Beatrice Offshore Windfarm

Environmental Statement Addendum

Annex 7C Note to Support the use of a 99% Avoidance Rate for the Beatrice Offshore Windfarm Collision Risk Modelling

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Note to support the use of a 99% avoidance rate for the Beatrice Offshore Wind Farm collision risk modelling

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CONTENTS

1. INTRODUCTION

In the collision risk modelling which formed part of the Environmental Statement (ES) submitted for the Beatrice Offshore Wind Farm, an avoidance rate of 99% was used for all seabird species. This is a higher rate of avoidance than the default value advocated by SNH (98%). Justification for the use of a 99% avoidance rate was presented in an appendix to the ornithological technical annex which supported the ES. This was based on a review of studies of avoidance behaviour presented in a draft report by the BTO to The Crown Estate led SOSS (Strategic Ornithological Support Services) working group (SOSS-02). Although some of the conclusions of the BTO review were revised for the final report, the data remain unaltered and their interpretation as presented in the Beatrice submission is considered to remain valid. The original appendix from the technical annex is appended at the end of this note (Appendix 1), with additional supporting information below.

The species identified as being at greatest risk of collision due to the Beatrice wind farm were kittiwake, great black-backed gull and herring gull. Therefore the following discussion focuses on the avoidance rate values for these species.

On the basis of observations of avoidance behaviour at operating wind farms and the differences in onshore and offshore survey methods and how these relate to avoidance rates (which are not currently taken into account), it is concluded that an avoidance rate of 98% is *over*-precautionary and a rate of 99% is considered to be more appropriate.

2. STUDIES AT OPERATING WIND FARMS AND THEORETICAL CONSIDERATIONS

Avoidance behaviour can be considered as occurring both in close proximity to the turbines ('micro' avoidance) and at greater distances ('macro' avoidance). Estimates of rates for both macro and micro avoidance have been estimated for a range of species from studies conducted at existing wind farms (SOSS-2; Appendix 1 for details). Theoretically, estimates for macro and micro avoidance can be combined to obtain an overall rate of avoidance:

Total avoidance = 1-((1-macro avoidance)*(1-micro avoidance)) [Eq.1]

However, this is only reliable if the distances over which micro- and macro-avoidance have been estimated have been reported, otherwise there may be either an 'overlap' in the two components leading to double accounting of avoidance, or there may be a gap between the end of macro and the beginning of micro, leading to underestimation of total avoidance. Unfortunately, the distances over which either macro- or micro-avoidance have been estimated are seldom if ever reported. Nonetheless, consideration of the estimates for each type of avoidance can be undertaken in terms of how rates of either macro or micro avoidance could be combined with *possible* values of the other and then comparing these with the range of estimates available. Thus, by more explicitly considering how the two forms of avoidance combine to produce an overall level of avoidance, it is possible to explore the implications of what a given overall avoidance rate (e.g. 98% , 99%) means in terms of macro and micro avoidance.

For example, for a given predicted *total* avoidance and any particular estimate of micro-avoidance, what would macro-avoidance need to be in order to satisfy Eq. 1, and vice versa.

Figure 1 provides a contour plot of overall avoidance rates generated from all combinations of macro- and micro-avoidance between 0.5 and 1. The darkest colour represents values in excess of 99% overall avoidance. This can be achieved, for example, with:

- Macro-avoidance of 0.98 (i.e. only 2 in 100 individuals enter the wind farm); and,
- Micro-avoidance of 0.5 (half of all birds within the wind farm take last minute avoiding action);

or with values of:

- 0.9 for both (1 in 10 birds enter the wind farm; 9 out of 10 birds within the wind farm take last minute avoiding action).

The lowest micro avoidance rate reported for gulls was 0.996 (Everaert & Kuijken 2007). Thus even with no macro avoidance behaviour, the total avoidance rate cannot be lower than this. Conversely, at the lowest reported macro avoidance rate for gulls of 0.73, a micro avoidance rate of 0.965 is sufficient to achieve an overall avoidance rate of 99%. What are the probable implications of a micro-avoidance rate of 0.965? At this rate of micro avoidance, the predicted collision rate would be more than 8 times as high as that predicted by the lowest empirical rate (0.996). A difference of this magnitude between predicted micro-avoidance (to satisfy a given overall rate) and that which has been estimated empirically seems unlikely, not least because the probability of either observing a collision or finding evidence for collisions would be much higher.

This form of sensitivity analysis is analogous to that which SNH used in support of raising the avoidance rate for geese from 98% to 99% (SNH 2010, Pendlebury 2006).

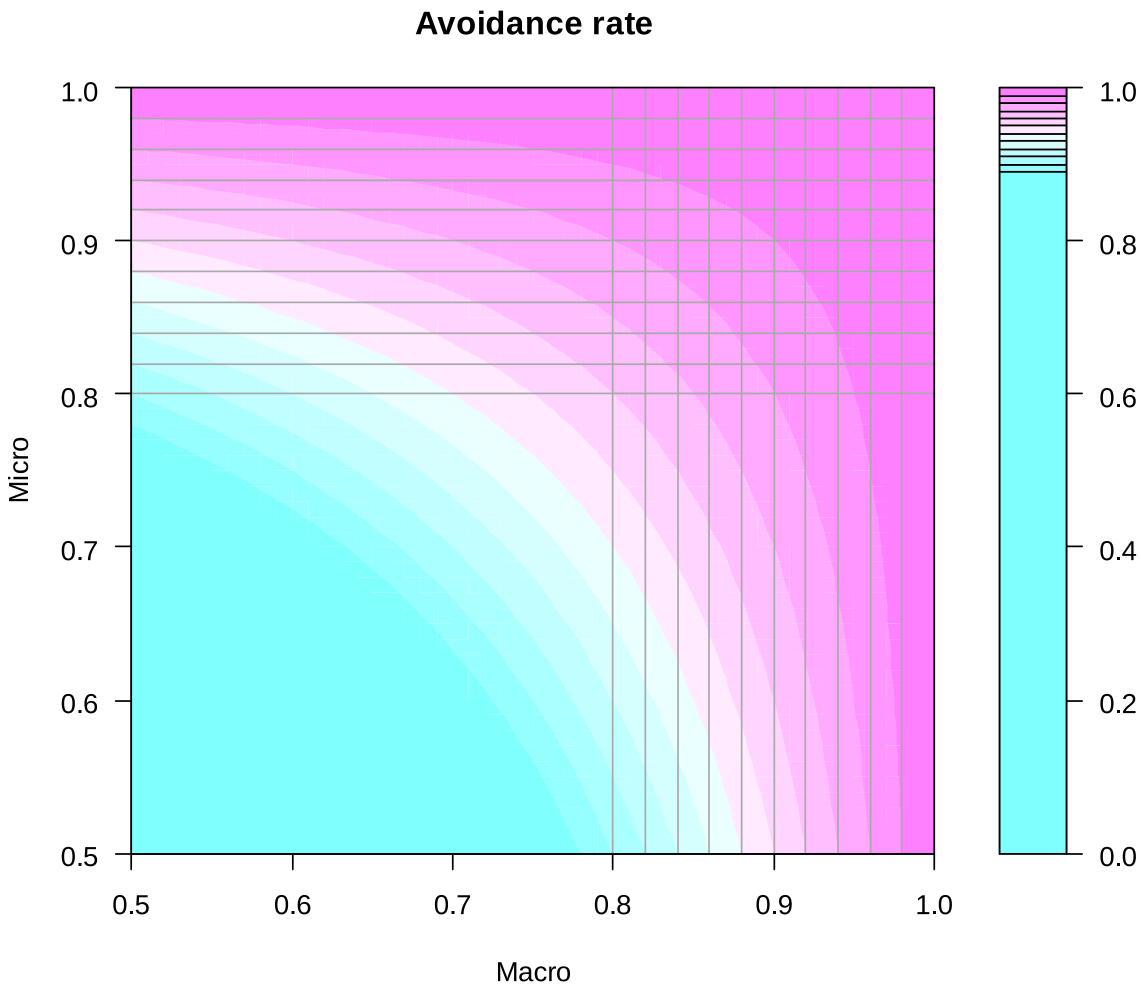

Figure 1. Illustration of how macro- and micro- avoidance combine to generate overall avoidance. The darkest colour is the 99% contour, the second darkest is the 98% contour. Grid lines at intervals of 0.02.

3. COMMENTS ON THE TRANSFERABILITY OF AVOIDANCE RATES BETWEEN ONSHORE AND OFFSHORE WIND FARM ASSESSMENTS

The avoidance rates provided by SNH in their collision risk modelling guidance (SNH 2010) are presented as either default values (typically 98%) for those species for which there is considered to be insufficient information for refinement, or species specific ones if data permit (e.g. 99% for geese). These rates have been estimated from observations and studies of bird flight behaviour in relation to onshore wind farms. However, survey methods for onshore wind farms are conducted using completely different methods from those used for offshore wind farms.

For onshore sites the proposed development area is surveyed from fixed vantage points located within 2km of all parts of the site (i.e. each vantage point utilises a 2km viewshed). The inference of this is that all birds flying at rotor height within 2km of the surveyor will be recorded. However, the rate at which birds will be detected within the 2km viewshed will not be uniform at all distances from the observer; detection rates decrease with increasing distance from the observer (Buckland et al. 2001). In the standard analysis methods for analysing data obtained from vantage point surveys no correction for decreasing detection rates is made. Thus, the precautionary 98% avoidance rate applied to the flight data collected by these methods can be regarded as in fact encompassing two sources of precaution; in the actual rate at which birds avoid turbines, and also in the likelihood that bird flight activity will have been under recorded due to the limitations of the survey methods.

Offshore wind farm sites are surveyed along transects, typically from boats, following regularly spaced transects. While the primary survey focus is on birds on the sea, flying birds are recorded within snapshot counts at regular intervals (e.g. 500m). Each snapshot records all birds seen flying within a nominal 300×300m box located in front and to the side of the vessel. Hence the furthest distance at which birds are recorded is 424m (the diagonally opposite corner of a box with sides of 300m). This is nearly a fifth of the distance over which birds are surveyed for onshore wind farms.

Furthermore, for species such as gulls there is a high likelihood that individuals will be attracted to the survey vessel, increasing the estimated flying activity. While the extent to which this may occur is not well known, casual observation of seabirds following fishing vessels indicates that such behaviour is commonplace. Recent work on gannets found that estimates of seabird density were approximately seven times as high when using boat survey data compared with aerial survey data (WWT 2012). The potential attraction of birds to survey vessels (which are typically similar in size to fishing vessels) was cited as a possible reason for this difference. By contrast, the presence of an observer in a terrestrial setting whilst undertaking a vantage point survey is very likely to reduce observed flight activity. At best this is likely to be a small effect, although it is possible that the effect may be large.

4. CONCLUSION

An avoidance rate of 98%, based on the analysis of data collected for onshore wind farms remains the default value advocated by SNH. However, as detailed above, there are good arguments that, for offshore assessments in particular, this rate is over precautionary. We therefore conclude that higher avoidance rates are appropriate for collision risk modelling for offshore wind farms. Consequently an avoidance rate of 99% has been used for the Beatrice offshore wind farm. Given the monitoring results summarised above and the methodological considerations, this is still considered to represent a precautionary rate.

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APPENDIX 1

Appendix 3 from the Ornithological Technical Annex of the Beatrice Offshore Wind Farm Environmental Statement

APPENDIX 3 – DERIVATION OF AVOIDANCE RATES FOR COLLISION RISK MODELLING

Justification for avoidance rates higher than 98% for use in CRM for the Beatrice Offshore Wind Farm

The current SNH guidance is to use an avoidance rate of 98% as a default for estimating collision mortality (SNH 2010). This is largely based on onshore wind farm studies.

The following is extracted from the SOSS-02 report (Cook *et al*. 2011). For clarity Table 3.2 in the original report has been split into two, grouping avoidance rates into near-field ('micro') and far-field ('macro'). Ideally these could be combined to give an overall avoidance rate for those species for which estimates of both type of avoidance are available. Unfortunately, the distinction between the two forms of avoidance (i.e. at what distance from the turbine macro avoidance becomes micro avoidance) has not always been defined, thus the two rates cannot be simply combined. However, the studies do provide valuable guidance on the range of rates which are appropriate for certain species.

In Table A3.1, micro avoidance rates are presented. It is of considerable note that none of the species in this table has a micro-avoidance rate of less than 99.1% (for migrant seaduck at night). The gull estimates range from 99.7 % to 99.9 %. Thus, when taking macro avoidance into account, overall avoidance must be higher than these rates.

Table A3.1. Extracted from Cook *et al*. (2011). Micro-avoidance rates for Offshore Wind Farms.

Species	Site	Avoidance rate	Type	Method	Source
Black-headed Gull	Brugge	0.997	Micro	Corpse Search	Everaert & Kuijken 2007
Black-headed Gull	Brugge	0.997	Micro	Corpse Search	Everaert & Kuijken 2007
Common Tern	Zeebrugge	0.999	Micro	Corpse Search	Everaert & Stienen 2007
Common Tern	Zeebrugge	0.999	Micro	Corpse Search	Everaert & Stienen 2007
Gulls	"De Put" Nieuwkapelle	0.997	Micro	Corpse Search	Everaert & Kuijken 2007
Gulls	Zeebrugge	0.996	Micro	Corpse Search	Everaert & Kuijken 2007
Gulls	Brugge	0.999	Micro	Corpse Search	Everaert & Kuijken 2007
Herring Gull	Brugge	0.999	Micro	Corpse Search	Everaert & Kuijken 2007

Species	Site	Avoidance rate	Type	Method	Source
Herring Gull	Brugge	0.999	Micro	Corpse Search	Everaert & Kuijken 2007
Migrant Sea Duck – Day	Nysted	0.996	Micro	Radar Observations	Desholm & Kahlert 2005
Migrant Sea Duck - Night	Nysted	0.991	Micro	Radar Observations	Desholm & Kahlert 2005
Mixture of resident and migrant species, including Gulls	3 Dutch onshore windfarms	0.999	Micro	Corpse Search	Krijgsveld *et al.* 2009
Sandwich Tern	Zeebrugge	0.999	Micro	Corpse Search	Everaert & Stienen 2007
Sandwich Tern	Zeebrugge	0.995	Micro	Corpse Search	Everaert & Stienen 2007

Table A3.2 presents macro avoidance rates. These are slightly more difficulty to interpret, however certain key aspects remain. Macro avoidance of offshore wind farms is typically lower than micro avoidance, with some species showing no avoidance at all (e.g. auks and grebes). Highest rates of macro avoidance have been recorded for gannet (96% and gulls (73 % – 76.4 %), while seaducks, wildfowl and other species all have lower rates of macro avoidance.

Table A3.2. Extracted from Cook *et al*. (2011). Macro-avoidance rates for Offshore Wind Farms.

Species	Site	Avoidance rate	Type	Method	Source
Alcids	Egmond aan Zee	0	Macro	Visual Observations	Everaert & Stienen 2007
Common Eider	Tuno Knob	0.53	Macro	Visual Observations	Larsen & Guillemette 2007
Common Scoter	Horns Rev	0.9	Macro	Radar Observations	Christiansen *et al.* 2004
Common Scoter	Horns Rev	0.886	Macro	Radar Observations	Christensen *et al.* 2006
Cormorants	Egmond aan Zee	0.43	Macro	Visual Observations	Krijgsveld *et al.* 2010
Divers	Egmond aan Zee	0.52	Macro	Visual Observations	Krijgsveld *et al.* 2010
Gannets	Egmond aan Zee	0.96	Macro	Visual Observations	Krijgsveld *et al.* 2010

Geese & Swans	Egmond aan Zee	0.82	Macro	Visual Observations	Krijgsveld *et al.* 2010
Grebes	Egmond aan Zee	0	Macro	Visual Observations	Krijgsveld *et al.* 2010
Gulls	Egmond aan Zee	0.73	Macro	Visual Observations	Krijgsveld *et al.* 2010
Gulls	Horns Rev	0.764	Macro	Radar Observations	Christensen *et al.* 2006
Landbirds	Egmond aan Zee	0.53	Macro	Visual Observations	Krijgsveld *et al.* 2010
Migrant Sea Duck	Nysted	0.9	Macro	Radar Observations	Christensen *et al.* 2006
Other Ducks	Egmond aan Zee	0.45	Macro	Visual Observations	Krijgsveld *et al.* 2010
Raptors & Owls	Egmond aan Zee	0.22	Macro	Visual Observations	Krijgsveld *et al.* 2010
Sea Ducks	Egmond aan Zee	0.67	Macro	Visual Observations	Krijgsveld *et al.* 2010
Skuas	Egmond aan Zee	0	Macro	Visual Observations	Krijgsveld *et al.* 2010
Terns	Egmond aan Zee	0.51	Macro	Visual Observations	Krijgsveld *et al.* 2010
Terns	Horns Rev	0.695	Macro	Radar Observations	Christensen *et al.* 2006
Waders	Egmond aan Zee	0.51	Macro	Visual Observations	Krijgsveld *et al.* 2010

The key aspect of this is that for those seabird species for which both micro and macro avoidance have been recorded, even allowing for uncertainty in the distinction between the two, the overall avoidance rates will be higher than that for either in isolation. Thus for gulls, the micro avoidance estimates of 99.7 % – 99.9 %, when combined with a macro rate of up 73 % will give rise to a higher rate. For example, a macro rate of 73 % and a micro rate of 99.7 % give an overall rate of 99.92 %. However, even if macro avoidance is reduced to 50%, the overall rate only declines to 99.85%. Perhaps most importantly, even if it is assumed that no birds avoid the wind farm (i.e. macro avoidance = 0), the overall avoidance rate cannot be less than the micro rate.

Determining appropriate precautionary avoidance rates

For gulls an overall avoidance rate of 99.5 % can be seen to be precautionary as this is in fact lower than the lowest reported micro rate.

For gannet, only macro avoidance has been reported (96 %). However, a micro avoidance rate of only 88% is sufficient to generate an overall rate >99.5 %. Such a micro-avoidance rate is considerably lower than for any other bird species (all >99 %), and this is therefore considered likely to be extremely precautionary.

For tern species, the lowest micro avoidance rate reported is 99.5 %, which is considered to provide a precautionary rate.

For skua, no macro avoidance has been observed, and no micro avoidance rate has been reported. Given the aerial abilities of these species, there seems little justification for assuming they would be at greater risk of collision than species such as gulls (indeed since they chase gulls on the wing they can be assumed to be at least as manoeuvrable), thus the 99.5% rate was used.

No avoidance estimates are available for fulmar. Maclean *et al*. (2009) suggest that 99.9% is suitable for this species, however a lower rate of 99.5% was considered appropriate until further data have been collected.

Overall an avoidance rate of 99 % has been used in the collision risk assessment presented for the Beatrice Offshore Wind Farm. Given the information presented above this is considered to be highly precautionary.