0.00	2.89	1.10	0.00	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.06	0.00	2.45	0.93	0.00	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.05	0.00	2.00	0.76	0.00	0.00	0.00	0.00	0.00

Table 1.92: Monthly collision risk estimates for lesser black-backed gull calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	0.00	0.00	0.00	0.79	0.34	8.65	5.62	1.63	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.66	0.28	7.21	4.68	1.36	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.52	0.22	5.77	3.75	1.09	0.00	0.00	0.00	0.00
PCH = Upper confidence metric												
99.4	0.00	0.00	0.00	1.83	0.78	20.19	13.11	3.81	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.53	0.65	16.83	10.93	3.18	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	1.22	0.52	13.46	8.74	2.54	0.00	0.00	0.00	0.00

Table 1.93: Monthly collision risk estimates for lesser black-backed gull calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	0.00	0.00	0.00	0.96	0.41	10.56	6.85	1.99	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.80	0.34	8.80	5.71	1.66	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.64	0.27	7.04	4.57	1.33	0.00	0.00	0.00	0.00
Flight height distribution = Upper confidence limit												

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.4	0.00	0.00	0.00	2.03	0.87	22.34	14.50	4.22	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	1.69	0.72	18.61	12.09	3.51	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	1.35	0.58	14.89	9.67	2.81	0.00	0.00	0.00	0.00
Flight height distribution = Lower confidence limit												
99.4	0.00	0.00	0.00	0.55	0.23	6.01	3.90	1.13	0.00	0.00	0.00	0.00
99.5	0.00	0.00	0.00	0.45	0.19	5.00	3.25	0.94	0.00	0.00	0.00	0.00
99.6	0.00	0.00	0.00	0.36	0.16	4.00	2.60	0.76	0.00	0.00	0.00	0.00

Table 1.94: Monthly collision risk estimates for lesser black-backed gull calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	0.00	0.00	0.00	0.63	0.27	6.95	4.51	1.31	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.53	0.23	5.88	3.82	1.11	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.44	0.19	4.81	3.12	0.91	0.00	0.00	0.00	0.00
Flight height distribution = Upper confidence limit												
98.7	0.00	0.00	0.00	1.87	0.80	20.53	13.33	3.88	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	1.58	0.67	17.37	11.28	3.28	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	1.29	0.55	14.21	9.23	2.68	0.00	0.00	0.00	0.00
Flight height distribution = Lower confidence limit												
98.7	0.00	0.00	0.00	0.30	0.13	3.25	2.11	0.61	0.00	0.00	0.00	0.00
98.9	0.00	0.00	0.00	0.25	0.11	2.75	1.79	0.52	0.00	0.00	0.00	0.00
99.1	0.00	0.00	0.00	0.20	0.09	2.25	1.46	0.42	0.00	0.00	0.00	0.00

Herring gull

Table 1.95: Monthly collision risk estimates for herring gull calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	1.09	0.00	0.00	0.00	0.40	0.40	0.00	1.85	0.00	0.00	2.63
99.5	0.00	0.91	0.00	0.00	0.00	0.33	0.33	0.00	1.54	0.00	0.00	2.19
99.6	0.00	0.72	0.00	0.00	0.00	0.26	0.27	0.00	1.23	0.00	0.00	1.75
Density = Mean estimate + UCL												
99.4	0.00	2.17	0.00	0.00	0.00	0.40	0.40	0.00	1.85	0.00	0.00	4.74
99.5	0.00	1.81	0.00	0.00	0.00	0.33	0.33	0.00	1.54	0.00	0.00	3.95
99.6	0.00	1.45	0.00	0.00	0.00	0.26	0.27	0.00	1.23	0.00	0.00	3.16
Density = Upper confidence limit												
99.4	0.00	2.17	0.00	0.00	0.00	1.39	1.20	0.00	4.03	0.00	0.00	4.74
99.5	0.00	1.81	0.00	0.00	0.00	1.16	1.00	0.00	3.36	0.00	0.00	3.95
99.6	0.00	1.45	0.00	0.00	0.00	0.92	0.80	0.00	2.69	0.00	0.00	3.16
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79
99.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66
99.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53

Table 1.96: Monthly collision risk estimates for herring gull calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	1.52	0.00	0.00	0.00	0.55	0.56	0.00	2.58	0.00	0.00	3.67
99.5	0.00	1.26	0.00	0.00	0.00	0.46	0.47	0.00	2.15	0.00	0.00	3.06
99.6	0.00	1.01	0.00	0.00	0.00	0.37	0.37	0.00	1.72	0.00	0.00	2.45
Density = Mean estimate + UCL												
99.4	0.00	3.03	0.00	0.00	0.00	0.55	0.56	0.00	2.58	0.00	0.00	6.61

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	0.00	2.53	0.00	0.00	0.00	0.46	0.47	0.00	2.15	0.00	0.00	5.51
99.6	0.00	2.02	0.00	0.00	0.00	0.37	0.37	0.00	1.72	0.00	0.00	4.41
Density = Upper confidence limit												
99.4	0.00	3.03	0.00	0.00	0.00	1.94	1.68	0.00	5.63	0.00	0.00	0.00
99.5	0.00	2.53	0.00	0.00	0.00	1.61	1.40	0.00	4.69	0.00	0.00	0.00
99.6	0.00	2.02	0.00	0.00	0.00	1.29	1.12	0.00	3.75	0.00	0.00	0.00
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10
99.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92
99.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73

Table 1.97: Monthly collision risk estimates for herring gull calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.8	0.00	1.02	0.00	0.00	0.00	0.37	0.38	0.00	1.73	0.00	0.00	2.47
99.0	0.00	0.85	0.00	0.00	0.00	0.31	0.31	0.00	1.45	0.00	0.00	2.06
99.2	0.00	0.68	0.00	0.00	0.00	0.25	0.25	0.00	1.16	0.00	0.00	1.65
Density = Mean estimate + UCL												
98.8	0.00	2.04	0.00	0.00	0.00	0.37	0.38	0.00	1.73	0.00	0.00	4.44
99.0	0.00	1.70	0.00	0.00	0.00	0.31	0.31	0.00	1.45	0.00	0.00	3.70
99.2	0.00	1.36	0.00	0.00	0.00	0.25	0.25	0.00	1.16	0.00	0.00	2.96
Density = Upper confidence limit												
98.8	0.00	2.04	0.00	0.00	0.00	1.30	1.13	0.00	3.78	0.00	0.00	4.44
99.0	0.00	1.70	0.00	0.00	0.00	1.08	0.94	0.00	3.15	0.00	0.00	3.70
99.2	0.00	1.36	0.00	0.00	0.00	0.87	0.75	0.00	2.52	0.00	0.00	2.96
Density = Lower confidence limit												
98.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62
99.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49

Table 1.98: Monthly collision risk estimates for herring gull calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	0.00	1.09	0.00	0.00	0.00	0.40	0.40	0.00	1.85	0.00	0.00	2.63
99.5	0.00	0.91	0.00	0.00	0.00	0.33	0.33	0.00	1.54	0.00	0.00	2.19
99.6	0.00	0.72	0.00	0.00	0.00	0.26	0.27	0.00	1.23	0.00	0.00	1.75
PCH = Upper confidence metric												
99.4	0.00	2.01	0.00	0.00	0.00	0.73	0.74	0.00	3.42	0.00	0.00	4.87
99.5	0.00	1.68	0.00	0.00	0.00	0.61	0.62	0.00	2.85	0.00	0.00	4.06
99.6	0.00	1.34	0.00	0.00	0.00	0.49	0.50	0.00	2.28	0.00	0.00	3.25

Table 1.99: Monthly collision risk estimates for herring gull calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	0.00	2.17	0.00	0.00	0.00	0.40	0.40	0.00	1.85	0.00	0.00	4.74
99.5	0.00	1.81	0.00	0.00	0.00	0.33	0.33	0.00	1.54	0.00	0.00	3.95
99.6	0.00	1.45	0.00	0.00	0.00	0.26	0.27	0.00	1.23	0.00	0.00	3.16
PCH = Upper confidence metric												
99.4	0.00	4.02	0.00	0.00	0.00	0.73	0.74	0.00	3.42	0.00	0.00	8.77
99.5	0.00	3.35	0.00	0.00	0.00	0.61	0.62	0.00	2.85	0.00	0.00	7.31
99.6	0.00	2.68	0.00	0.00	0.00	0.49	0.50	0.00	2.28	0.00	0.00	5.85

Table 1.100: Monthly collision risk estimates for herring gull calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	0.00	1.52	0.00	0.00	0.00	0.55	0.56	0.00	2.58	0.00	0.00	3.67
99.5	0.00	1.26	0.00	0.00	0.00	0.46	0.47	0.00	2.15	0.00	0.00	3.06
99.6	0.00	1.01	0.00	0.00	0.00	0.37	0.37	0.00	1.72	0.00	0.00	2.45
Flight height distribution = Upper confidence limit												
99.4	0.00	2.55	0.00	0.00	0.00	0.93	0.94	0.00	4.33	0.00	0.00	6.17
99.5	0.00	2.12	0.00	0.00	0.00	0.77	0.78	0.00	3.61	0.00	0.00	5.14
99.6	0.00	1.70	0.00	0.00	0.00	0.62	0.63	0.00	2.89	0.00	0.00	4.11
Flight height distribution = Lower confidence limit												
99.4	0.00	1.02	0.00	0.00	0.00	0.37	0.38	0.00	1.73	0.00	0.00	2.46
99.5	0.00	0.85	0.00	0.00	0.00	0.31	0.31	0.00	1.44	0.00	0.00	2.05
99.6	0.00	0.68	0.00	0.00	0.00	0.25	0.25	0.00	1.15	0.00	0.00	1.64

Table 1.101: Monthly collision risk estimates for herring gull calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	0.00	3.03	0.00	0.00	0.00	0.55	0.56	0.00	2.58	0.00	0.00	6.61
99.5	0.00	2.53	0.00	0.00	0.00	0.46	0.47	0.00	2.15	0.00	0.00	5.51
99.6	0.00	2.02	0.00	0.00	0.00	0.37	0.37	0.00	1.72	0.00	0.00	4.41
Flight height distribution = Upper confidence limit												
99.4	0.00	5.10	0.00	0.00	0.00	0.93	0.94	0.00	4.33	0.00	0.00	11.10
99.5	0.00	4.25	0.00	0.00	0.00	0.77	0.78	0.00	3.61	0.00	0.00	9.25
99.6	0.00	3.40	0.00	0.00	0.00	0.62	0.63	0.00	2.89	0.00	0.00	7.40
Flight height distribution = Lower confidence limit												
99.4	0.00	2.03	0.00	0.00	0.00	0.37	0.38	0.00	1.73	0.00	0.00	4.43

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	0.00	1.70	0.00	0.00	0.00	0.31	0.31	0.00	1.44	0.00	0.00	3.70
99.6	0.00	1.36	0.00	0.00	0.00	0.25	0.25	0.00	1.15	0.00	0.00	2.96

Table 1.102: Monthly collision risk estimates for herring gull calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.8	0.00	1.02	0.00	0.00	0.00	0.37	0.38	0.00	1.73	0.00	0.00	2.47
99.0	0.00	0.85	0.00	0.00	0.00	0.31	0.31	0.00	1.45	0.00	0.00	2.06
99.2	0.00	0.68	0.00	0.00	0.00	0.25	0.25	0.00	1.16	0.00	0.00	1.65
Flight height distribution = Upper confidence limit												
98.8	0.00	2.44	0.00	0.00	0.00	0.89	0.90	0.00	4.14	0.00	0.00	5.90
99.0	0.00	2.03	0.00	0.00	0.00	0.74	0.75	0.00	3.45	0.00	0.00	4.92
99.2	0.00	1.62	0.00	0.00	0.00	0.59	0.60	0.00	2.76	0.00	0.00	3.93
Flight height distribution = Lower confidence limit												
98.8	0.00	0.60	0.00	0.00	0.00	0.22	0.22	0.00	1.01	0.00	0.00	1.44
99.0	0.00	0.50	0.00	0.00	0.00	0.18	0.18	0.00	0.84	0.00	0.00	1.20
99.2	0.00	0.40	0.00	0.00	0.00	0.14	0.15	0.00	0.68	0.00	0.00	0.96

Table 1.103: Monthly collision risk estimates for herring gull calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.8	0.00	2.04	0.00	0.00	0.00	0.37	0.38	0.00	1.73	0.00	0.00	4.44
99.0	0.00	1.70	0.00	0.00	0.00	0.31	0.31	0.00	1.45	0.00	0.00	3.70
99.2	0.00	1.36	0.00	0.00	0.00	0.25	0.25	0.00	1.16	0.00	0.00	2.96
Flight height distribution = Upper confidence limit												

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
98.8	0.00	4.87	0.00	0.00	0.00	0.89	0.90	0.00	4.14	0.00	0.00	10.62
99.0	0.00	4.06	0.00	0.00	0.00	0.74	0.75	0.00	3.45	0.00	0.00	8.85
99.2	0.00	3.25	0.00	0.00	0.00	0.59	0.60	0.00	2.76	0.00	0.00	7.08
Flight height distribution = Lower confidence limit												
98.8	0.00	1.19	0.00	0.00	0.00	0.22	0.22	0.00	1.01	0.00	0.00	2.60
99.0	0.00	0.99	0.00	0.00	0.00	0.18	0.18	0.00	0.84	0.00	0.00	2.17
99.2	0.00	0.79	0.00	0.00	0.00	0.14	0.15	0.00	0.68	0.00	0.00	1.73

Table 1.104: Monthly collision risk estimates for herring gull calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	1.38	0.00	0.00	0.00	0.43	0.44	0.00	2.18	0.00	0.00	3.56
99.5	0.00	1.15	0.00	0.00	0.00	0.36	0.37	0.00	1.82	0.00	0.00	2.97
99.6	0.00	0.92	0.00	0.00	0.00	0.29	0.29	0.00	1.45	0.00	0.00	2.38
Density = Mean estimate + UCL												
99.4	0.00	2.76	0.00	0.00	0.00	0.43	0.44	0.00	2.18	0.00	0.00	6.41
99.5	0.00	2.30	0.00	0.00	0.00	0.36	0.37	0.00	1.82	0.00	0.00	5.35
99.6	0.00	1.84	0.00	0.00	0.00	0.29	0.29	0.00	1.45	0.00	0.00	4.28
Density = Upper confidence limit												
99.4	0.00	2.76	0.00	0.00	0.00	1.52	1.32	0.00	4.76	0.00	0.00	6.41
99.5	0.00	2.30	0.00	0.00	0.00	1.26	1.10	0.00	3.97	0.00	0.00	5.35
99.6	0.00	1.84	0.00	0.00	0.00	1.01	0.88	0.00	3.17	0.00	0.00	4.28
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07
99.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89
99.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71

Table 1.105: Monthly collision risk estimates for herring gull calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	0.00	1.92	0.00	0.00	0.00	0.60	0.62	0.00	3.05	0.00	0.00	4.97
99.5	0.00	1.60	0.00	0.00	0.00	0.50	0.51	0.00	2.54	0.00	0.00	4.15
99.6	0.00	1.28	0.00	0.00	0.00	0.40	0.41	0.00	2.03	0.00	0.00	3.32
Density = Mean estimate + UCL												
99.4	0.00	3.85	0.00	0.00	0.00	0.60	0.62	0.00	3.05	0.00	0.00	8.95
99.5	0.00	3.21	0.00	0.00	0.00	0.50	0.51	0.00	2.54	0.00	0.00	7.46
99.6	0.00	2.57	0.00	0.00	0.00	0.40	0.41	0.00	2.03	0.00	0.00	5.97
Density = Upper confidence limit												
99.4	0.00	3.85	0.00	0.00	0.00	2.12	1.85	0.00	6.64	0.00	0.00	8.95
99.5	0.00	3.21	0.00	0.00	0.00	1.76	1.54	0.00	5.54	0.00	0.00	7.46
99.6	0.00	2.57	0.00	0.00	0.00	1.41	1.23	0.00	4.43	0.00	0.00	5.97
Density = Lower confidence limit												
99.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49
99.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.24
99.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99

Table 1.106: Monthly collision risk estimates for herring gull calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.8	0.00	1.29	0.00	0.00	0.00	0.41	0.41	0.00	2.05	0.00	0.00	3.34
99.0	0.00	1.08	0.00	0.00	0.00	0.34	0.35	0.00	1.71	0.00	0.00	2.79
99.2	0.00	0.86	0.00	0.00	0.00	0.27	0.28	0.00	1.36	0.00	0.00	2.23
Density = Mean estimate + UCL												
98.8	0.00	2.59	0.00	0.00	0.00	0.41	0.41	0.00	2.05	0.00	0.00	6.02
99.0	0.00	2.16	0.00	0.00	0.00	0.34	0.35	0.00	1.71	0.00	0.00	5.02

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.2	0.00	1.72	0.00	0.00	0.00	0.27	0.28	0.00	1.36	0.00	0.00	4.01
Density = Upper confidence limit												
98.8	0.00	2.59	0.00	0.00	0.00	1.42	1.24	0.00	4.47	0.00	0.00	6.02
99.0	0.00	2.16	0.00	0.00	0.00	1.19	1.04	0.00	3.72	0.00	0.00	5.02
99.2	0.00	1.72	0.00	0.00	0.00	0.95	0.83	0.00	2.98	0.00	0.00	4.01
Density = Lower confidence limit												
98.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
99.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84
99.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67

Table 1.107: Monthly collision risk estimates for herring gull calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	0.00	1.38	0.00	0.00	0.00	0.43	0.44	0.00	2.18	0.00	0.00	3.56
99.5	0.00	1.15	0.00	0.00	0.00	0.36	0.37	0.00	1.82	0.00	0.00	2.97
99.6	0.00	0.92	0.00	0.00	0.00	0.29	0.29	0.00	1.45	0.00	0.00	2.38
PCH = Upper confidence metric												
99.4	0.00	2.55	0.00	0.00	0.00	0.80	0.82	0.00	4.04	0.00	0.00	6.60
99.5	0.00	2.13	0.00	0.00	0.00	0.67	0.68	0.00	3.37	0.00	0.00	5.50
99.6	0.00	1.70	0.00	0.00	0.00	0.53	0.55	0.00	2.69	0.00	0.00	4.40

Table 1.108: Monthly collision risk estimates for herring gull calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	0.00	2.76	0.00	0.00	0.00	0.43	0.44	0.00	2.18	0.00	0.00	6.41

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	0.00	2.30	0.00	0.00	0.00	0.36	0.37	0.00	1.82	0.00	0.00	5.35
99.6	0.00	1.84	0.00	0.00	0.00	0.29	0.29	0.00	1.45	0.00	0.00	4.28
PCH = Upper confidence metric												
99.4	0.00	5.10	0.00	0.00	0.00	0.80	0.82	0.00	4.04	0.00	0.00	0.00
99.5	0.00	4.25	0.00	0.00	0.00	0.67	0.68	0.00	3.37	0.00	0.00	0.00
99.6	0.00	3.40	0.00	0.00	0.00	0.53	0.55	0.00	2.69	0.00	0.00	0.00

Table 1.109: Monthly collision risk estimates for herring gull calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	0.00	1.92	0.00	0.00	0.00	0.60	0.62	0.00	3.05	0.00	0.00	4.97
99.5	0.00	1.60	0.00	0.00	0.00	0.50	0.51	0.00	2.54	0.00	0.00	4.15
99.6	0.00	1.28	0.00	0.00	0.00	0.40	0.41	0.00	2.03	0.00	0.00	3.32
Flight height distribution = Upper confidence limit												
99.4	0.00	3.23	0.00	0.00	0.00	1.02	1.04	0.00	5.11	0.00	0.00	8.35
99.5	0.00	2.69	0.00	0.00	0.00	0.85	0.86	0.00	4.26	0.00	0.00	6.96
99.6	0.00	2.15	0.00	0.00	0.00	0.68	0.69	0.00	3.41	0.00	0.00	5.57
Flight height distribution = Lower confidence limit												
99.4	0.00	1.29	0.00	0.00	0.00	0.41	0.41	0.00	2.04	0.00	0.00	3.34
99.5	0.00	1.08	0.00	0.00	0.00	0.34	0.34	0.00	1.70	0.00	0.00	2.78
99.6	0.00	0.86	0.00	0.00	0.00	0.27	0.28	0.00	1.36	0.00	0.00	2.22

Table 1.110: Monthly collision risk estimates for herring gull calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.4	0.00	3.85	0.00	0.00	0.00	0.60	0.62	0.00	3.05	0.00	0.00	8.95
99.5	0.00	3.21	0.00	0.00	0.00	0.50	0.51	0.00	2.54	0.00	0.00	7.46
99.6	0.00	2.57	0.00	0.00	0.00	0.40	0.41	0.00	2.03	0.00	0.00	5.97
Flight height distribution = Upper confidence limit												
99.4	0.00	6.46	0.00	0.00	0.00	1.02	1.04	0.00	5.11	0.00	0.00	15.04
99.5	0.00	5.38	0.00	0.00	0.00	0.85	0.86	0.00	4.26	0.00	0.00	12.53
99.6	0.00	4.31	0.00	0.00	0.00	0.68	0.69	0.00	3.41	0.00	0.00	10.03
Flight height distribution = Lower confidence limit												
99.4	0.00	2.58	0.00	0.00	0.00	0.41	0.41	0.00	2.04	0.00	0.00	6.01
99.5	0.00	2.15	0.00	0.00	0.00	0.34	0.34	0.00	1.70	0.00	0.00	5.00
99.6	0.00	1.72	0.00	0.00	0.00	0.27	0.28	0.00	1.36	0.00	0.00	4.00

Table 1.111: Monthly collision risk estimates for herring gull calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.8	0.00	1.29	0.00	0.00	0.00	0.41	0.41	0.00	2.05	0.00	0.00	3.34
99.0	0.00	1.08	0.00	0.00	0.00	0.34	0.35	0.00	1.71	0.00	0.00	2.79
99.2	0.00	0.86	0.00	0.00	0.00	0.27	0.28	0.00	1.36	0.00	0.00	2.23
Flight height distribution = Upper confidence limit												
98.8	0.00	3.09	0.00	0.00	0.00	0.97	0.99	0.00	4.89	0.00	0.00	7.99
99.0	0.00	2.57	0.00	0.00	0.00	0.81	0.82	0.00	4.07	0.00	0.00	6.66
99.2	0.00	2.06	0.00	0.00	0.00	0.65	0.66	0.00	3.26	0.00	0.00	5.33
Flight height distribution = Lower confidence limit												
98.8	0.00	0.76	0.00	0.00	0.00	0.24	0.24	0.00	1.20	0.00	0.00	1.95
99.0	0.00	0.63	0.00	0.00	0.00	0.20	0.20	0.00	1.00	0.00	0.00	1.63
99.2	0.00	0.50	0.00	0.00	0.00	0.16	0.16	0.00	0.80	0.00	0.00	1.30

Table 1.112: Monthly collision risk estimates for herring gull calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.8	0.00	2.59	0.00	0.00	0.00	0.41	0.41	0.00	2.05	0.00	0.00	6.02
99.0	0.00	2.16	0.00	0.00	0.00	0.34	0.35	0.00	1.71	0.00	0.00	5.02
99.2	0.00	1.72	0.00	0.00	0.00	0.27	0.28	0.00	1.36	0.00	0.00	4.01
Flight height distribution = Upper confidence limit												
98.8	0.00	6.18	0.00	0.00	0.00	0.97	0.99	0.00	4.89	0.00	0.00	14.38
99.0	0.00	5.15	0.00	0.00	0.00	0.81	0.82	0.00	4.07	0.00	0.00	11.98
99.2	0.00	4.12	0.00	0.00	0.00	0.65	0.66	0.00	3.26	0.00	0.00	9.59
Flight height distribution = Lower confidence limit												
98.8	0.00	1.51	0.00	0.00	0.00	0.24	0.24	0.00	1.20	0.00	0.00	3.52
99.0	0.00	1.26	0.00	0.00	0.00	0.20	0.20	0.00	1.00	0.00	0.00	2.93
99.2	0.00	1.01	0.00	0.00	0.00	0.16	0.16	0.00	0.80	0.00	0.00	2.35

Great black-backed gull

Table 1.113: Monthly collision risk estimates for great black-backed gull calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	2.79	0.78	0.88	0.22	0.00	0.62	7.63	0.72	2.46	1.98	3.18	9.34
99.5	2.33	0.65	0.73	0.19	0.00	0.52	6.36	0.60	2.05	1.65	2.65	7.78
99.6	1.86	0.52	0.59	0.15	0.00	0.42	5.08	0.48	1.64	1.32	2.12	6.23
Density = Mean estimate + UCL												
99.4	5.43	1.69	1.94	0.22	0.00	0.62	7.63	0.72	2.46	1.98	3.18	14.02
99.5	4.53	1.41	1.61	0.19	0.00	0.52	6.36	0.60	2.05	1.65	2.65	11.69
99.6	3.62	1.13	1.29	0.15	0.00	0.42	5.08	0.48	1.64	1.32	2.12	9.35
Density = Upper confidence limit												

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.4	5.43	1.69	1.94	0.50	0.00	1.11	15.21	1.21	4.68	3.01	4.14	14.02
99.5	4.53	1.41	1.61	0.42	0.00	0.93	12.68	1.00	3.90	2.51	3.45	11.69
99.6	3.62	1.13	1.29	0.34	0.00	0.74	10.14	0.80	3.12	2.01	2.76	9.35
Density = Lower confidence limit												
99.4	0.60	0.00	0.00	0.00	0.00	0.14	0.04	0.24	0.00	0.00	2.23	5.56
99.5	0.50	0.00	0.00	0.00	0.00	0.11	0.03	0.20	0.00	0.00	1.86	4.64
99.6	0.40	0.00	0.00	0.00	0.00	0.09	0.03	0.16	0.00	0.00	1.49	3.71

Table 1.114: Monthly collision risk estimates for great black-backed gull calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	5.81	1.61	1.83	0.47	0.00	1.30	15.86	1.50	5.11	4.11	6.62	19.42
99.5	4.84	1.34	1.53	0.39	0.00	1.08	13.22	1.25	4.26	3.42	5.52	16.18
99.6	3.87	1.07	1.22	0.31	0.00	0.86	10.57	1.00	3.41	2.74	4.41	12.94
Density = Mean estimate + UCL												
99.4	11.30	3.51	4.03	0.47	0.00	1.30	15.86	1.50	5.11	4.11	6.62	29.16
99.5	9.42	2.93	3.35	0.39	0.00	1.08	13.22	1.25	4.26	3.42	5.52	24.30
99.6	7.53	2.34	2.68	0.31	0.00	0.86	10.57	1.00	3.41	2.74	4.41	19.44
Density = Upper confidence limit												
99.4	11.30	3.51	4.03	1.05	0.00	2.31	31.63	2.51	9.73	6.26	8.61	29.16
99.5	9.42	2.93	3.35	0.87	0.00	1.92	26.36	2.09	8.11	5.22	7.18	24.30
99.6	7.53	2.34	2.68	0.70	0.00	1.54	21.09	1.67	6.49	4.18	5.74	19.44
Density = Lower confidence limit												
99.4	1.26	0.00	0.00	0.00	0.00	0.28	0.09	0.50	0.00	0.00	4.63	11.57
99.5	1.05	0.00	0.00	0.00	0.00	0.24	0.07	0.42	0.00	0.00	3.86	9.64
99.6	0.84	0.00	0.00	0.00	0.00	0.19	0.06	0.33	0.00	0.00	3.09	7.71

Table 1.115: Monthly collision risk estimates for great black-backed gull calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	4.54	1.26	1.43	0.36	0.00	1.01	12.39	1.17	4.00	3.21	5.17	15.17
98.9	3.84	1.07	1.21	0.31	0.00	0.86	10.49	0.99	3.38	2.72	4.38	12.84
99.1	3.14	0.87	0.99	0.25	0.00	0.70	8.58	0.81	2.77	2.22	3.58	10.50
Density = Mean estimate + UCL												
98.7	8.83	2.74	3.15	0.36	0.00	1.01	12.39	1.17	4.00	3.21	5.17	22.79
98.9	7.47	2.32	2.66	0.31	0.00	0.86	10.49	0.99	3.38	2.72	4.38	19.28
99.1	6.11	1.90	2.18	0.25	0.00	0.70	8.58	0.81	2.77	2.22	3.58	15.77
Density = Upper confidence limit												
98.7	8.83	2.74	3.15	0.82	0.00	1.80	24.72	1.96	7.60	4.89	6.73	22.79
98.9	7.47	2.32	2.66	0.69	0.00	1.53	20.92	1.66	6.43	4.14	5.69	19.28
99.1	6.11	1.90	2.18	0.57	0.00	1.25	17.11	1.36	5.26	3.39	4.66	15.77
Density = Lower confidence limit												
98.7	0.98	0.00	0.00	0.00	0.00	0.22	0.07	0.39	0.00	0.00	3.62	9.04
98.9	0.83	0.00	0.00	0.00	0.00	0.19	0.06	0.33	0.00	0.00	3.06	7.65
99.1	0.68	0.00	0.00	0.00	0.00	0.15	0.05	0.27	0.00	0.00	2.51	6.26

Table 1.116: Monthly collision risk estimates for great black-backed gull calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	2.79	0.78	0.88	0.22	0.00	0.62	7.63	0.72	2.46	1.98	3.18	9.34
99.5	2.33	0.65	0.73	0.19	0.00	0.52	6.36	0.60	2.05	1.65	2.65	7.78
99.6	1.86	0.52	0.59	0.15	0.00	0.42	5.08	0.48	1.64	1.32	2.12	6.23
PCH = Upper confidence metric												
99.4	7.31	2.03	2.31	0.59	0.00	1.63	19.95	1.89	6.43	5.17	8.33	24.42

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.5	6.09	1.69	1.92	0.49	0.00	1.36	16.62	1.58	5.36	4.31	6.94	20.35
99.6	4.87	1.35	1.54	0.39	0.00	1.09	13.30	1.26	4.29	3.45	5.55	16.28

Table 1.117: Monthly collision risk estimates for great black-backed gull calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	5.43	1.69	1.94	0.22	0.00	0.62	7.63	0.72	2.46	1.98	3.18	14.02
99.5	4.53	1.41	1.61	0.19	0.00	0.52	6.36	0.60	2.05	1.65	2.65	11.69
99.6	3.62	1.13	1.29	0.15	0.00	0.42	5.08	0.48	1.64	1.32	2.12	9.35
PCH = Upper confidence metric												
99.4	14.21	4.42	5.06	0.59	0.00	1.63	19.95	1.89	6.43	5.17	8.33	36.68
99.5	11.84	3.68	4.22	0.49	0.00	1.36	16.62	1.58	5.36	4.31	6.94	30.56
99.6	9.48	2.94	3.38	0.39	0.00	1.09	13.30	1.26	4.29	3.45	5.55	24.45

Table 1.118: Monthly collision risk estimates for great black-backed gull calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	5.81	1.61	1.83	0.47	0.00	1.30	15.86	1.50	5.11	4.11	6.62	19.42
99.5	4.84	1.34	1.53	0.39	0.00	1.08	13.22	1.25	4.26	3.42	5.52	16.18
99.6	3.87	1.07	1.22	0.31	0.00	0.86	10.57	1.00	3.41	2.74	4.41	12.94
Flight height distribution = Upper confidence limit												
99.4	10.03	2.78	3.16	0.80	0.00	2.24	27.39	2.60	8.83	7.10	11.43	33.53
99.5	8.36	2.32	2.64	0.67	0.00	1.87	22.82	2.16	7.36	5.91	9.53	27.94
99.6	6.69	1.86	2.11	0.54	0.00	1.49	18.26	1.73	5.89	4.73	7.62	22.35
Flight height distribution = Lower confidence limit												

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
99.4	4.57	1.27	1.44	0.37	0.00	1.02	12.48	1.18	4.03	3.23	5.21	15.28
99.5	3.81	1.06	1.20	0.31	0.00	0.85	10.40	0.99	3.36	2.70	4.34	12.74
99.6	3.05	0.85	0.96	0.24	0.00	0.68	8.32	0.79	2.68	2.16	3.48	10.19

Table 1.119: Monthly collision risk estimates for great black-backed gull calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	11.30	3.51	4.03	0.47	0.00	1.30	15.86	1.50	5.11	4.11	6.62	29.16
99.5	9.42	2.93	3.35	0.39	0.00	1.08	13.22	1.25	4.26	3.42	5.52	24.30
99.6	7.53	2.34	2.68	0.31	0.00	0.86	10.57	1.00	3.41	2.74	4.41	19.44
Flight height distribution = Upper confidence limit												
99.4	19.51	6.06	6.95	0.80	0.00	2.24	27.39	2.60	8.83	7.10	11.43	50.35
99.5	16.26	5.05	5.79	0.67	0.00	1.87	22.82	2.16	7.36	5.91	9.53	41.96
99.6	13.01	4.04	4.63	0.54	0.00	1.49	18.26	1.73	5.89	4.73	7.62	33.57
Flight height distribution = Lower confidence limit												
99.4	8.90	2.76	3.17	0.37	0.00	1.02	12.48	1.18	4.03	3.23	5.21	22.95
99.5	7.41	2.30	2.64	0.31	0.00	0.85	10.40	0.99	3.36	2.70	4.34	19.13
99.6	5.93	1.84	2.11	0.24	0.00	0.68	8.32	0.79	2.68	2.16	3.48	15.30

Table 1.120: Monthly collision risk estimates for great black-backed gull calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	4.54	1.26	1.43	0.36	0.00	1.01	12.39	1.17	4.00	3.21	5.17	15.17
98.9	3.84	1.07	1.21	0.31	0.00	0.86	10.49	0.99	3.38	2.72	4.38	12.84
99.1	3.14	0.87	0.99	0.25	0.00	0.70	8.58	0.81	2.77	2.22	3.58	10.50

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Upper confidence limit												
98.7	10.94	3.04	3.45	0.88	0.00	2.44	29.87	2.83	9.63	7.74	12.47	36.57
98.9	9.26	2.57	2.92	0.74	0.00	2.07	25.27	2.40	8.15	6.55	10.55	30.94
99.1	7.58	2.10	2.39	0.61	0.00	1.69	20.68	1.96	6.67	5.36	8.63	25.31
Flight height distribution = Lower confidence limit												
98.7	3.17	0.88	1.00	0.25	0.00	0.71	8.65	0.82	2.79	2.24	3.61	10.59
98.9	2.68	0.74	0.85	0.21	0.00	0.60	7.32	0.69	2.36	1.90	3.06	8.96
99.1	2.19	0.61	0.69	0.18	0.00	0.49	5.99	0.57	1.93	1.55	2.50	7.33

Table 1.121: Monthly collision risk estimates for great black-backed gull calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 2.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	8.83	2.74	3.15	0.36	0.00	1.01	12.39	1.17	4.00	3.21	5.17	22.79
98.9	7.47	2.32	2.66	0.31	0.00	0.86	10.49	0.99	3.38	2.72	4.38	19.28
99.1	6.11	1.90	2.18	0.25	0.00	0.70	8.58	0.81	2.77	2.22	3.58	15.77
Flight height distribution = Upper confidence limit												
98.7	21.28	6.61	7.58	0.88	0.00	2.44	29.87	2.83	9.63	7.74	12.47	54.91
98.9	18.01	5.59	6.41	0.74	0.00	2.07	25.27	2.40	8.15	6.55	10.55	46.47
99.1	14.73	4.58	5.25	0.61	0.00	1.69	20.68	1.96	6.67	5.36	8.63	38.02
Flight height distribution = Lower confidence limit												
98.7	6.16	1.92	2.20	0.25	0.00	0.71	8.65	0.82	2.79	2.24	3.61	15.91
98.9	5.22	1.62	1.86	0.21	0.00	0.60	7.32	0.69	2.36	1.90	3.06	13.46
99.1	4.27	1.33	1.52	0.18	0.00	0.49	5.99	0.57	1.93	1.55	2.50	11.01

Table 1.122: Monthly collision risk estimates for great black-backed gull calculated using Option 1 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	3.72	0.98	1.06	0.26	0.00	0.68	8.40	0.82	2.90	2.45	4.17	12.65
99.5	3.10	0.82	0.89	0.21	0.00	0.57	7.00	0.68	2.42	2.04	3.47	10.54
99.6	2.48	0.66	0.71	0.17	0.00	0.45	5.60	0.55	1.94	1.63	2.78	8.43
Density = Mean estimate + UCL												
99.4	7.24	2.14	2.33	0.26	0.00	0.68	8.40	0.82	2.90	2.45	4.17	18.99
99.5	6.03	1.78	1.94	0.21	0.00	0.57	7.00	0.68	2.42	2.04	3.47	15.83
99.6	4.83	1.43	1.56	0.17	0.00	0.45	5.60	0.55	1.94	1.63	2.78	12.66
Density = Upper confidence limit												
99.4	7.24	2.14	2.33	0.58	0.00	1.21	16.75	1.37	5.52	3.73	5.42	18.99
99.5	6.03	1.78	1.94	0.48	0.00	1.01	13.96	1.14	4.60	3.11	4.51	15.83
99.6	4.83	1.43	1.56	0.39	0.00	0.81	11.17	0.91	3.68	2.49	3.61	12.66
Density = Lower confidence limit												
99.4	0.80	0.00	0.00	0.00	0.00	0.15	0.05	0.27	0.00	0.00	2.91	7.53
99.5	0.67	0.00	0.00	0.00	0.00	0.12	0.04	0.23	0.00	0.00	2.43	6.28
99.6	0.54	0.00	0.00	0.00	0.00	0.10	0.03	0.18	0.00	0.00	1.94	5.02

Table 1.123: Monthly collision risk estimates for great black-backed gull calculated using Option 2 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
99.4	7.74	2.04	2.21	0.54	0.00	1.42	17.47	1.70	6.04	5.09	8.66	26.30
99.5	6.45	1.70	1.84	0.45	0.00	1.18	14.55	1.42	5.03	4.25	7.22	21.91
99.6	5.16	1.36	1.47	0.36	0.00	0.95	11.64	1.14	4.02	3.40	5.77	17.53
Density = Mean estimate + UCL												
99.4	15.05	4.45	4.85	0.54	0.00	1.42	17.47	1.70	6.04	5.09	8.66	39.49
99.5	12.54	3.71	4.04	0.45	0.00	1.18	14.55	1.42	5.03	4.25	7.22	32.91
99.6	10.03	2.97	3.23	0.36	0.00	0.95	11.64	1.14	4.02	3.40	5.77	26.33

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Upper confidence limit												
99.4	15.05	4.45	4.85	1.21	0.00	2.52	34.83	2.84	11.48	7.77	11.26	39.49
99.5	12.54	3.71	4.04	1.01	0.00	2.10	29.03	2.37	9.57	6.47	9.38	32.91
99.6	10.03	2.97	3.23	0.81	0.00	1.68	23.22	1.89	7.66	5.18	7.51	26.33
Density = Lower confidence limit												
99.4	1.67	0.00	0.00	0.00	0.00	0.31	0.10	0.57	0.00	0.00	6.06	15.67
99.5	1.39	0.00	0.00	0.00	0.00	0.26	0.08	0.47	0.00	0.00	5.05	13.06
99.6	1.11	0.00	0.00	0.00	0.00	0.21	0.06	0.38	0.00	0.00	4.04	10.44

Table 1.124: Monthly collision risk estimates for great black-backed gull calculated using Option 3 of Band (2012) using confidence intervals associated with density with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Density = Mean estimate												
98.7	6.05	1.60	1.73	0.42	0.00	1.11	13.65	1.33	4.72	3.98	6.77	20.55
98.9	5.12	1.35	1.46	0.35	0.00	0.94	11.55	1.13	3.99	3.37	5.73	17.39
99.1	4.19	1.11	1.19	0.29	0.00	0.77	9.45	0.92	3.27	2.76	4.69	14.23
Density = Mean estimate + UCL												
98.7	11.76	3.48	3.79	0.42	0.00	1.11	13.65	1.33	4.72	3.98	6.77	30.86
98.9	9.95	2.94	3.21	0.35	0.00	0.94	11.55	1.13	3.99	3.37	5.73	26.11
99.1	8.14	2.41	2.62	0.29	0.00	0.77	9.45	0.92	3.27	2.76	4.69	21.36
Density = Upper confidence limit												
98.7	11.76	3.48	3.79	0.94	0.00	1.97	27.22	2.22	8.97	6.07	8.80	30.86
98.9	9.95	2.94	3.21	0.80	0.00	1.67	23.03	1.88	7.59	5.13	7.45	26.11
99.1	8.14	2.41	2.62	0.65	0.00	1.37	18.84	1.54	6.21	4.20	6.09	21.36
Density = Lower confidence limit												
98.7	1.31	0.00	0.00	0.00	0.00	0.24	0.08	0.44	0.00	0.00	4.74	12.24
98.9	1.11	0.00	0.00	0.00	0.00	0.21	0.06	0.37	0.00	0.00	4.01	10.36
99.1	0.90	0.00	0.00	0.00	0.00	0.17	0.05	0.31	0.00	0.00	3.28	8.48

Table 1.125: Monthly collision risk estimates for great black-backed gull calculated using Option 1 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	3.72	0.98	1.06	0.26	0.00	0.68	8.40	0.82	2.90	2.45	4.17	12.65
99.5	3.10	0.82	0.89	0.21	0.00	0.57	7.00	0.68	2.42	2.04	3.47	10.54
99.6	2.48	0.66	0.71	0.17	0.00	0.45	5.60	0.55	1.94	1.63	2.78	8.43
PCH = Upper confidence metric												
99.4	9.73	2.57	2.78	0.67	0.00	1.78	21.97	2.14	7.59	6.41	10.89	33.07
99.5	8.11	2.14	2.32	0.56	0.00	1.49	18.31	1.79	6.33	5.34	9.08	27.56
99.6	6.49	1.71	1.85	0.45	0.00	1.19	14.65	1.43	5.06	4.27	7.26	22.05

Table 1.126: Monthly collision risk estimates for great black-backed gull calculated using Option 1 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCH = Mean estimate												
99.4	7.24	2.14	2.33	0.26	0.00	0.68	8.40	0.82	2.90	2.45	4.17	18.99
99.5	6.03	1.78	1.94	0.21	0.00	0.57	7.00	0.68	2.42	2.04	3.47	15.83
99.6	4.83	1.43	1.56	0.17	0.00	0.45	5.60	0.55	1.94	1.63	2.78	12.66
PCH = Upper confidence metric												
99.4	18.93	5.60	6.10	0.67	0.00	1.78	21.97	2.14	7.59	6.41	10.89	49.67
99.5	15.77	4.67	5.08	0.56	0.00	1.49	18.31	1.79	6.33	5.34	9.08	41.39
99.6	12.62	3.73	4.07	0.45	0.00	1.19	14.65	1.43	5.06	4.27	7.26	33.11

Table 1.127: Monthly collision risk estimates for great black-backed gull calculated using Option 2 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	7.74	2.04	2.21	0.54	0.00	1.42	17.47	1.70	6.04	5.09	8.66	26.30
99.5	6.45	1.70	1.84	0.45	0.00	1.18	14.55	1.42	5.03	4.25	7.22	21.91
99.6	5.16	1.36	1.47	0.36	0.00	0.95	11.64	1.14	4.02	3.40	5.77	17.53
Flight height distribution = Upper confidence limit												
99.4	13.36	3.53	3.81	0.93	0.00	2.45	30.16	2.94	10.42	8.80	14.95	45.41
99.5	11.14	2.94	3.18	0.77	0.00	2.04	25.13	2.45	8.69	7.33	12.46	37.84
99.6	8.91	2.35	2.54	0.62	0.00	1.63	20.11	1.96	6.95	5.86	9.97	30.27
Flight height distribution = Lower confidence limit												
99.4	6.09	1.61	1.74	0.42	0.00	1.12	13.75	1.34	4.75	4.01	6.82	20.70
99.5	5.08	1.34	1.45	0.35	0.00	0.93	11.46	1.12	3.96	3.34	5.68	17.25
99.6	4.06	1.07	1.16	0.28	0.00	0.74	9.17	0.89	3.17	2.67	4.54	13.80

Table 1.128: Monthly collision risk estimates for great black-backed gull calculated using Option 2 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
99.4	15.05	4.45	4.85	0.54	0.00	1.42	17.47	1.70	6.04	5.09	8.66	15.05
99.5	12.54	3.71	4.04	0.45	0.00	1.18	14.55	1.42	5.03	4.25	7.22	12.54
99.6	10.03	2.97	3.23	0.36	0.00	0.95	11.64	1.14	4.02	3.40	5.77	10.03
Flight height distribution = Upper confidence limit												
99.4	25.99	7.69	8.38	0.93	0.00	2.45	30.16	2.94	10.42	8.80	14.95	68.19
99.5	21.65	6.41	6.98	0.77	0.00	2.04	25.13	2.45	8.69	7.33	12.46	56.82
99.6	17.32	5.12	5.58	0.62	0.00	1.63	20.11	1.96	6.95	5.86	9.97	45.46
Flight height distribution = Lower confidence limit												
99.4	11.85	3.50	3.82	0.42	0.00	1.12	13.75	1.34	4.75	4.01	6.82	31.08
99.5	9.87	2.92	3.18	0.35	0.00	0.93	11.46	1.12	3.96	3.34	5.68	25.90
99.6	7.90	2.34	2.55	0.28	0.00	0.74	9.17	0.89	3.17	2.67	4.54	20.72

Table 1.129: Monthly collision risk estimates for great black-backed gull calculated using Option 3 of Band (2012) using the mean estimate of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	6.05	1.60	1.73	0.42	0.00	1.11	13.65	1.33	4.72	3.98	6.77	20.55
98.9	5.12	1.35	1.46	0.35	0.00	0.94	11.55	1.13	3.99	3.37	5.73	17.39
99.1	4.19	1.11	1.19	0.29	0.00	0.77	9.45	0.92	3.27	2.76	4.69	14.23
Flight height distribution = Upper confidence limit												
98.7	14.57	3.85	4.16	1.01	0.00	2.67	32.89	3.21	11.37	9.59	16.31	49.52
98.9	12.33	3.26	3.52	0.85	0.00	2.26	27.83	2.71	9.62	8.12	13.80	41.90
99.1	10.09	2.67	2.88	0.70	0.00	1.85	22.77	2.22	7.87	6.64	11.29	34.28
Flight height distribution = Lower confidence limit												
98.7	4.22	1.12	1.20	0.29	0.00	0.77	9.53	0.93	3.29	2.78	4.72	14.35
98.9	3.57	0.94	1.02	0.25	0.00	0.65	8.06	0.79	2.79	2.35	4.00	12.14
99.1	2.92	0.77	0.83	0.20	0.00	0.54	6.60	0.64	2.28	1.92	3.27	9.93

Table 1.130: Monthly collision risk estimates for great black-backed gull calculated using Option 3 of Band (2012) using the mean estimate + UCL of density and confidence intervals associated with flight height distribution with a nocturnal activity factor of 3.

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Maximum likelihood												
98.7	11.76	3.48	3.79	0.42	0.00	1.11	13.65	1.33	4.72	3.98	6.77	30.86
98.9	9.95	2.94	3.21	0.35	0.00	0.94	11.55	1.13	3.99	3.37	5.73	26.11
99.1	8.14	2.41	2.62	0.29	0.00	0.77	9.45	0.92	3.27	2.76	4.69	21.36
Flight height distribution = Upper confidence limit												
98.7	28.34	8.38	9.14	1.01	0.00	2.67	32.89	3.21	11.37	9.59	16.31	74.37
98.9	23.98	7.09	7.73	0.85	0.00	2.26	27.83	2.71	9.62	8.12	13.80	62.93
99.1	19.62	5.80	6.32	0.70	0.00	1.85	22.77	2.22	7.87	6.64	11.29	51.49

Avoidance rate (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flight height distribution = Lower confidence limit												
98.7	8.21	2.43	2.65	0.29	0.00	0.77	9.53	0.93	3.29	2.78	4.72	21.54
98.9	6.95	2.06	2.24	0.25	0.00	0.65	8.06	0.79	2.79	2.35	4.00	18.23
99.1	5.68	1.68	1.83	0.20	0.00	0.54	6.60	0.64	2.28	1.92	3.27	14.91

Appendix C – Apportioned collision risk estimates

Gannet

Table 1.131: Apportioned collision risk estimates for gannet when using the alternative analysis and confidence metrics associated with density

Band model Option	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)								Total
			Post-breeding	Pre-breeding	Breeding						
			4.8	6.2	10	20	30	40.4	46.5	63.3	72.8	
Option 1	1	Application	0	0	-	-	-	3	-	-	-	4
		LCL	0	0	1	1	2	3	3	4	5	1-5
		Mean	0	0	1	2	3	4	5	6	7	1-8
		Mean+UCL	0	0	1	2	3	4	5	7	8	2-8
		UCL	0	0	2	3	5	7	8	11	12	2-13
	2	LCL	0	0	1	1	2	2	3	4	4	1-5
		Mean	0	0	1	2	4	5	6	7	9	2-9
		Mean+UCL	0	0	1	2	4	5	6	8	9	2-10
		UCL	0	0	1	3	4	6	7	9	11	2-11
Option 2	1	Application	1	0	-	-	-	7	-	-	-	8
		LCL	0	0	1	3	4	6	7	9	11	2-12
		Mean	0	0	2	4	7	9	10	14	16	3-17
		Mean+UCL	0	1	2	5	7	10	11	15	17	3-18

Band model	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)									Total
		UCL	1	1	4	7	11	15	17	24	27	5-29
	2	LCL	0	0	1	3	4	5	6	8	9	2-10
		Mean	1	1	3	5	8	10	12	16	19	4-20
		Mean+UCL	1	1	3	5	8	11	13	17	20	4-22
		UCL	1	1	3	6	10	13	15	20	23	4-25
Option 3	1	Application	0	0	-	-	-	3	-	-	-	3
		LCL	0	0	1	1	2	2	3	4	4	1-5
		Mean	0	0	1	2	3	4	4	6	7	1-7
		Mean+UCL	0	0	1	2	3	4	5	6	7	1-8
		UCL	0	0	2	3	5	6	7	10	11	2-12
	2	LCL	0	0	1	1	2	2	2	3	4	1-4
		Mean	0	0	1	2	3	4	5	7	8	2-8
		Mean+UCL	0	0	1	2	3	5	5	7	8	2-9
		UCL	0	0	1	3	4	5	6	8	10	2-10

Table 1.132: Apportioned collision risk estimates for gannet when using the alternative analysis and confidence metrics associated with flight height data and the mean estimate density scenario

Band model Option	Nocturnal activity factor	Flight height data	Seasonal apportioning rate(s) (%)									Total
			Post-breeding	Pre-breeding	Breeding							
			4.8	6.2	10	20	30	40.4	46.5	63.3	72.8	
Option 1	1	Mean estimate	0	0	1	2	3	4	5	6	7	1-8
		UCL	1	1	3	6	9	0	14	19	22	4-24
	2	Mean	0	0	1	2	4	5	6	7	9	2-9
		UCL	1	1	4	7	11	0	17	22	26	5-28
Option 2	1	LCL	0	0	1	1	2	0	3	4	5	1-5
		Maximum likelihood	0	0	2	4	7	9	10	14	16	3-17
		UCL	1	1	5	10	15	0	23	31	36	7-38
	2	LCL	0	0	1	2	2	0	4	5	6	1-6
		Maximum likelihood	1	1	3	5	8	10	12	16	19	4-20
		UCL	1	2	6	12	17	0	27	36	42	9-45
Option 3	1	LCL	0	0	0	0	1	2	1	1	2	0-2
		Maximum likelihood	0	0	1	2	3	4	4	6	7	1-7

Band model	Nocturnal activity factor	Flight height data	Seasonal apportioning rate(s) (%)									Total
		UCL	0	1	3	5	8	18	12	16	19	4-21
	2	LCL	0	0	0	1	1	2	1	2	2	0-2
		Maximum likelihood	0	0	1	2	3	4	5	7	8	2-8
		UCL	1	1	3	6	9	21	14	19	22	4-23

Table 1.133: Apportioned collision risk estimates for gannet when using the alternative analysis and confidence metrics associated with flight height data and the mean estimate + UCL density scenario

Band model Option	Nocturnal activity factor	Flight height data	Seasonal apportioning rate(s) (%)									Total
			Post-breeding	Pre-breeding	Breeding							
			4.8	6.2	10	20	30	40.4	46.5	63.3	72.8	
Option 1	1	Mean estimate	0	0	1	2	3	4	5	7	8	2-8
		UCL	1	1	3	6	10	0	15	20	23	5-25
	2	Mean	0	0	1	2	4	5	6	8	9	2-10
		UCL	1	1	4	7	11	0	17	24	27	6-29
Option 2	1	LCL	0	0	1	1	2	0	3	5	5	1-6
		Maximum likelihood	0	1	2	5	7	10	11	15	17	3-18
		UCL	1	1	5	10	16	0	24	33	38	8-40
	2	LCL	0	0	1	2	3	0	4	5	6	1-7
		Maximum likelihood	1	1	3	5	8	11	13	17	20	4-22
		UCL	1	2	6	12	18	0	28	38	44	10-48
Option 3	1	LCL	0	0	0	0	1	2	1	1	2	0-2
		Maximum likelihood	0	0	1	2	3	4	5	6	7	1-8

Band model	Nocturnal activity factor	Flight height data	Seasonal apportioning rate(s) (%)									Total
		UCL	0	1	3	5	8	19	12	17	20	4-21
	2	LCL	0	0	0	1	1	2	1	2	2	0-2
		Maximum likelihood	0	0	1	2	3	5	5	7	8	2-9
		UCL	1	1	3	6	9	22	15	20	23	5-25

Kittiwake

Table 1.134: Apportioned collision risk estimates for kittiwake when using the alternative analysis and confidence metrics associated with density

Band model Option (avoidance rate)	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)												Total
			Post-breeding	Pre-breeding	Breeding										
			5.4	7.2	10	20	37.4	41.7	75.8	77.5	82.2	87.9	93.1	95.3	
Option 1 (98.9%)	2	Application	1	1	-	-	-	10	-	-	-	-	-	-	11
		LCL	1	0	2	4	8	9	17	17	18	19	21	21	3-22
		Mean	1	0	3	6	12	13	24	24	26	28	29	30	4-31
		Mean+UCL	1	0	4	7	13	15	27	27	29	31	33	34	5-35
		UCL	1	0	5	10	19	21	38	39	42	45	47	48	7-50
	3	LCL	0	0	2	4	7	8	15	15	16	17	18	19	3-19
		Mean	1	0	4	7	13	15	27	28	29	31	33	34	5-35
		Mean+UCL	1	0	4	8	15	17	31	31	33	36	38	38	6-40
		UCL	1	0	4	9	17	19	34	35	37	39	41	42	6-44
Option 1 (99.2%)	2	Application	1	0	-	-	-	7	-	-	-	-	-	-	8
		LCL	0	0	2	3	6	7	12	12	13	14	15	15	2-16
		Mean	1	0	2	5	9	10	17	18	19	20	21	22	3-22
		Mean+UCL	1	0	3	5	10	11	19	20	21	23	24	25	3-25
		UCL	1	0	4	7	14	15	28	29	30	32	34	35	5-36

Band model	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)												Total
	3	LCL	0	0	1	3	5	6	11	11	12	13	13	14	2-14
		Mean	1	0	3	5	10	11	20	20	21	23	24	25	3-26
		Mean+UCL	1	0	3	6	11	12	22	23	24	26	27	28	4-29
		UCL	1	0	3	6	12	14	25	25	27	28	30	31	4-32
Option 2 (98.9%)	2	Application	4	3	-	-	-	51	-	-	-	-	-	-	58
		LCL	3	1	12	23	44	49	88	90	96	102	108	111	15-115
		Mean	5	1	19	38	70	78	142	145	154	165	175	179	21-162
		Mean+UCL	6	2	21	42	79	89	161	165	175	187	198	202	25-184
		UCL	7	2	27	53	100	111	202	206	219	234	248	254	36-263
	3	LCL	3	0	10	21	38	43	78	80	85	90	96	98	13-101
		Mean	4	1	17	33	62	69	125	128	136	145	154	158	25-185
		Mean+UCL	5	1	19	37	70	78	141	144	153	163	173	177	29-211
		UCL	6	1	23	47	88	98	177	181	192	206	218	223	30-230
Option 2 (99.2%)	2	Application	3	2	-	-	-	37	-	-	-	-	-	-	42
		LCL	2	0	8	17	32	35	64	66	70	74	79	81	11-83
		Mean	3	1	12	24	45	50	91	93	99	106	112	115	16-118
		Mean+UCL	4	1	14	27	51	56	103	105	111	119	126	129	18-133
		UCL	5	1	19	39	72	81	147	150	159	170	180	185	26-191
	3	LCL	2	0	7	15	28	31	57	58	62	66	70	71	10-73

Band model	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)												Total
		Mean	4	1	14	27	51	57	103	106	112	120	127	130	18-134
		Mean+UCL	5	1	15	31	58	64	117	120	127	136	144	147	21-153
		UCL	4	1	17	34	64	71	129	132	140	150	159	162	22-167
Option 3 (98%)	2	Application	1	1	-	-	-	20	-	-	-	-	-	-	20
		LCL	3	1	4	8	15	17	31	31	33	36	38	39	7-42
		Mean	1	0	6	12	22	24	44	45	47	51	54	55	7-57
		Mean+UCL	2	0	6	13	24	27	49	50	53	57	60	62	9-64
		UCL	3	1	9	19	35	39	70	72	76	81	86	88	12-91
	3	LCL	1	0	4	7	13	15	27	28	29	31	33	34	5-35
		Mean	2	0	7	13	24	27	49	51	54	57	61	62	9-64
		Mean+UCL	2	1	7	15	28	31	56	57	61	65	69	70	10-73
		UCL	2	0	8	16	30	34	62	63	67	72	76	78	11-80

Table 1.135: Apportioned collision risk estimates for kittiwake when using the alternative analysis and confidence metrics associated with flight height data and the mean estimate density scenario

Band model Option (avoidance rate)	Nocturnal activity factor	Flight height data	Seasonal apportioning rate(s) (%)												Total
			Post-breeding	Pre-breeding	Breeding										
			5.4	7.2	10	20	37.4	41.7	75.8	77.5	82.2	87.9	93.1	95.3	
Option 1 (98.9%)	2	Mean estimate	1	0	3	6	12	13	24	24	26	28	29	30	4-31
		UCL	2	0	7	14	26	30	54	55	58	62	66	67	9-70
	3	Mean estimate	1	0	4	7	13	15	27	28	29	31	33	34	5-35
		UCL	2	0	8	16	30	33	61	62	66	71	75	76	11-79
Option 1 (99.2%)	2	Mean estimate	1	0	2	5	9	10	17	18	19	20	21	22	3-22
		UCL	1	0	5	10	19	21	39	40	42	45	48	49	7-51
	3	Mean estimate	1	0	3	5	10	11	20	20	21	23	24	25	3-26
		UCL	2	0	6	12	22	24	44	45	48	51	54	56	8-58
Option 2 (98.9%)	2	LCL	3	1	11	22	40	45	82	84	89	95	101	103	14-106
		Maximum likelihood	5	1	19	38	70	78	142	145	154	165	175	179	21-162

Band model	Nocturnal activity factor	Flight height	Seasonal apportioning rate(s) (%)												Total
		UCL	5	1	22	43	81	90	164	168	178	190	201	206	28-213
	3	LCL	3	1	12	25	46	51	93	95	101	108	114	117	16-121
		Maximum likelihood	4	1	17	33	62	69	125	128	136	145	154	158	25-185
		UCL	7	1	25	49	92	102	186	190	202	216	229	234	33-242
Option 2 (99.2%)	2	LCL	2	0	8	16	29	33	60	61	65	69	73	75	10-77
		Maximum likelihood	3	1	12	24	45	50	91	93	99	106	112	115	16-118
		UCL	4	1	16	31	59	66	119	122	129	138	147	150	20-155
	3	LCL	2	1	9	18	33	37	68	69	73	78	83	85	12-88
		Maximum likelihood	4	1	14	27	51	57	103	106	112	120	127	130	18-134
		UCL	5	1	18	36	67	74	135	138	147	157	166	170	24-176
Option 3 (98%)	2	LCL	1	0	3	7	13	14	26	26	28	30	31	32	4-33
		Maximum likelihood	1	0	6	12	22	24	44	45	47	51	54	55	7-57
		UCL	2	0	8	16	31	34	62	63	67	72	76	78	11-80

Band model	Nocturnal activity factor	Flight height	Seasonal apportioning rate(s) (%)												Total
	3	LCL	1	0	4	8	14	16	29	30	32	34	36	37	5-38
		Maximum likelihood	2	0	7	13	24	27	49	51	54	57	61	62	9-64
		UCL	3	1	9	19	35	39	70	72	76	81	86	88	12-91

Table 1.136: Apportioned collision risk estimates for kittiwake when using the alternative analysis and confidence metrics associated with flight height data and the mean estimate + UCL density scenario

Band model Option (avoidance rate)	Nocturnal activity factor	Density scenario	Seasonal apportioning rate(s) (%)												Total
			Post-breeding	Pre-breeding	Breeding										
			5.4	7.2	10	20	37.4	41.7	75.8	77.5	82.2	87.9	93.1	95.3	
Option 1 (98.9%)	2	Mean estimate	1	0	4	7	13	15	27	27	29	31	33	34	5-35
		UCL	2	1	8	16	30	33	60	62	65	70	74	76	11-79
	3	Mean estimate	1	0	4	8	15	17	31	31	33	36	38	38	6-40
		UCL	3	1	9	18	34	38	69	70	75	80	85	87	13-90
Option 1 (99.2%)	2	Mean estimate	1	0	3	5	10	11	19	20	21	23	24	25	3-25
		UCL	2	0	6	12	22	24	44	45	48	51	54	55	8-57
	3	Mean estimate	1	0	3	6	11	12	22	23	24	26	27	28	4-29
		UCL	2	1	7	13	25	28	50	51	54	58	62	63	9-66
Option 2 (98.9%)	2	LCL	3	1	12	24	46	51	92	94	100	107	113	116	16-120
		Maximum likelihood	6	2	21	42	79	89	161	165	175	187	198	202	25-184

Band	Nocturnal	Density	Seasonal apportioning rate(s) (%)												Total
		UCL	7	2	24	49	91	102	185	189	200	214	227	232	33-240
	3	LCL	4	1	14	28	52	58	105	108	114	122	129	132	19-138
		Maximum likelihood	5	1	19	37	70	78	141	144	153	163	173	177	29-211
		UCL	8	2	28	56	104	116	211	215	229	244	259	265	39-276
Option 2 (99.2%)	2	LCL	2	1	9	18	33	37	67	69	73	78	82	84	12-87
		Maximum likelihood	4	1	14	27	51	56	103	105	111	119	126	129	18-133
		UCL	5	1	18	35	66	74	134	137	146	156	165	169	24-175
	3	LCL	3	1	10	20	38	42	77	78	83	89	94	96	14-100
		Maximum likelihood	5	1	15	31	58	64	117	120	127	136	144	147	21-153
		UCL	6	2	20	40	76	84	153	157	166	178	188	193	28-200
Option 3 (98%)	2	LCL	1	0	4	8	14	16	29	29	31	33	35	36	5-38
		Maximum likelihood	2	0	6	13	24	27	49	50	53	57	60	62	9-64

Band	Nocturnal	Density	Seasonal apportioning rate(s) (%)												Total
		UCL	2	1	9	18	34	38	70	71	75	81	85	87	12-91
	3	LCL	1	0	4	9	16	18	33	34	36	38	40	41	6-43
		Maximum likelihood	2	1	7	15	28	31	56	57	61	65	69	70	10-73
		UCL	3	1	10	21	39	44	79	81	86	92	98	100	15-104