Beatrice Offshore Wind Farm - Environmental Statement

Marine Scotland Science has reviewed the ES submitted for the Beatrice Offshore Windfarm. Overall the ES, although very large, is well presented, contains the sections required including technical annexes and appropriate cross referencing. The figures used are clear and well set out with visible labels and scale bars. It is also good to see that comments from previous reviews/consultations were taken on board.

4 Process and Methodology

Section 4.2.1 does not discuss how it deals with effects on the environment that are unknown. The progression from para 6 to 7 suggests that there are no unknowns associated with the project.

6 Site selection

The site selection summary is very brief and does not summarise the information in the section presented in Section 6. Paragraph 38 in the section is not covered by the ES.

7 Project description

The ES adopts a Rochdale Envelope approach and states that the scope of the application stops at the MHWS mark. Consequently the precise nature of the work is currently unknown resulting in a general construction programme (Table 7.5) for the anticipated works with no detailed timing for the individual components of the project. Also by not including all the components of the project in the ES potentially the sum of the impacts of the entire project cannot be assessed.

Alternatives for different scenarios (including a no development scenario) are considered, using different devices and installation methods for a range of sizes consistent with current and future device designs. Differences in the size of the devices are reflected in the numbers of turbines to be used. The processes involved in operating the project are described for some aspects of the work in particular the installation of the turbine devices, interconnector cables and OFTW. The installation of a gravity based structure is estimated to take two weeks. The installation of 277 devices using this approach would take over 10 years to complete. If each turbine required 6,000 tonnes of rock for site preparation, a total of over 1.5 million tonnes would be required. On top of this would be the scour protection volume of 26,663 m3 per turbine (9.5.8. para 264). Where would the rock come from? How realistic are some of the options presented?

The types and quantities of raw materials needed for construction and operation are not detailed. Consequently although the different design options are discussed, it was not clear from the information included which options would use fewer resources in their construction and keep to a minimum the infrastructure required for their installation e.g. vessel activity for different devices, quarrying activities, sea disposal etc. How does this influence the efficiency in energy use and raw materials for the project (See section 4.2.1 Para 6)?

8 Designated Sites and Legislation

The main options and components of the project are shown on a series of maps. The lease area and OFTW corridor are clearly marked however, the turbine locations and the inter connector cables are not shown. The preferred option for the OFTW landfall and the preferred route to the onshore substation at Blackhillock are not shown in detail. This would be useful given the proximity of the OFTW landfall to the SSSI (51). Figure 8.2 has site 51 annotated as both a SAC and as a SSSI however, Annex 8a only refers to 51 as a SAC for the Lower River Spey-Spey Bay. Other activities such as Beatrice Platform, MORL site and Beatrice wind farm are also outlined on the maps. The area of land covered by the proposed windfarm lease and OTFTW corridor are provided.

9 and 21 Physical processes and geomorphology

Perhaps the most significant potential effects are related to the disturbance of seabed sediments. This is reflected in the ES with most of Section 9 focussing on these issues. Throughout the ES the level of impact and the sensitivity of the receptor in question are given, and a number of them repeated in Table 9.8. These assessments of the impact and sensitivity are considered to be appropriate throughout Section 9.

The good amount of attention paid to the potential cumulative effects was very welcome. The list of potential effects and reasoning behind the majority of them being scoped out early was good. The ES then focused on the developments occurring in and around the Moray Firth Round 3 site in an adequate level of detail.

The technical appendices submitted were all interesting, useful and extremely rigorous. They were very welcome as they helped explain some reasoning behind a number of the statements within the ES.

The multibeam echosounder data collected was processed into a bathymetry layer for the lease area. However, there is very little information presented on the survey method, standards and data processing. Also there is a reference to the collection of subsurface geophysical data recorded in section 9.2.5.2 para 20. Are these data included in the ES, does it include sub-bottom profiling information? This would be a very useful layer of information that would assist in the identification of the most appropriate foundation design for different parts of the lease area.

Can concerns over the potential for scour be taken into consideration at an engineering level i.e. factor in the extent of the predicted scour into the foundation design? What scour has been observed around the Beatrice wind turbines?

10 and 22 Benthic Ecology

The developer has adequately addressed the key issues in a rigorous and appropriate manner.

11 and 23 Fish and Shellfish Ecology

We note that there are a very large number of unknowns at this stage in terms of the development and that the ES attempts to assess a worst case scenario.

As a result, it should be noted that current knowledge is rather sparse in many cases and as such much of the superficially quantitative assessment of effects can be little more than expert opinion or informed guess work. It is in this context that LOT and MS should view the findings of this ES in general terms. Research planned by MSS in the coming year will help increase certainty over risk in relation to EMF. Monitoring work at a selection of wind farm sites could further help alleviate concerns over fish movement through these developments if desired.

The recognition of uncertainty in the ES assessment is welcomed.

Marine Fish and shellfish species

Sandeels
Due to the sensitivity of the species, potential area of impact from gravity base infrastructure and the lack of knowledge of density and distribution of patches of Sandeels. We do not agree that this impact can be assessed as negligible (section 11 para.98). A more conservative approach should be taken and the impact assessed at least as minor and probable rather than negligible and probable.

Due to the significance this species has in the food chain, it would be pertinent for the developer to establish the distribution of sandeels to identify the key areas (most dense patches) used by the species. We would recommend the developer try and carry out some further sampling between now and construction to improve the knowledge of distribution. This will help when micrositing the devices to enable the developer to avoid damaging key patches as these may be the most important in terms of the food chain links.

It would be useful for this extra sandeel sampling to be similar in methodology to that carried out by the MORL development to allow for the two data sets to be comparable and help identify/monitor cumulative impacts as well as impacts at the individual site level.

There may also be an opportunity to use the bird data to help identify sandeel patches. If species of bird that are known to prey on sandeels are present and shown to be feeding, this may indicate the presence of important/dense sandeel patches.

Herring
The developer has appropriately identified the potential issues for herring with regards to sedimentation and habitat loss. The developer has identified that herring may be affected by noise from construction and that soft start piling will be used to mitigate against physical damage from noise. However the duration of construction and the periods at which this noise activity will occur is of concern as this may restrict herring from spawning at the site. If this spans consecutive spawning periods for several years in a row it may have the potential of

displacing these fish permanently form the area. This is of concern because of the proximity to the Orkney/Shetland stock which is the least stable of the herring stocks and this stock has not recovered to the same extent as the other stocks, as a result would be more susceptible to added pressures upon it. It is difficult to see how this impact can be assessed as unlikely and again we would suggest this impact would be probable.

Changes in fishing activity
Although some consideration to changes in fishing activity has been shown, there has been little mention of displacement. Is it realistic that the same level of activity will continue during the operational phase? The cumulative impact of displaced fishing activity on sandeels for example has not be assessed here.

Freshwater and Migratory species

Section 11 Paragraph 48. It should be noted that the position of this wind farm puts it on potential migratory routes for all east coast salmon SAC rivers, not just those listed in table 11.8.

Construction Noise
Paragraph 80 (Chapter 11) states that the magnitude of noise effects is considered to be small, with salmon classified as medium sensitivity, with an overall expected outcome of probable negative, but minor impacts.

The developers have carried out modelling to show that a relatively small area of sea is affected by noise levels that will be detectable to salmon when compared to other species. They have based their assessment of hearing on the best available (but very limited) information that there is on this topic.

However, I am unclear how they are able to decide that the effects will be small. This is because they don't really know how fish will respond to the noise or what the consequences are for migrating salmon. For example, will migrating fish be permanently shifted from their regular migratory routes such that it affects homing, or will they be forced to migrate additional distance thereby compromising energy reserves and survival or would the activities only result in small and very short term changes in direction with no long-term consequences? Given the uncertainty over migratory routes (acknowledged by the E.S.), the limited information on behavioural responses to noise and the lack of robust previous monitoring of wind farm construction activities, it should be recognised that any assessment of likely impact will be highly uncertain.

EMF
Paragraph 118 states that EMF effects will be small due to the area affected by EMF. However, this ignores the fact that the cables are linear features requiring migrating fish to pass over them. As such the total area affected seems unimportant.

The ES correctly notes that there is evidence of eels, salmon and sea trout responding to EMF's, that the field strength is greatest close to the bed and that burying the cables reduces the chance of fish coming into close proximity to the cables. However, the ES also states that salmon will not come into proximity with the cables because they swim at shallow depths. This remains uncertain and is the subject of research by MSS. Furthermore, the power will eventually be exported to land at which point the cables will come into shallower water.

We note that although the ES states the magnetic field strengths expected from the cables, it does not also state the values that diadromous fish can be expected to respond to. We presume this is because this information is not reliably available. We also note that this is the subject of additional research by MSS.

Nevertheless, the values presented in Table 11.7 (which are very low compared to the earth's background magnetic field) generally support the assertion of a minor negative but probable impact for salmon, sea trout and eels

Operational Noise

The ES seems to suggest that salmon could detect noise from operational wind farms (turbines?) at distances of 0.4-25km based on work by Walhberg and Westerberg (2005), but that other studies suggest noise levels are insufficient to cause any behavioural reaction (Vella *et al.,* 2001). The ES then goes on to conclude that operational noise would constitute a negative, minor, but unlikely impact. Operational noise is one of the greatest concerns for this development because it is a potentially long term and large scale impact. Previous studies have suggested that salmon could use the noise of waves breaking on the shore to orientate them offshore, thereby assisting migration. If the noise coming from operational wind farms confuses this signal it could have knock on consequences for migratory routes and behaviour. One of the main problems with assessment of this risk is the lack of robust field based data on the movements of diadromous fish in offshore wind farm areas, compounded by relatively poor information on hearing and behavioural responses to noise. Therefore there must remain considerable uncertainty in the effects of operational noise at present that is perhaps under reflected in the "unlikely" classification that cannot be resolved at this time.

Mitigation measures

We note that no mitigation is proposed for the construction phase and that burial of cables is proposed for the operational phase. Burial seems to be a sensible precaution in the absence of further information on fish responses to EMF. The developers could explore options for construction outside of peak migration periods for smolts.

Monitoring

Given the unknown consequences of operational wind farms on fish migration and behaviour MS LOT may wish to consider the opportunities for assessing salmonid movement through the wind farm, funded either by the developer, groups of developers or a combination of developers and MSS. This could help inform future ES assessment. One option would potentially involve the deployment of acoustic receivers on wind farm structures with tagging of smolts in rivers and adults from coastal nets.

Cumulative assessment

We note that the cumulative assessment has considered the impact of other developments and concludes that a negative moderate cumulative effect is possible. This seems a reasonable assessment given the large number of uncertainties in the assessment.

Screening for AA (Table 11.23)

Given all the uncertainties we are not clear that a likely significant effect of SAC rivers would not occur for the project alone, but agree that in combination a likely significant effect seems appropriate. However, we once again emphasise the large number of uncertainties which can affect this assessment in either direction.

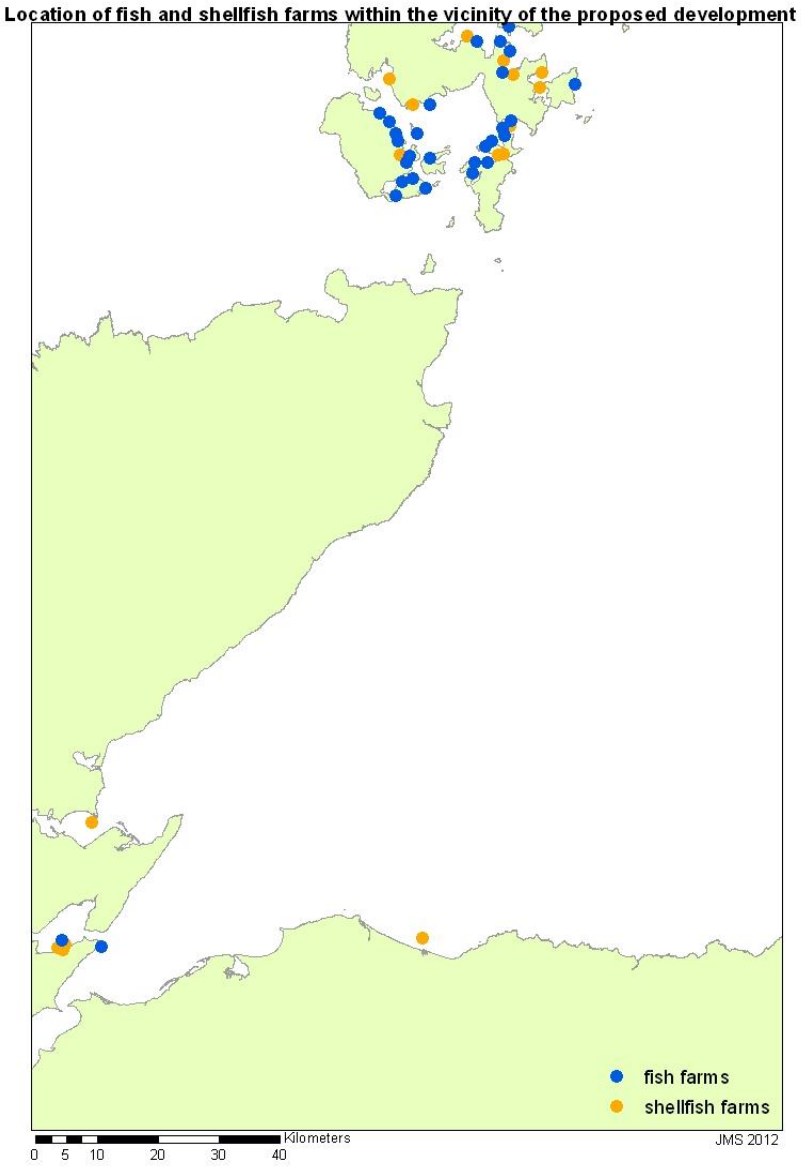
Aquaculture

There are no aquaculture sites within the proposed boundaries of the Beatrice Offshore Windfarm site. There is however, an active mussel site close to where the cable route corridor joins the land between Norrie Scalp and Portgordon (see map attached below). This site is operated by Spey Bay Mussel Farm. This site is situated ~3km from the cable route corridor.

There are also another three active shellfish sites within the Moray Firth area, there is a mussel farm operated by Cromarty Mussels, a pacific oyster farm operated by Black Isle Seafood Ltd and another pacific oyster farm operated by MacKenzie Oysters. The closest site is ~90km from the boundaries of the Moray Offshore Wind Farm.

There is also 2 inactive finfish sites within the Moray Firth area. One is a rainbow trout and salmon site and the other a salmon site. Both owned by Northern Isles Salmon and have been inactive since 2003.

There is no other seawater aquaculture sites on the east coast of Scotland, to the south of the proposed development. To the north the next closest sites would be around Orkney.



16 and 27 Commercial Fisheries

The maximum construction period of 5 years described (section 16, para 38) as the worst case scenario may need to be re-evaluated following assessment of the build time (possibly of 10 years) as suggested above.

Although we note that by the data presented by the developer the scallop fishing would appear to constitute a small proportion compared to the whole Moray Firth or UK waters (section 16 para 58). It is unclear at this point as to whether the developer has fully taken into consideration that there is a large wind development that will be impacting on the scallop ground in a similar way. It should also be noted that not all the ground in the Moray Firth is

suitable for Scallops with large areas of the Firth made up of Muddy sediments that are not favourable for this species.

The over 15m VMS data provided would support the assessment for loss of fishing grounds being classed as minor. However it is unclear as to the extent of the Moray Firth under 15 (non-VMS) vessel activity. The impact on this proportion of the fleet would be perceived as being of greater significance given the restrictions on ground to which these vessels are able to access and then the compounded effect of increased competition from other displaced vessel activity. Table 16.10 should perhaps show the significance of impacts on local and UK fleet. In general the UK fleet would show the sensitivities described but it would be likely that several of the perceived effects would be of greater sensitivity to more locally restricted vessels.

marinescotland

T:+44 (0)1224 295579 F: +44 (0)1224 295524
E: MS.MarineLicensing@scotland.gsi.gov.uk

The Scottish Government
Riaghaltas na h-Alba

LEGACY 2014
XX COMMONWEALTH GAMES
SCOTLAND

Gayle Holland
Marine Scotland
Licensing Operations Team
375 Victoria Road
Aberdeen
AB11 9DB

16 July 2013

Dear Gayle

BEATRICE ADDENDUM – MSS COMMENTS

Thank-you for your e-mail dated 04 June 2013 requesting comments from Marine Scotland Science on the above proposal.

Marine Scotland Science Advice

Marine Scotland Science (MSS) have provided comments on Marine Fish Ecology and Diadromous Fish. Our comments are as follows.

Marine Fish Ecology

Herring

With the new evidence from the recent ICES working group on Herring held earlier this year it is believed that the potential risk posed to Herring from these developments (at the individual level) has reduced slightly due to the population increasing. However there is still a potential for impact, the increasing population will be looking for additional grounds to spawn on and therefore may utilise the suitable sediments in the area. Due to the relatively small area that these suitable sediments cover near the developments compared to the wider Orkney/Shetland area the potential risk at the population level could be reduced. In terms of cumulative impact this would still be of medium significance.

There are also new spawning area maps currently being modelled. These should be available in the next month (by August). We would like to use these to confirm the advice from ICES before any final decisions/discussions take place.

As a result we would not be recommending a complete ban on piling activities during the spawning period however we would recommend that the developers reduce the level of noise impact they are having on the marine environment during the spawning period.

This could be done using various methods and some potential options are offered below but this is by no means an exhaustive list.

Complete reduction of blow force energy used during spawning season where physically possible thought the whole site. This would need to be considered with additional contextual information to determine the benefits of reduction in noise compared to increase in duration.

Reduction in blow force as above but only for the identified peak spawning period. This would be determined with a suitable survey methodology agreed with SNH/MSS. Piling noise would be reduced when spawning activity is identified and would remain at this level until the continual survey showed that the main spawning had tailed off and normal piling levels could be restarted.

This could also be further modified only to take in pile locations that have 90dBht contours that enter the areas of sediment habitat that is suitable for herring spawning.

The surveys could also be carried out and if no spawning is occurring in the 90dBht contour zone then piling would not have to be reduced in intensity.

These reductions in blow force would need to be decided upon by MSLOT and these would need to be consistent across both BOWL and MORL developments. Bearing in mind that BOWL is nearer to the areas of suitable habitat. MSS would welcome continued discussions on this matter with the developer and MSLOT.

Cod and sandeels

Due to the lack of certainty MSS would welcome the commitment from the developer to conduct pre-construction surveys for cod and sandeels, keeping methodologies consistent between Beatrice and the Moray Firth Offshore Renewables development. These surveys would provide a good baseline of evidence as to where these species are and whether they are potentially effected post installation of the development. MSS would welcome continued discussions on this matter with the developer and MSLOT.

Commercial fisheries

MSS welcomes the commitment to continued engagement with the fishing industry and participation in the commercial fisheries working group within the Moray Firth area. This should help meet and address concerns as they emerge. Especially with regards to cable burial depths (MSS would recommend 1m minimum where possible rather than 0.6m), cable protection and over trawl surveys post installation.

Diadromous Fish

MSS comments on previous material remain in place. The uncertainties, including about the extent to which salmon, sea trout and eels from or destined for different rivers use the area, and their behaviour within the area, still remain.

MSS have the following comments on the new material (Vol 1. Section 5 Fish and Shellfish Ecology) and on the SNCB advice on BOWL.

- The selection of rivers for HRA with respect to salmon is still as advised by SNH. We note again that the salmon from or returning to SAC rivers, other than those selected, could also be affected and that FL's thinking was that rivers from further afield, particularly on the Scottish east coast should also be given HRA consideration.
- Although Malcolm et al (2010) and Gill and Bartlett (2010) are referred to in the text and in Appendix 16B, they are key references which we would have expected to be in the Vol 1. Section 5 reference list.
- Any large amounts of dredging and redeposition of sediments need careful consideration and additional consideration will be necessary if the development uses gravity bases. Vol 1. Section 5 page 5-39 may overstate the ability of fish, particularly small fish, to avoid areas with high SSC.
- Other than the choice of rivers selected for HRA, we would fully support the excellent SNCB advice, including the setting up of an expert panel to ensure good monitoring arrangements and adaptive mitigation will be in place, which will be very important.

- MSS would also note that with respect to EMF concerns that in addition to what SNCB states in Appendix C(ii) that BOWL advised that the export cable will also be directionally drilled to 800 m from shore, which in view of its close proximity to the mouth of the River Spey will provide additional protection.
- MSS also note that many good points in relation to diadromous fish issues have also been made at the earlier stages by external consultees.
- My comments on the SNCB advice also apply to the SNCB advice on MORL, as relevant

Hopefully these comments are helpful to you. If you wish to discuss any matters further contact the MSS Renewables in-box MS_Renewables@scotland.gsi.gov.uk.

Yours sincerely

Paul Stainer
Marine Scotland Science

Marine Scotland Science advice to MS- LOT on Ornithology assessments provided by BOWL and MORL, and ornithological advice to LOT provided by JNCC & SNH dated 8 July 2013.

25 July 2013

Summary

1. Clarification of a number of points are required to determine whether the conclusions reached by the BOWL, MORL and the SNCB's on the significance of predicted effects upon SPA populations are sound.
2. A preliminary assessment of PVA outputs presented by BOWL, MORL and the SNCBs indicates that the species of concern remain GBBGU and HERGU and also potentially PUFFI and RAZOR (but see comments on PVAs below).
3. A list of recommended actions that would allow the issues identified to be resolved are presented in Table 3.

Collision Models

4. Whilst arguments are presented by BOWL and MORL for increasing avoidance rates above 98% for Option 1 in the standard Band model, no arguments are presented for increasing avoidance rates in the extended model Option 3. Therefore until evidence suggests otherwise, an avoidance rate of 98% should be used in the extended Band 2012 model's Option 3 for estimating collisions.
5. It is apparent from the Excel CRM spreadsheets used by BOWL and MORL that the collision rates estimated using Option 1 and Option 2 of Band 2012 differ considerably for the majority of species, suggesting that flight height distributions differ between the site data and those presented in Cooke et al 2012. Comparison of site-specific data with Cook et al alongside discussion of potential reasons for these differences would help to justify the use of Cook et al 2012 data.
6. The Band 2012 collision model does not assume a uniform blade width. Rather, the blades taper towards their tips and the overestimate in collisions described by MORL (page 16, "Collision risk modelling – mean blade width") is not correct.
7. As identified by the SNCBs, differences exist between the BOWL and MORL CRMs in the level of nocturnal activity and flapping versus gliding flight action. Combining outputs to inform a CIA is problematic unless a 'common currency' is adopted. The recommended input parameters provided by SNH and JNCC allow a 'common currency' to be achieved.
8. SNH and JNCC have recalculated collision rates and used a standard method for accounting for individuals that are not part of the breeding SPA population. This approach appears to have resulted in reductions in the number of SPA birds predicted to collide, although the calculations undertaken by the SNCBs are not clearly presented in their advice.

Displacement Models

9. Both MORL and BOWL have used the mean peak estimates of birds in the displacement assessment. This is likely to result in overestimates of at sea abundances due to the inclusion of passage birds from more northerly breeding areas, birds from the wider area undertaking post/ failed breeding dispersal, or non-breeding birds from the wider area prospecting at breeding colonies during the latter part of the breeding season. Displacement effects are therefore likely to be overstated.

10. Both MORL and BOWL have included birds in flight and on the water in displacement assessments. This will overestimate abundance and for some species this overestimate is likely to be significant. However, it would not be appropriate to use only birds on the water to assess displacement effects as birds in flight of some species e.g. GANNE, KITTI may be actively foraging and therefore susceptible to displacement. Whilst MORL have previously included only birds "using the water" in displacement assessments, no definition of this term for any species has been provided, nor has any information been provided to suggest that objective and repeatable at sea assessments of whether birds in flight are transiting or "using the water" is possible.
11. BOWL have included an adjustment for turnover of individuals at sea during the breeding season to estimate the number of individuals potentially displaced.
12. MORL have argued that the use of mean seasonal peak abundance results in a significant overestimate of abundance and that a further adjustment to account for turnover is unnecessary.
13. Uncertainty exists over the level of displacement from windfarms, with information from a limited number of studies available. BOWL and MORL have presented slightly different displacement rates for the species of interest. However, a precautionary estimate of the proportion of birds potentially displaced has been identified by SNH and JNCC in their advice and should be used for as 'common currency' for cumulative impact assessments (Table 1).

Table 1: Proportion of birds at sea displaced

Species	Proportion Displaced
Fulmar	0.5
Gannet	0.6
Kittiwake	0.4
Guillemot	0.6
Razorbill	0.6
Puffin	0.6

14. Significant uncertainty also exists over the likely effects of displacement upon individuals. BOWL and MORL have presented assessments that assume that 100% of displaced birds (and therefore the pair) will fail to breed successfully. This is likely to be unrealistically high and lead to an over estimate of the effects of displacement. The results from the MSS research project on displacement effects being undertaken by CEH are due very shortly (mid August 2013), and these should be used to inform the magnitude of any displacement effects.

Population Viability Analysis (PVA)

15. The model outputs presented by BOWL and MORL are largely as requested by JNCC, SNH and MSS with the exception of the number and size of tabulated increments of effects and the starting populations assumed.

16. The BOWL PVA probability outputs are presented for a relatively small number of collision rate values and relatively large increments, making exploration of change in probability of decline difficult. Whilst the tabulated probability outputs presented by MORL include a larger number of scenarios and therefore potential effects than BOWL, the resolution of the potential range of effects makes the tabulated outputs difficult to use.

17. The tabulated probability outputs for e.g. GBBGU PVAs should be presented in increments of single birds up to 20, and then larger increments to the maximum value predicted. For HERGU, increments of e.g. 10 birds should be presented up to 100 after which increments of 20 birds to the maximum value predicted. Where probabilities of a population decline reach 1.00, no further increments in collision should be presented.

18. The starting populations used in the PVAs differ between BOWL and MORL but the reasons for this and the implications for interpreting the results are unclear.

19. Demographic rates included in the PVAs differ between BOWL and MORL. As the true demographic rates are unknown for the sites and species concerned, developers have selected the rates that they believe are most appropriate. The differences in demographic rates used by the two developers are not seen as a problem by MSS as the 'right' demographic rates are not known.

20. As SNH and JNCC indicate, the PVAs are based on demographic rates that are not spatially or temporally specific to the colonies. Due to the limited number of studies undertaken, having current demographic data from the colony of interest will be the exception rather than the rule. However, consideration should be given to this lack of site-specific data when interpreting the outputs from population models.

21. Confirmation is required from MORL and BOWL on whether they have presented the probabilities that the population at the end of the modelled period will be lower than the starting population, or have presented probabilities that the population will fall below the starting population at any point during the modelled period.

22. BOWL and MORL indicate in paragraph 111 and Section 7.5 respectively that the ECC SPA population of GBBGU will continue to grow until additional annual mortality exceeds 70-75 birds. Assuming a starting population of 175 pairs this seems unrealistic, as does the estimated growth rate of c. 1.10.

23. Whilst it is clear that the probability of a decline in a population will be heavily influenced by the demographic rates and estimated population growth rate in the model, it is less clear how sensitive the *change* in probability of decline will be. An analysis of the sensitivity to demographic rates of the change in probability of decline produced by the PVAs should be carried out. It is advised that productivity and adult survival be manipulated to produce growth rates of 0.98, 1.00 and 1.02 for GBBGU, HERGU and GUILLE at ECC. This will provide evidence on whether the change in probabilities of decline (and any assessment of acceptable levels of change that depends upon them) are sensitive to demographic rates. Until this is carried out MSS advise that the dismissal of the PVA outputs for use in any- assessment would be premature.

Potential Biological Removal (PBR)

24. In their advice dated 8 July 2013, SNH and JNCC provide preliminary PBR values for key SPAs and suggest that these outputs may be more appropriate for determining acceptable levels of change than the PVA outputs. As discussed above, MSS advise that discarding PVA outputs at this stage is premature. We also advise that care is required in selecting the most appropriate values for inclusion in a PBR, and in the application of outputs to discrete populations.

25. As acknowledged in the SNCB advice, the R_{max} values used in the PBR are based on the growth rates estimated by the PVAs. These may be an underestimate of maximum potential growth rates and if this is the case, the PBR value will be too low.

26. As identified by BOWL and acknowledged by JNCC and SNH, breeding populations may include significant numbers of adults that do not breed each year. For example, in GBBGU this was estimated to increase the number of adults in the SPA population by 30%. For a population of 175 pairs, rather than 350 individuals (175 pairs *2), the population size would be 30% greater (466 individuals). The incorporation of a correction factor to account for non-breeding adults within the SPA populations would result in an increase in the PBR. Care must be taken to ensure that double counting of non-breeding adult birds e.g. via the SNH CRM calculations does not occur.

27. The *f* value used by SNH/JNCC for some SPA populations has been set at 0.1 (based on Dillingham pers comm.) but it is unclear how this value has been reached and whether it is justified. A doubling of *f* values results in a doubling of PBR values and so the setting of appropriate *f* values is crucial.

28. It is unclear how the PBR outputs presented by SNH and JNCC can be used in determining the significance of displacement of birds where the primary effect is expected to be a reduction in productivity rather than adult mortality.

Assessment of Magnitude of Predicted Effects

29. MSS recommend that where possible the use of more than one tool to determine acceptable levels of change to SPA populations is used. Assuming appropriate N_{min}, R_{max} and *f* values are identified and used, PBR and associated 'harvest rates' may provide a valuable 'sense check' for PVA outputs.

30. A method using IPCC likelihood criteria is currently being developed by MSS for use in determining acceptable levels of change (Bennet, in prep). The Assessing Biological Change (ABC) method also allows uncertainty in the modelled growth rates to be accounted for.

31. Whilst at present it is not possible to apply the ABC method to the tables of outputs presented by BOWL due to the large increments in additional mortality, it can be applied to the MORL PVA outputs (Table 2). However, the values presented are for illustrative purposes only and do not represent MSS advice on acceptable levels of change.

32. Assuming that changes in probability of decline are not sensitive to unrealistic demographic rates, a preliminary application of the ABC method suggests that GBBGU, HERGU and PUFFI at ECC SPA are of potential concern.

33. The conclusions of the preliminary assessment using ABC differs from the advice presented by the SNCBs in that a larger magnitude of effect may be acceptable for GBBGU and HERGU (though the predicted effects presented by BOWL and MORL would remain a significant concern). It also indicates that displacement effects on GUILLE and RAZOR at ECC, and PUFFI at NCC are unlikely to have significant effects upon the SPA populations.

34. As discussed above, it is unclear how sensitive the change in probabilities of population decline (or any assessment based on them) may be to the demographic rates used and this needs to be clarified as a matter of urgency.

35. At present it is difficult to envisage an assessment of levels of change concluding that the magnitude of impacts on GBBGU predicted by the worst case scenarios of BOWL and MORL would be acceptable. However, additional work is required to tease apart the true magnitude of predicted effects and understand the implications on the SPA populations (Table 3).

Table 2: MORL baseline probabilities of decline and 'acceptable' increases in probabilities of decline following application of the ABC method, and comparison with PBR values and predicted magnitudes of effects presented by SNH/ JNCC is their joint advice dated 8 July 2013.

Species	Collision or Displacement Effects	Baseline P of decline	MORL estimated growth rate	Evidence of SPA population decline?	'Forced' baseline P of decline	Increase in P of decline	P of decline limit	Estimated additional effect*	SNCB Values			
										Predicted Effects		
									PBR	MORL	BOWL	SUM
GBBGU	Collision	0.052	1.107	Y	0.925 "Very Likely"	0.0375	0.0375	~6	2	7.5	15	22.5
HERGU	Collision	0.739	1.0344	Y	0.925 "Very Likely"	0.0375	0.7765	~30	43	27	42	69
PUFFI - ECC	Displacement	0.006	1.0796	Y	0.5 "About as likely as	0.25	0.256	~110	2-7	136	80	216
PUFFI - NCC	Displacement	0.023	1.0796	Y	0.5 "About as likely as	0.25	0.273	>1500	4-12	492	323	815
GUILLE- ECC	Displacement	0.161	1.0575	Y	0.925 "Very Likely"	0.0375	0.1985	>3500	563-1687	3209	2118	5327
GUILLE- NCC	Displacement	0.16	1.0575	Y	0.925 "Very Likely"	0.0375	0.1975	>3000	248-745	200	132	332
RAZOR- ECC	Displacement	0.003	1.0801	Y	0.85 "Likely"	0.075	0.078	>800	111-334	776	357	1133
RAZOR- NCC	Displacement	0.003	1.0801	Y	0.85 "Likely"	0.075	0.078	~350	15-46	15	7	22
KITTI- ECC	Collision	0.993	0.9827	Y	N/A Refflected in PVA	0.0035	0.9965	>100	467-1400	70	21	91
KITTI- NCC	Collision	0.993	0.9827	Y	N/A Refflected in PVA	0.0035	0.9965	>100	117-352	70	21	91

N.B. ***Change in probability of decline may be sensitive to demographic rates used and the estimated additional effect values presented are for **illustrative purposes only.

Table 3: Recommended next steps

Task	Dev.	SNCB	MSS	Other
Provision of displacement and collision effects in a 'common currency' to allow CIA. Use approach used by SNH/JNCC in advice 8/7/13 as starting point.	■			
Provision of detail on CRM calculations and apportioning methods used by SNCBs		■		
Provision of tabulated PVA outputs at finer resolution so that full range of potential effects can be explored.	■			
Quantify magnitude of potential overestimate of displaced birds through the use of mean seasonal peak and birds in flight and on the water (this has been presented by MORL).	■			
Incorporate CEH modelled displacement effects into displacement assessment and compare results with those where 100% breeding failure assumed.	■			
Clarify starting populations used and implications for PVA outputs and the interpretation of results.	■			
Assessment of sensitivity of *change* in P of decline to demographic rates used in PVAs. Alter productivity and adult survival rates to produce growth rates of 0.98, 1.00 and 1.02 for GBBGU, HERGU and PUFFI at a single SPA.	■			■
Apply ABC method to SPA populations using BOWL & MORL outputs.			■	
Undertake external expert review of BOWL and MORL PVA methods and conclusions reached.			■	■
Review & sensitivity analysis of ABC method.		■	■	■
Re-apply ABC method following review of PVAs & sensitivity of change in P to demographic rates.			■	
Identify appropriate R_{max} values for PBRs relevant populations.	■	■	■	
Identify most appropriate *f* values for PBR.	■	■	■	
Offshore foraging distances from breeding colonies of GBBGU and HERGU.	■			
Are boat-based density estimates of gulls artificially inflated due to attraction to vessels (as per SOSS gannet PVA).	■			
Provide information on gull collision rates at terrestrial wind farms in Caithness.		■		
Exploration of survey data from the breeding season. Any evidence that GBBGU and HERGU in project areas were not from ECC SPA?	■			

MSS interim advice to MS-LOT on Common Currency spread sheets provided by BOWL and MORL, and advice received from JNCC and SNH on 28 August 2013

Jared Wilson
September 4 2013

The common currency spread sheets provided by BOWL and MORL have proven to be extremely helpful. They provide a concise and clear synthesis of the approaches taken by the developers and the potential implications of any differences on the magnitude of predicted effects. They also have the potential to identify where a novel approach identified by one developer could be adopted by the other.

The common currency tables have also clarified to the SNCBs and MSS how predicted effects have been apportioned to SPA and non-SPA populations.

A number of approaches taken by the developers do not adhere to advice provided by JNCC and SNH (see memo dated 28 August 2013) and the MSS advice below deals predominantly with these differences.

1. Nocturnal Activity

BOWL propose reducing the level of nocturnal activity in GBBGU and HERGU from the SNCB advice of 3 (50%) to 2 (25%), whilst MORL propose 1.5 (12.5%) during the breeding season and 2 for the non-breeding season. The nocturnal activity values produced by Furness & Wade (2012) were based on observations of attendance at fishing vessels at night (Garthe & Huppop, 1996). Gull attraction to fishing vessels has been widely reported (Hudson and Furness, 1988; Skov and Durinck, 2001) and indeed was the basis of the Garthe & Huppop study. One of the conclusions of this study was that ship lighting was far more significant for nocturnal gull activity than moonlight. There is therefore considerable uncertainty over whether observations of nocturnal activity at fishing vessels are representative of nocturnal activity in the wider environment, and whether they should be converted into percentage values in the manner of the Band Collision Risk Model (Band 2012). This uncertainty is reflected in the comments attributed to Bob Furness in the SNCB advice of 28 August 2013.

The SNCB advice (and the Camphuysen pers. comm provided) are unclear about whether diurnal, diel, or nocturnal activity are being discussed. Garthe & Huppop (1996) found a reduction in the number of gulls attending fishing vessels during hours of darkness (but see point above regarding attraction of gulls to fishing vessels and whether it is therefore representative of the wider environment). Analysis of lesser black backed gull tag data from East Anglia indicated that when birds were away from the colony and offshore at night, 90% of their time was spent sitting on the water (APEM, 2013). Similar patterns of extensive periods of time offshore being spent resting on the water have been observed elsewhere (Shamoun-Barnes et al 2011).

It therefore appears that 1) the nocturnal activity values for gulls are principally based on observations from fishing vessels which are unlikely to be representative of nocturnal activity in the wider environment 2) there appears to be no basis for the conversion of nocturnal activity values into percentages and 3) evidence exists for a substantial proportion of time spent offshore (and not attending fishing vessels) at night being spent on the water. MSS therefore advise that the nocturnal activity level of 3 (50%) for gulls should be reduced to a still precautionary value of 2 (25%) during the breeding season and the non-breeding season for use in the Band Collision Risk Model.

This would result in no change to the collision estimates presented by BOWL (but see below) and a small increase in predicted collision estimate of 2.4 during the breeding season presented by MORL (but see below).

2. Gull attraction to Boats

JNCC and SNH are correct in highlighting the difficulties in attempting to convert abundance estimates derived using different survey platforms. However, the studies cited in their advice of 28 August 2013 aimed to compare abundance estimates produced using different analysis methods and/or aerial survey methods and whilst land based vantage point data were included in one of the studies, none included boat based surveys. The relevance of these studies to the arguments presented by both BOWL and MORL that at sea abundance estimates were inflated due to attraction of gulls to survey vessels is therefore unclear.

As discussed above, gulls and other opportunistic seabird species often utilise discards from fishing activities, with large number of gulls and other species often occurring in close proximity to fishing vessels (Furness et al, 1988; Garthe & Huppop, 1996; etc). There is also evidence that a range of seabird species are attracted to survey vessels, presumably due to the perception of foraging opportunities, and that abundance estimates can be artificially inflated (Hyrenbach, 2001; Clarke et al 2003; Spear et al 2004; Borberg et al, 2006). It has been estimated that vessel attraction occurs over distances of c. 10 km (Skow & Durinck, 2001; Heinemann, 1981). The SOSS gannet PVA project required that a conversation rate of 7 was applied to at sea abundance estimates to ensure that boat based and aerial survey data could be combined for analysis (SOSS, 2012). Whilst the mechanism for the observed differences is unclear (see papers cited by the SNCBs in their advice of August 28 2013), it seems likely that attraction to survey vessels was one of the drivers. Attraction of birds towards the observation platform would undermine one of the principal assumptions of absolute abundance estimation.

The argument presented by BOWL and MORL that the boat based abundance estimates for GBBGU and HERGU are artificially inflated due to attraction to the survey vessels does therefore have merit. The comparison of boat and aerial survey estimates presented by BOWL and by MORL suggests that attraction to survey vessels similar to those discussed above is occurring. Whilst the magnitude of the any overestimate is based on limited data it is highly likely to occur and MSS therefore recommend that a precautionary correction value of 2.0 rather than the

value of c. 4 proposed by the developers be applied to GBBGU and HERGU abundance estimates.

This would have the effect of doubling the number of GBBGU and HERGU predicted to collide as presented by the developers (but halving the numbers that would result if no correction factor was applied).

3. Apportioning methods

3.1 SPA/ non SPA

Whilst the apportioning methods used by BOWL and MORL differ considerably, there is uncertainty at present over which method is the most appropriate. MSS therefore advise that currently we do not see any reason why the apportioning values presented by the developers should not be combined for use in a cumulative assessment.

This would result in no change to the apportioning values presented by the developers.

3.2 Proportion of adult gulls

Both MORL and BOWL have indicated to MS LOT why the calculation requested in the SNCB advice of 28 August 2013 is not necessary and MSS are content with the calculation not having been undertaken.

This would result in no change to the values presented by the developers.

3.3 Accounting for sabbatical gulls

MSS agree with the approach taken by BOWL and MORL and accepted by the SNCBs.

This would result in no change to the values presented by the developers.

4. Displacement calculations

4.1 Mean peak vs mean

The auk breeding season used for the assessment is from April to July and so now excludes August peak in abundance observed for puffin which artificially inflated the abundance estimate. Based on survey results presented by the developers, the breeding season peak in auk (guillemot, razorbill and puffin) abundance occurs during April and May, coinciding with either the pre-laying or incubation stage of the three auk species. Due to the potential for laying and incubating birds being particularly vulnerable to reduced foraging opportunity or increases in time away from the nest, as well as the difficulty in properly addressing turnover, MSS advice that the mean seasonal peak value be used rather than mean.

The use of mean seasonal peak rather than the mean value proposed by the developers would result in an in birds potentially displaced by c. 50% compared to those presented by BOWL and MORL.

4.2 All birds vs birds on the water

As per previous and SNCB MSS advice, all birds rather than birds on the water should be included in the assessment of displacement due to difficulties differentiating between birds transiting through the area and those utilising the sea. This approach may also provide a surrogate for barrier effects.

The use of all birds rather that birds on the water or 'using the water' would increase the number of birds potentially displaced presented by BOWL and MORL by c. 10%.

4.3 Turnover adjustment

MSS agree with the SNCBs that at present there is no method available to account for turnover of individuals and MSS therefore advise that the turnover adjustment applied by BOWL be removed.

This would result in no change to MORL displacement values but a reduction to the BOWL displacement values of c. 50%. This reduction would also be reflected in the cumulative assessment.

4.4 Proportion displaced

Setting the proportion of birds displaced at 50% appears reasonable. However, the proportion of birds displaced is highly likely to be effected by the turbine spacing.

This would result in no change to the values presented by the developers.

4.5 Proportion failing to breed successfully

The proportion of displaced birds failing to breed successfully will be strongly influenced by the results of the CEH Displacement project.

5. Summary of implications of applying MSS advice

The estimated magnitude of effects predicted using the approaches taken by the developers as well as those based on SNCB advice and MSS advice are presented for displacement (Table 1) and collision (Table 2) effects.

5.1 Displacement effects

The advice provided by the SNCBs and MSS would result in a slight decrease in the number of guillemot potentially displaced presented by BOWL and MORL (from 3550 to 2494), an increase in razorbill (from 650 to 787), and in increase in puffin at ECC (51 to 88) and NCC (16 to 32). However, this currently assumes that 100% of

displaced birds will fail to breed successfully. The CEH displacement project will help identify the proportion of displaced birds that may fail to breed, and the potential population level implications of this. At present, based on advice provided by MSS (and the SNCBs) displacement of puffin at NCC cliffs SPA is not of concern.

5.2 Collision effects

As discussed above, a number of issues with the approaches taken to estimate number of collisions have been raised by the SNCB's in their advice. Whilst MSS advise that some of the arguments presented by BOWL and MORL are valid, we do not agree that evidence currently exists for the proposed magnitudes of adjustment to account for attraction to survey vessels or reduction in nocturnal activity to 1.5.

Application of the MSS advice discussed above would result in the number of GBBGU predicted to collide increasing from 8.6 and 2.7 at BOWL and MORL respectively to 17.3 and c. 5.7 (N. B. this latter value does not currently account for increasing nocturnal activity in the summer from 1.5 to 2). Similarly the number of HERGU collisions would increase from 14.0 and 7.2 for BOWL and MORL respectively to 27.2 and c. 15.6 (N. B. this latter value does not account for increasing nocturnal activity in the summer from 1.5 to 2). Application of the SNCB advice would approximately quadruple the values presented by the developers.

However, regardless of whether MSS or SNCB advice is followed, the resultant collision estimates indicate that the number of GBBGU (and potentially HERGU) predicted to collide are too large to be able to demonstrate no significant effect on the ECC SPA population.

It should be noted that MORL have provided a calculation that is required to adjust the number of collisions for use against the MORL PVA outputs. The calculation provided by MORL has been applied to collision estimates from both the MORL and BOWL and these values are presented in Table 2. Whilst no such adjustment is required for the BOWL PVA, the values for use with the BOWL PVA outputs are also presented for completeness (Table 2).

Table 1. Summary of Displacement Effects*

Based on developer submission	
GU ECC BOWL	2540
GU ECC MORL	1010
GU ECC	**3550**
RZ ECC BOWL	338
RZ ECC MORL	311
RZ ECC	**650**
PU ECC BOWL	31
PU ECC MORL	20
PU ECC	**51**
PU NCC BOWL	16
PU NCC MORL	0
PU NCC	**16**
Based on SNCB advice	
GU ECC BOWL	1772
GU ECC MORL	1721
GU ECC	**3494**
RZ ECC BOWL	293
RZ ECC MORL	495
RZ ECC	**787**
PU ECC BOWL	63
PU ECC MORL	25
PU ECC	**88**
PU NCC BOWL	44
PU NCC MORL	0
PU NCC	**44**
Based on MSS advice	
GU ECC BOWL	1172
GU ECC MORL	1721
GU ECC	**3494**
RZ ECC BOWL	293
RZ ECC MORL	495
RZ ECC	**787**
PU ECC BOWL	63
PU ECC MORL	25
PU ECC	**88**
PU NCC BOWL	32
PU NCC MORL	0
PU NCC	**32**

* Totals currently assume 100% of displaced birds fail to breed successfully. This will be revised down on receipt of CEH displacement project outputs.

Table 2: Summary of Displacement Collision Effects*

Based on developer submission	Site Collisions	Total Collisions	Values for use with BOWL PVA	Values for use with MORL PVA
BOWL GBBGU	**8.6**	**11.3**	8.6	5.6
MORL GBBGU	**2.7**		2.7	1.7
BOWL HERGU	**14.0**	**21.2**	14.0	9.1
MORL HERGU	**7.2**		7.2	3.3
Based on SNCB advice				
BOWL GBBGU	**34.6**	**46.0**	34.6	22.5
MORL GBBGU	**11.4**		11.4	7.4
BOWL HERGU	**54.4**	**85.5**	54.4	35.4
MORL HERGU	**31.1**		31.1	14.1
Based on MSS advice				
BOWL GBBGU	**17.3**	**23.0**	17.3	11.2
MORL GBBGU	**5.7**		5.7	3.7
BOWL HERGU	**27.2**	**42.8**	27.2	17.7
MORL HERGU	**15.6**		15.6	7.1

* Note that this does not currently account for increasing nocturnal activity for MORL during the breeding season from 1.5 to 2.

References

APEM (2013). East Anglia ONE Offshore Windfarm Lesser Black-backed Gull Tagging Data Analysis Appendix 2L. http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010025/2.%20Post-Submission/Representations/ExA%20Questions/Round%201/Responses/EAOL%20-%20Lesser%20Black%20Backed%20Gull%20Tagging%20Data%20Analysis.pdf

Band, B. (2012). SOSS-02: A review of methods to estimate the risk of bird collisions with offshore wind farms. SOSS.

Borberg, J.M., Ballance, L.T., Pitman, R.L. & Ainley, D.G. 2005. A test for bias attributable to seabird avoidance of ships during surveys conducted in the tropical Pacific. Marine Ornithology 33: 173–179.

Furness & Wade (2012). Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report to Scottish Government. http://www.scotland.gov.uk/Resource/0040/00401641.pdf

Furness, R.W.; Hudson, A.V.; Ensor, K. (1988). Interactions between scavenging seabirds and commercial fisheries around the British Isles, in: Burger, J. (Ed.) (1988). Seabirds and other marine vertebrates: competition, predation, and other interactions. pp. 240-268.

Garthe, S. & Hüppop, O. (1996) Nocturnal scavenging by gulls in the southern North Sea. Colonial Waterbirds, 19, 232–241.

Heinemann, D. 1981. A rangefinder for pelagic bird censusing. J. Wildl. Manage. 45:489-493.

Henkel, L.A., Ford, R.G., Tyler, W.B. & Davis, J.N. 2007. Comparison of aerial and boat-based survey methods for Marbled

Murrelets Brachyramphus marmoratus and other marine birds. Marine Ornithology 35: 145–151.
Hyrenbach K. D. (2001). Albatross response to survey vessels: implications for studies of the distribution, abundance, and prey consumption of seabird populations. Mar Ecol Prog Ser. Vol. 212: 283–295
Shamoun-Baranes J, Bouten W, Camphuysen CJ, Baaij E (2011). Riding the tide: intriguing observations of gulls resting at sea during breeding. IBIS 153:411-415.
Skov, H. and Durinck, J. (2001). Seabird attraction to fishing vessels is a local process. J Mar Ecol Prog Ser, Vol. 214: 289–298.
Spear, L.B., Ainley, D.G., Hardesty, B.D., Howell, S.N.G. & Webb, S.W. Reducing biases affecting at-sea surveys of seabirds: use of multiple observer teams. Marine Ornithology 32: 147–157.

MSS advice to MS-LOT: BOWL and MORL Ornithological note from JNCC and SNH dated 29 October 2013

Jared Wilson
31 October 2013

IMPACT THRESHOLDS

MSS note that the advice provided by SNH and JNCC appears to be based predominantly on the use of PBR, with the population model outputs used alongside percentage change in baseline survival or productivity as supporting information only.

MSS have based their advice on the population model outputs provided by BOWL and MORL, taking into account the potential issues associated with using these models to predict into an uncertain future, particularly where available demographic rates may not be contemporary to the present situation. The ABC method has been used to identify acceptable levels of change, and these have been compared against available metrics including the f-value required to obtain similar values using PBR, and comparison with percentage change in baseline survival/ productivity. Whilst MSS do not believe in this case that PBR etc. provide an appropriate method for establishing acceptable levels of change, they do provide an opportunity for 'sense checking' threshold values.

Whilst no method for assessing the significance of predicted effects is without its issues, MSS advise that the population model outputs with the precautionary application of the ABC method (alongside sense checking against available metrics) provides the best available information for undertaking the assessment.

COLLISION RISK

Great black-backed gull

For greater black-backed gull at East Caithness Cliffs SPA, **MSS advise no adverse effect on site integrity if cumulative mortality is approximately 10 birds per annum**. This is based on:

- Application of the ABC method to the BOWL and MORL population model outputs assuming a precautionary likelihood of a population decline in the absence of additional mortality of "Likely" (*threshold of 15 and 13 respectively*[1]). MSS advise that the use of "Very Likely" in the SNCB note of 29 October 2013 is overly precautionary.
- Acknowledgement that whilst density dependent effects would increase the resilience of the population to additional adult mortality, the evidence supporting such a relationship is limited.

[1] Note that these values are not directly transferable between population models due to slight differences in approach taken by the two developers.

- The view that a PBR f-value of 0.5 is appropriate for the population concerned as evidence suggests that it is at or perhaps just above its carrying capacity (*threshold of 10*). MSS advise that the application of an f-value of 0.3 in the SNCB note of 29 October 2013 has not been justified and is overly precautionary.
- The apparent stabilisation of the population around a new carrying capacity driven by changes to the wider environment (e.g. reduction in fishery waste).

Herring gull

MSS agree with the conclusion reached by SNH and JNCC.

DISPLACEMENT EFFECTS

The PBR approach has been developed for adult mortality. In an attempt to use the approach with productivity i.e. displacement effects, the SNCBs have used an approach that converts chick mortality into 'equivalent' adult mortality values. MSS advise that it is very unclear whether the resulting values are meaningful both in terms of the values produced and the subsequent application of the PBR threshold.

Guillemot

MSS agree with the conclusion reached by SNH and JNCC.

Razorbill

MSS agree with the conclusion reached by SNH and JNCC.

Puffin

For puffin at East Caithness Cliffs SPA, MSS advise that **no adverse effect on site integrity will occur based on the current number of birds estimated to be displaced**. This is based on:

- The highly precautionary manner in which displacement effects have been over estimated:
    - It has been assumed that 100% of displaced birds fail to breed successfully.
    - The assumption that each displaced bird represents a discrete pair (i.e. 1 displaced bird = 1 failed pair and 500 displaced birds= 500 failed pairs).
    - The near doubling in turbine spacing resulting from BOWL's move from WCS to MLS has not been accounted for in the proportion of birds being displaced or the percentage of pairs failing to breed successfully.
    - Habituation of birds to the presence of wind turbines during the 25 year life of the wind farms has not been considered.

    - Evidence to suggest that the displacement rate of 60% applied to the auk species is too high.
    - Birds on the water and in flight have assumed to be displaced and therefore fail to breed successfully.
    - The mean seasonal peak rather than the mean abundance estimates have been used.
- Application of the ABC method to the BOWL and MORL population model outputs assuming a likelihood of a population decline in the absence of any additional displacement effects of "Likely" (*thresholds of 30 and 105 respectively*).
- The BOWL population model's assumption (based on SNCB advice) that each displaced individual equates to a pair that fails to breed successfully is overly precautionary (this is reflected in the lower ABC threshold value).
- Exclusion of PBR in the assessment of productivity effects.
- Examination of percentage change in productivity resulting from displacement effects as estimated using the highly precautionary approach identified above.

For puffin at North Caithness Cliffs SPA, MSS agree with the conclusion reached by SNH and JNCC.

Note of Conference Call between Marine Scotland Science, SNH and JNCC

22 November 2013

JNCC: Karen Hall, Sophy Allen
SNH: Erica Knott, Catriona Gall, Alex Robbins
MSS: Jared Wilson
MS-LOT: Gayle Holland, Robert Main

Moray Firth common currency and threshold units.

Summary

The meeting concluded that the thresholds derived from ABC and PBR in fact relate to different components of the population (ABC – all birds; PBR – adult birds only). As a result, once estimates are adjusted to relate to breeding adults the collision mortality from the Beatrice and MORL wind farm proposals do not exceed the thresholds of additional adult mortality set through PBR for the great black-backed gull (GBBGU) population of the East Caithness Cliffs (ECC) SPA .

Note

At the RSAG meeting held 24 October, all parties had used the collision mortality estimates presented in row 36 of the common currency spread sheet (attached below) to inform discussion and resulting advice. The estimates in row 36 are for the total number of birds of all age classes from ECC SPA that are predicted to collide.

MSS identified a GBBGU threshold of **13 (MORL)** and **15 (BOWL)** birds, applying the ABC method to the respective population model outputs, using the 'likely' category (advice dated 31 October). For MORL, the collision mortality estimates presented in row 39: 4.03 for MORL and 5.60 for BOWL and a cumulative total of **9.63**, have been adjusted so that they can be compared against the threshold (**13**) and appropriate metrics derived from applying ABC to the MORL population model. The BOWL PVA threshold of **15** is for 'all birds' and can be directly compared against the estimated collision mortalities in row 36: 6.20 GBBGU mortalities for MORL, 8.62 for BOWL and a cumulative total of **14.82** (see row 45). The MORL PVA threshold of 13 equates to an 'all birds' value of approximately 20.

SNH & JNCC identified a GBBU threshold of up to **6** birds, derived from PBR (advice dated 29 October). We have now confirmed that this threshold relates to adult birds, excluding sabbaticals. Therefore the relevant collision estimates to compare against this threshold (i.e. for breeding adults only) are presented in row 23 below for the breeding season (1.80 GBBGU adult mortalities for MORL and 1.96 for BOWL), and rows 34 (MORL) and 32 (BOWL) for the non breeding season (GBBGU adult mortalities of 0.14 and 0.05 respectively). This gives a cumulative total of (breeding) adult collision mortalities of **3.95**.

We therefore agreed that these estimates of GBBGU collision mortality for MORL and BOWL would not result in adverse effect on site integrity when considered against the relevant thresholds, using comparable metrics.

However, SNH & JNCC noted that the estimated mortalities are approaching the threshold values (ABC or PBR) and that a precautionary approach may be warranted

as there are so many areas of uncertainty in the underlying data and impact assessment process (see SNCB letters dated 8 July, memo of 28 August and advice note of 29 October 2013). Note also, that further to common currency discussions between MSS, SNCBs and the developers, it has been agreed that a breeding period of May – August be used for GBBGU, on which the SNCB and MSS advice is based (and that the spread sheet below refers to).

This issue regarding comparability of metrics applies equally to herring gull. We have already confirmed, however, that there are no outstanding concerns in respect of this species (as noted in the SNCB advice of 29 October and MSS advice of 31 October).

It was also agreed that there were no implications from the confirmation of PBR values referring to adults only for the advice previously provided by the SNCBs on displacement effects.

1		GBBGU, ECC		GBBGU, ECC		HERGU, ECC		HERGU, ECC	
2	**CRM**	**MORL**		**BOWL**		**MORL**		**BOWL**	
3	**Bird Parameters**								
4	Bird Length	0.71		0.71		0.61		0.61	
5	Wing span	1.575		1.575		1.44		1.44	
6	Flight speed	13.7		13.7		12.8		12.8	
7	Noct Activity	2		2		2		2	
8	Flap/Glide	Flapping		Flapping		Flapping		Flapping	
9	Option 1, 2, 3	3		3		3		3	
10	Breeding season	May-Aug		May-Aug		May-Aug		May-Aug	
11	Avoidance Rate	98%		98%		98%		98%	
12	**Windfarm scenario**	S3.6, M&T 5MW		MLS		S3.6, M&T 5MW		MLS	
13	Annual Collisions	105.2		109.3		136.1		182.09	
14	Breeding Season Collisions	22.6		25.43		20.4		12.72	
15	Non breeding season Collisions	82.6		83.87		115.7		169.37	
16									
17	**Collision Apportioning (summer)**	morl	Running Tot	bowl	Running Tot	morl	Running Tot	bowl	Running Tot
18	CRM collisions (breeding season)	22.6	22.56	25.43	25.43	20.4	20.40	12.72	12.72
19	Boat-based bias	2	11.28	2	12.72	2	10.20	2	6.36
20	Prop from SPA	0.5	5.64	0.633	8.05	0.375	3.83	0.851	5.41
21	Prop immature birds	0.51	2.88	0.625	5.03	0.43	1.64	0.625	3.38
22	Prop adults	0.49	2.76	0.375	3.02	0.57	2.18	0.375	1.32
23	exclude sabatical adults	0.35	**1.80**	0.35	**1.96**	0.35	**1.42**	0.35	0.46
24	Sub-Total SPA birds (breeding season)		5.64		8.0		3.83		5.41
25									
26	**Collision Apportioning (winter)**	morl	Running Tot	bowl	Running Tot	morl	Running Tot	bowl	Running Tot
27	CRM collisions (non-breeding season)		82.63	83.87	83.87		115.70	169.37	169.37
28	Boat-based bias	2	41.32	2	41.94	2	57.85	2	84.69
29	Prop from SPA	0.0136	0.56	0.0136	0.57	0.375	36.16	0.139	11.77
30	Prop immature birds	0.51	0.29	0.625	0.36	0.43	15.55	0.43	5.06
31	Prop adults	0.49	0.28	0.375	0.14	0.57	20.61	0.57	4.36
32	exclude sabatical adults	0.35	0.18	0.35	0.05	0.35	13.40	0.35	1.53
33	remove winter influx adults	1	**0.18**	1		0.2	**2.68**	1	
34	remove winter influx immatures	0.5	0.14	0		0.5	7.77	0	
35	Sub-Total SPA birds (breeding season)		0.56		0.57		**11.90**		11.77
36	**Total (SPA birds, all age classes)**		**6.20**		**8.62**		**15.72**		**17.18**
37									
38	**For use with BOWL PVA outputs**		**6.20**		**8.62**		**15.72**		**17.18**
39	**For use with MORL PVA outputs**		**4.03**		**5.60**		**7.19**		**11.17**
40									
43	**SUMMARY**								

44		**Project total (all SPA birds, all age classes)**	**Cummulative total (all SPA birds, all age classes)**	Project total (adults excluding sabaticals)	cummulative total (adults excluding sabaticals)	Comparison with PBR values (assuming PBR calculations are based on adult breeding birds excluding sabaticals) should be made with cummulative values in grey cells
45	**BOWL (MLS) GBBGU**	**8.62**	**14.82**	2.01	3.95	
46	**MORL GBBGU**	**6.20**		1.94		
47	**BOWL (MLS) HERGU**	**17.18**	**32.90**	1.99	11.18	
48	**MORL HERGU**	**15.72**		9.19		

28 November 2013

Development of ornithological advice to LOT since 8 July 2013

This document summarises the key discussions held between MSS and the SNCBs since the receipt of the SNCB ornithology advice for BOWL and MORL on 8 July 2013, and how these fed into advice provided. This was an iterative process driven by the adoption of a 'common currency' approach by the SNCBs, MSS and the Moray Firth wind farm developers.

Thresholds of acceptable change

As per MSS advice provided to MS-LOT on 29 October 2013, MSS used the precautionary application of the ABC method to both the BOWL and MORL population models to set thresholds of change for GBBGU, HERGU, PUFFI, GUILL and RAZOR. The SNCBs applied PBR to produce thresholds of acceptable change as per their advice of 8 July 2013 and 29 October 2013.

Collision Effects

Based on the SNCB advice of 8 July 2013, collision risk to great black-backed gull and herring gull at East Caithness Cliffs were of concern. A number of outstanding issues relating to collision effects were identified in the SNCB advice and these were addressed during the common currency discussions between MORL, BOWL, SNH, JNCC and MSS that occurred during August 2013 and are summarised in the MSS advice to LOT dated 4 September 2013. At a meeting between MSS, SNH and JNCC held on 15 October 2013 it was agreed that the approach advised by MSS on 4 September 2013 should be adopted to inform the advice to MS-LOT on collision effects.

The rationale behind the approaches used in the displacement common currency table are summarised below.

Bird parameters

There was agreement on the bird parameters (wingspan, flight speed etc.) used in the collision risk models.

Nocturnal activity

Differences in opinion between the SNCBs and BOWL and MORL existed in the degree of nocturnal activity exhibited by the two gull species. The approach taken in this assessment is that set out and justified in the MSS advice of 4 September 2013, with nocturnal activity levels of 2 used.

Extended Band Model (Option 3)

As per the RSAG meeting on 5 September 2013, this assessment is based on the use of the extended version of the Band collision risk model (Option 3). Comparison of outputs from Options 1 and 3 was undertaken to identify whether substantial differences in values and therefore flight heights between the site data and the pooled data in Cook et al 2012 existed. There were no reasons to suspect that site specific drivers would cause flight heights to differ to the sites included in Cook et al 2012, and it was accepted that pooling robustness was likely to result in the Cook et al being robust to errors (but not systematic bias) in flight

height estimation. Any systematic bias in flight height estimates either from site specific or Cook et al data would be carried through the CRM calculations, regardless of the option used.

Breeding season
The breeding seasons for GBBGU and HERGU of May-August used in the common currency are those used in the ES submitted by BOWL and MORL. The use of May- August for BOWL and MORL is accepted by the SNCBs as per the note of the meeting held on 22 November 2013.

Avoidance rate
As per the RSAG meeting on 5 September 2013, this assessment is based on the use of an avoidance rate of 98% and the extended version of the Band collision risk model (option 3). Arguments presented by the developers for increasing avoidance rates for use with the standard Band model (i.e. Options 1 and 2) were considered but at present MSS felt that due to uncertainty surrounding avoidance rates, particularly in relation to the adoption of the extended Band model, that the avoidance rates should not be revised.

Wind farm scenario
Advice was based on the WCS presented by BOWL and MORL. Subsequent amendments to the design envelopes have not therefore been captured by SNCB advice to LOT. Changes to turbine parameters can be captured by revising CRMs to feed into the 'common currency' table. The MSS advice to LOT accounts for the decision by BOWL to move from their Worst Case Scenario to Most Likely Scenario i.e. a smaller number of larger turbines with increased spacing between turbines. .

Boat based bias
For this assessment a correction factor of 2 is used to account for gull attraction to survey vessels. This halves the original estimate and is seen as precautionary. The justification for this is included in the MSS advice to LOT on 2 September 2013.

Apportioning to breeding colony
BOWL applied an apportioning tool similar to that being developed by SNH to assign effects to colonies whilst MORL used bird flight data. These methods both have merit and have been used in the assessment. Both developers assigned effects to SPA and non-SPA colonies.

Exclude sabbatical birds
Both developers included 'sabbatical' birds i.e. adult birds within the population that did not breed each year.

Winter influx birds
Large numbers of birds form northern Europe and Russia move into the area for the winter period and this was accounted for by both developers. A proportion of collisions during the non-breeding season were therefore assigned to this influx population.

In their advice of 29 October 2013 the SNCBs advised no adverse effect on HERGU and adverse effect upon GBBGU at ECC due to collision effects. MSS stated in their advice of 31 October 2013 that no adverse effect on GBBGU at ECC would result. Following discussions held on 22 November 2013 clarifying the metrics used in the ABC and PBR thresholds and their relation to the values presented in the common currency table, the SNCBs concluded no adverse effect on GBBGU at ECC.

MSS and SNCB both advise **no adverse effect** upon GBBGU and HERGU.

Displacement Effects

Based on the SNCB advice of 8 July 2013, species and SPAs of concern due to potential displacement effects were common guillemot at ECC, razorbill at ECC and Atlantic puffin at both ECC and NCC. The SNCB advice identified a number of outstanding issues relating to assessment methods used to quantify displacement effects and these were addressed during the common currency discussions between MORL, BOWL, SNH, JNCC and MSS that occurred during August 2013 and are summarised in the MSS advice to LOT dated 4 September 2013. At a meeting between MSS, SNH and JNCC held on 15 October 2013 it was agreed that the approach advised by MSS on 4 September 2013 should be adopted to inform advice to LOT on displacement effects on GUILL, RAZOR and PUFFI.

The rationale behind the approaches used in the displacement common currency table are summarised below.

Breeding season

Whilst no differences between the developers and SNCBs in breeding season were identified, it became apparent that for PUFFI the inclusion of August within the breeding season was not appropriate due to cessation of provisioning of chick by adults prior to August and the influx of non breeding individuals to breeding colonies during August. This increase in numbers was apparent from the at sea abundance estimates during August and this month was excluded from the breeding season for PUFFU.

Mean seasonal peak

Both developers used the mean abundance estimates in their assessments of displacement effects rather than the mean seasonal peak previously advised by the SNCB's. Whilst the latter is likely to overestimate abundance, it provides a precautionary estimate that may account for issues of turnover (see below). The mean seasonal peak abundance estimates were therefore used.

All birds or birds on the water

The SNCBs advised that all birds should be used in the displacement assessment, whilst BOWL and MORL considered that birds on the water or birds using the water would be more appropriate. Due to difficulties in objectively assigning birds in flight to 'using the water' or transiting, the precautionary values of all birds have been used in assessing displacement effects.

Turnover

It was agreed that there is currently no accepted method for accounting for turnover of individuals at sea in the assessments. Instead, the precautionary mean seasonal peak and all birds are used.

Proportion displaced

The displacement values of 60% have been used for guillemot, razorbill and puffin which is higher than the 50% in the SNCB advice 28 August 2013 but consistent with their advice of 8 July 2013. The displacement rate has not been adjusted to account for the significant increase in turbine spacing associated with BOWL moving from WCS to MLS, nor of the effects of habituation to the presence of turbines that is expected to occur over the lifetime of the wind farm. These levels of displacement are therefore viewed by MSS as precautionary.

Proportion SPA

BOWL applied an apportioning tool similar to that being developed by SNH to assign effects to colonies whilst MORL used data on bird flight direction gathered during surveys of the site. These methods both have merit and have been used in the assessment.

Proportion of birds that fail to breed successfully
This has been assumed to be 100%, and each displaced bird has been assumed to represent a distinct pair. This is an absolute worst case scenario and extremely precautionary.

SNCBs advice on 29 October 2013 concluded no adverse effect on GUILL, RAZOR, and PUFFI at NCC but **adverse effect upon PUFFI at ECC** due to displacement effects.

MSS advice on 31 October 2013 concluded **no adverse effect on PUFFI at ECC**. As stated in the advice of 31 October 2013 MSS advise no adverse effects due to:

- The highly precautionary manner in which displacement effects have been over estimated:
    - It has been assumed that 100% of displaced birds fail to breed successfully.
    - The assumption that each displaced bird represents a discrete pair (i.e. 1 displaced bird = 1 failed pair and 500 displaced birds= 500 failed pairs).
    - MORL's assumption that 100% of birds observed at sea are adults when in fact approximately 30% are likely to be of non breeding age.
    - The near doubling in turbine spacing resulting from BOWL's move from WCS to MLS has not been accounted for in the proportion of birds being displaced or the percentage of pairs failing to breed successfully.
    - Habituation of birds to the presence of wind turbines during the 25 year life of the wind farms has not been considered.
    - Evidence to suggest that the displacement rate of 60% applied to the auk species is too high.
    - Birds on the water and in flight have assumed to be displaced and therefore fail to breed successfully.
    - The mean seasonal peak rather than the mean abundance estimates have been used.
- Application of the ABC method to the BOWL and MORL population model outputs assuming a likelihood of a population decline in the absence of any additional displacement effects of "Likely" (*thresholds of 30 and 105 respectively*).
- The BOWL population model's assumption (based on SNCB advice) that each displaced individual equates to a pair that fails to breed successfully is overly precautionary (this is reflected in the lower ABC threshold value).
- Exclusion of PBR in the assessment of productivity effects.
- Examination of percentage change in productivity resulting from displacement effects as estimated using the highly precautionary approach identified above.

Marine Scotland Science
Advice to MS-LOT on MORL and BOWL
Marine Mammals

This is the first written advice on marine mammals provided by Marine Scotland Science (MSS) to MS-LOT on the MORL and BOWL developments, although we have been involved in discussions regarding these developments and have provided verbal advice. We have seen the advice received by MS-LOT from SNH and JNCC (the SNCBs) and have been involved in subsequent discussions with them and MS-LOT regarding this. Below we outline the content of these discussions as well as where we agree or do not agree with advice provided by SNH and JNCC on the individual projects and cumulatively. Additionally, we refer MS-LOT to the advice we provided on the cumulative impacts from the Inner Moray Firth port developments to bottlenose dolphins (provided on 7th November 2013).

BOTTLENOSE DOLPHIN (*Tursiops truncatus*)

The SNCBs advise that the management unit for bottlenose dolphins that should be considered is Coastal East Scotland (CES). This is often confused with the Moray Firth SAC, which is designated for bottlenose dolphins, but is confined spatially to the inner Moray Firth. However, we consider that all bottlenose dolphins within the CES belong to the SAC population because a high proportion of the animals that use the Tay area (for example) have also been seen within the SAC itself. The reference population estimate for this management unit is between 162 and 253 animals (95% highest posterior density intervals - HPDI), with a median of 195 individuals (Cheney et al., 2013). This is taken from photo identification data collected in 2006. Estimates have been produced for subsequent years, but the 2006 estimate is used because it incorporates more data collection, due to increased funding provide as part of a Scottish Government and SNH funded project (Thompson et al. 2011).

MORL and BOWL carried out cumulative assessments of the impact of wind farm construction on the bottlenose dolphin population, under various different construction scenarios. The assumption was made that animals that suffer Permanent Threshold Shift (PTS - a permanent change in hearing ability at a particular frequency), had a 25% increased mortality risk, while animals subject to noise levels sufficient to cause disturbance would fail to breed in that year (due to reduced feeding opportunity). The magnitude of these effects on mortality and breeding success is based on expert opinion and is untested, but is likely to represent a high degree of precaution. For example, we know that bottlenose dolphins inhabit and forage within areas with a high level of disturbance, such as Aberdeen harbour (e.g. Stockin et al., 2006), which indicates that noise levels sufficient to cause disturbance may be tolerated where food is available and therefore may not influence foraging success.

In fact, noise propagation modelling in the ESs showed that no bottlenose dolphins were predicted to receive noise levels sufficient to induce PTS under any of the modelled scenarios. This is largely due to the distance between the wind farm sites and the southern coast of the Moray Firth, where bottlenose dolphins are more likely to occur. There is therefore no predicted effect on survival of bottlenose dolphins

from the MORL and BOWL developments, since there is no PTS predicted. There may be effects on their breeding success, as a result of disturbance.

Population viability analysis (PVA) incorporating the numbers of calves not added to the population due to effects of disturbance on breeding success showed that the population may decline somewhat during construction, but is then predicted to recover to baseline levels within the expected lifetime of the wind farms (25 years). No assessment was undertaken at a closer time point than this. However, the reduction in numbers of animals lies within the 95% HPDI for the population estimate, so it is unlikely that such changes could be detected at a population level. MSS agree with the SNCB advice that there will be no adverse impact to the population, or significant effect to the Moray Firth SAC from the MORL and BOWL developments.

Noise propagation modelling indicates that bottlenose dolphins may receive noise levels sufficient to cause disturbance in some areas of their range. MSS therefore advise that an EPS licence will be required for bottlenose dolphins. However, evidence from the PVA modelling indicates that there will no impact on the favourable conservation status of the population.

In combination effects

The potential for in combination effects with port developments in the inner Moray Firth was suggested in the MORL and BOWL ESs, but not taken any further because at the time of their submission, there were too few details about what work would be undertaken at the ports. Three proposals are now at different stages in the planning system; at Nigg (Global Energy Nigg), Ardersier (Port of Ardersier Limited) and Invergordon (the Cromarty Firth Port Authority).

Modelling was undertaken to inform understanding of the potential cumulative effects on the bottlenose dolphins associated with the Moray Firth SAC of the construction of these three port developments, the increase in vessel traffic that may ensue from the upgrading works and the pile driving at the BOWL and MORL sites in the Moray Firth. The modelling gave two main outputs of the population effects; one based on the effects to the subset of the CES population which regularly uses the SAC and one on the effects to the whole CES population. The advice of the SNCBs and MSS has always been that effects from development should be assessed against the CES population. When this reference population is used, although there is an immediate decline in the population, more than 50% of the model outcomes return to baseline by the time piling at MORL and BOWL ends (five or six years depending on scenarios). This can be interpreted as the median population outcome from the simulation modelling being at least equal to the starting population size. MSS therefore advise that the MORL, BOWL, Nigg, Ardersier and Invergordon developments in combination will not have an adverse effect on the integrity of the Moray Firth SAC.

MSS also advise that this model is highly precautionary, with a noise dose-response curve that is unlikely to hold in reality, since it indicates displacement of bottlenose dolphins at noise levels that have been measured as background in key foraging areas.

HARBOUR PORPOISE (*Phocoena phocoena*)

The appropriate management unit for harbour porpoise is the North Sea. This area is estimated to contain 227,298 animals, with 95% confidence intervals ranging from 176,360 to 292,948 animals (Hammond et al., 2013). There is currently one candidate SAC for harbour porpoise, off the coast of Northern Ireland; the Skerries and Causeway cSAC. There is no evidence of connectivity between the Moray Firth and this cSAC, and it occurs within the West Scotland management unit. MSS therefore advise that an HRA is not required.

Significant disturbance is predicted to occur at ranges of around 10-15 km, so we advise that an EPS licence would be required. Evidence from studies of harbour porpoise responses to seismic surveys in the Moray Firth suggests that animals were displaced by noise effects within 10 km, equivalent to noise levels of between 165 and 172 dB re 1 µPa (peak to peak) and between 145 and 151 dB re 1 $\mu Pa^2 s^{-1}$ (SEL). Displaced animals returned within a few hours, but the duration of displacement declined over the survey period (10 days in this case), indicating an increasing tolerance of noise (Thompson (P.M.) et al. 2013a).

Cumulative assessments of the number of animals exposed to noise levels sufficient to cause PTS have been undertaken by the developers, which include construction works at both the MORL and BOWL sites. In these assessments, the reference population that has been used is the sum of animals modelled to be in 4x4 km cells across the whole Moray Firth. This sums to 6,120 porpoises. None of the modelled scenarios predict PTS in more than 0.6% of this regional population, and when tested against the management unit population estimate of 227,298 animals, this percentage will be very much lower. MSS therefore advise that the MORL and BOWL developments will not have a significant adverse effect on the North Sea, or Moray Firth harbour porpoise population.

MINKE WHALE (*Balaenoptera acutorostrata*)

The management unit for minke whale is British and Irish waters. This area is estimated to contain 23,163 animals, with 95% confidence intervals ranging from 13,772 to 38,958 (Hammond et al., 2013, Macleod et al., 2009). There are no SACs for minke whales in UK waters, so no HRA is necessary. Predicted ranges of physical and auditory injury will be mitigated through implementation of the JNCC piling guidelines.

The developers will need to apply for an EPS licence because noise from pile driving will disturb minke whales. MSS agree with the SNCB advice that the disturbance from piling will not affect the favourable conservation status of the minke whale population. However, disturbance of individual animals is likely to occur, both inside and outside of Scottish Territorial Waters, from both developments, necessitating an EPS licence.

WDC have made reference to their concerns regarding the effect of pile driving noise on minke whales within the search area for MPAs. A search location has been

defined in the southern Moray Firth, which might include minke whales but no MPA boundaries exist and it has not yet been determined that the site will be taken forward as an MPA. MSS therefore advise that at this time it is not appropriate to consider effects to minke whales in this area in the context of effects to a protected site (such as would be undertaken for an HRA).

HARBOUR SEAL (*Phoca vitulina*)

The management unit for harbour seals is the Moray Firth Seal Management Area. The most recent SCOS report states that the count of animals in 2011 in the inner Moray Firth was 674 (SCOS, 2012). The trend for this population has been a decline in the past decade, but the counts since 2007 indicate that it may now have stabilised.

Likely significant effect was identified by the SNCBs for the Dornoch Firth and Morrich More SAC in relation to construction works at the MORL and BOWL sites. The population effects were assessed through the seal assessment framework developed by Thompson (P.M.) et al. (2013b), and were presented in the ESs for both MORL and BOWL. They demonstrated that for both projects alone and cumulatively, there would be an effect on the population of harbour seals within the Moray Firth seal management area, during the construction period, but that this would recover following the end of construction. Advice from the SNCBs on this basis stated that there would be no adverse impact on SAC site integrity.

In combination effects

The potential for in combination effects with port developments in the inner Moray Firth was suggested in the MORL ES, but not taken any further because at the time of their submission, there were too few details about what work would be undertaken. Three proposals are now at different stages in the planning system; at Nigg (Global Energy Nigg), Ardersier (Port of Ardersier Limited) and Invergordon (the Cromarty Firth Port Authority). The developments at Ardersier and Nigg are at the limit of the range at which we would consider them likely to have a significant effect on the Dornoch Firth and Morrich More SAC. The Ardersier development has applied only to use vibropiling. MSS therefore advise that the impact on harbour seals from construction noise at Ardersier is not significant. The Appropriate Assessment for the Nigg development concluded that there would be no adverse effect from that development to the site integrity of the Dornoch Firth and Morrich More SAC.

Further discussions have been underway regarding the potential for corkscrew injuries to harbour seals from construction and operation of the port at Ardersier. There is currently not enough information to allow a quantitative assessment of the likely numbers of animals affected, because the mechanism by which these injuries occur is not known. Discussions surrounding Ardersier have centred on increased monitoring to detect whether seals using that area are in fact killed through these corkscrew injuries. There have been a small number of reports of corkscrew seals in the inner Moray Firth, but the area is not considered to be a hotspot for this currently (Thompson, D. et al., 2013).

GREY SEAL (*Halichoerus grypus*)

The SNCB advice does not consider grey seals with respect to either MORL or BOWL. The relevant management unit for grey seals is the Moray Firth, with respect to seal licensing. The minimum population size for these purposes is 2900 animals (see http://scotland.gov.uk/Resource/0042/00428606.doc). SCOS does not report on grey seals in the Moray Firth because no breeding colonies have been identified.

MSS advice is that there are no SACs for grey seals within the range that we would normally consider for this species (100 km). We are aware that grey seals travel large distances when foraging, but there is no clear connectivity between the development areas and any SAC. MSS therefore advise that HRA for grey seals is not necessary. Additionally, we agree with the developers that the numbers of grey seals that may be affected by the development do not pose a risk to their population status. Grey seal numbers in Scotland are increasing and the PBR values for all areas are large and the recovery factor used for determining the PBR is 1 (see document above), which is the highest value it can take, indicating scientific confidence that the population is robust.

Monitoring and Mitigation

The SNCBs have made reference to the requirement for monitoring and mitigation plans to be submitted post consent, should this be granted. MSS support this and would look to developing strategies that would minimise the impacts of disturbance to all marine mammal species.

Mitigation
At a minimum we would expect the JNCC piling guidelines (or measures of equivalent capacity to mitigate) to be followed. Correctly applied, this will mitigate physical and auditory injury to marine mammals. We would expect that plans would be drawn up to manage construction impacts, such as piling and vessel movements to minimise the potential effects to marine mammals. This should include techniques to reduce the noise level at source where these are practical, in order to reduce the range at which animals may be disturbed.

Monitoring
We would also request that the developers carry out monitoring to validate the predictions made in their ESs regarding levels of disturbance and their effect on populations of marine mammals. We note that MORL and BOWL have been consulting with the University of Aberdeen on a marine mammal monitoring plan that would fulfil this, and would provide useful evidence to inform future rounds of wind farm development.

References

Cheney, B., Thompson, P.M., Ingram, S.N., Hammond, P.S., Stevick, P.T., Durban, J.W., Culloch, R.M., Elwen, S.H., Mandleberg, L., Janik, V.M., Quick, N.J., Islas-

Villanueva, V., Robinson, K.P., Costa, M., Eisfeld, S.M., Walters, A., Phillips, C., Weir, C.R., Evans, P.G.H., Anderwald, P., Reid, R.J., Reid, J.B., Wilson, B. (2013) Integrating multiple data sources to assess the distribution and abundance of bottlenose dolphins *Tursiops truncatus* in Scottish water. *Mammal Review*, **43**, 71-88

Hammond, PS, Macleod, K, Berggren, P, Borchers, DL, Burt, ML, Cañadas, A, Desportes, G, Donovan, GP, Gilles, A, Gillespie, D, Gordon, J, Hiby, L, Kuklik, I, Leaper, R, Lehnert, K, Leopold, M, Lovell, P, Øien, N, Paxton, CGM, Ridoux, V, Rogan, E, Samarra, F, Scheidat, M, Sequeira, M, Siebert, U, Skov, H, Swift, R, Tasker, ML, Teilmann, J, Van Canneyt, O & Vázquez, JA. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. *Biological Conservation*, **164**, 107-122.

Macleod,K., Burt, M.L., Cañadas, A., Rogan, E., Santos, B., Uriarte, A., Van Canneyt, O., Vázquez, J. A. and Hammond, P. S. 2009. Design-based estimates of cetacean abundance in offshore European Atlantic waters. Appendix I in the Final Report of the Cetacean Offshore Distribution and Abundance in the European Atlantic. 16pp

SCOS (2012) Special Committee On Seals Main Advice: Scientific Advice on Matters Related to the Management of Seal Populations. http://www.smru.st-andrews.ac.uk/documents/1199.pdf

Stockin, K.A., Weir, C.R. & Pierce, G.J. (2006) Examining the importance of Aberdeenshire (UK) coastal waters for North Sea bottlenose dolphins (*Tursiops truncatus*). *Journal of the Marine Biological Association of the UK*, **86**, 201-207.

Thompson, D., Culloch, R., Milne, R. (2013) Current state of knowledge of the extent, causes and population effects of unusual mortality events in Scottish seals. Report commissioned by The Scottish Government under MMSS/001/11. http://www.smru.st-and.ac.uk/documents/1282.pdf

Thompson, P.M., Brookes, K.L., Graham, I.M., Barton, T.R., Needham, K., Bradbury, G., Merchant, N.D. (2013) Short-term disturbance by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises. *Proceedings of the Royal Society B*, **208** http://dx.doi.org/10.1098/rspb.2013.2001

Thompson, P.M., Cheney, B., Ingram, S., Stevick, P., Wilson, B. & Hammond, P.S. (eds) (2011) Distribution, abundance and population structure of bottlenose dolphins in Scottish waters. Scottish Natural Heritage commissioned report number 354. http://www.snh.org.uk/pdfs/publications/commissioned_reports/354.pdf

Thompson, P.M., Hastie, G.D., Nedwell, J., Barham, R., Brookes, K.L., Cordes, L.S., Bailey, H. & McLean N. (2013b) Framework for assessing impacts of pile-driving noise from offshore wind farm construction on a harbour seal population. *Environmental Impact Assessment Review*, **43**, 73-85.