EXAMINING BETWEEN-YEAR NATURAL VARIATION IN SEABIRD NUMBERS AND DISTRIBUTION AT AN OFFSHORE WIND FARM DEVELOPMENT SITE

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Introduction

The large year-to-year changes that can occur in the marine environment make it difficult to detect and measure changes to bird populations caused by offshore wind farms.

Consequently, a robust survey design is essential to both inform pre-construction Environmental Impact Assessment (EIA) and subsequent post-construction monitoring of effects for projects that are consented.

In 2009 Mainstream Renewable Power Ltd were awarded the exclusive rights to develop the proposed 450MW Neart na Gaoithe Wind Farm. The project is located in the outer Firth of Forth, 15.5 km off the Fife coast in eastern Scotland (Figure 1). The offshore Planning Application and Environmental Statement (ES) for Neart na Gaoithe Wind Farm was submitted to Marine Scotland in July 2012. Details of the Neart na Gaoithe project can be found at www.neartnagaoithe.com

The use of Before-After-Control-Impact (BACI) study designs to monitor the impact of offshore wind farms has become standard practise (e.g. SNH 2009, Drewitt and Langston 2006, Fox *et al.* 2006). However, there are concerns that BACI studies have little power to detect change, particularly those relating to potential displacement of seabirds (Underwood *et al.* 1991, 1994). In addition, for far-ranging species like seabirds there are inevitable difficulties with identifying truly independent control sites in the vicinity of the development site. Our study overcomes the shortcomings of BACI and instead uses a Before-After-Gradient (BAG) design (Mainstream RP 2009).

The Before-After-Gradient (BAG) design assumes that:

- Impacts decline with increasing distance from the source (Ellis and Schneider 1997, Morrison *et al.* 2008);
- Any impacts due to displacement and habitat loss will be detected on the basis of changes in the distribution of seabirds in the area surveyed;

Survey method

The Study Area has two components: the Wind Farm Site and the surrounding 8 km-wide Buffer Area. Three years of monthly boat-based ESAS surveys were conducted between November 2009 and November 2012. The survey methods used followed COWRIE guidelines (Camphuysen *et al.*, 2004) and all surveyors were ESAS accredited. The surveys covered the whole Study Area evenly, using parallel transects 2 km apart (Figure 1);

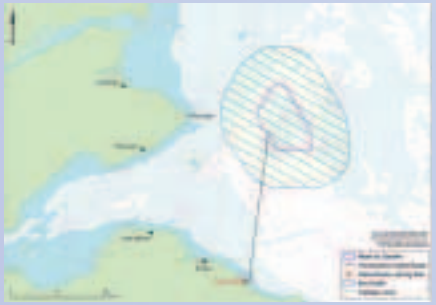

Figure 1: Location of Neart na Gaoithe wind farm site

Data analyses

Distance 6.0 software was used to estimate monthly numbers and densities for the most frequently recorded species. Species distribution was mapped at a resolution of 2 km across the Study Area.

Results

Baseline surveys in Year 1 and Year 2 recorded:

- A total of 29 seabird species in the Study Area in Year 1, with 26 species recorded in Year 2;
- Gannet, kittiwake, guillemot, razorbill and puffin were the five most frequently recorded species, accounting for 83.4% all birds recorded in the Wind Farm Site in Year 1, and 91.4% in Year 2 (based on raw numbers). Peak estimated numbers for the Wind Farm Site for Years 1 and 2, together with the month and corresponding estimate for the Buffer Area are shown in Table 1.

Species	Year 1			Year 2		
	Wind Farm Site	Buffer Area	Month	Wind Farm Site	Buffer Area	Month
Gannet	739	3,366	September	1,634	3,499	April
Kittiwake	2,195	3,772	September	1,616	3,578	July
Guillemot	8,315	20,136	October	3,272	3,773	April
Razorbill	3,054	19,892	October	877	14,165	October
Puffin	2,461	23,728	August	2,480	6,717	July

Table 1: Peak estimated numbers of the five most frequently recorded species in the Wind Farm Site in Years 1 & 2, with month and corresponding total for Buffer Area

Between-year differences in abundance

The extent of between-year differences in abundance varied across species. For example, estimated numbers of gannets between April and October for both the Wind Farm Site and the Buffer Area were higher in Year 2, compared to Year 1 (Figure 2). Estimated numbers of gannets between November and March were similar.

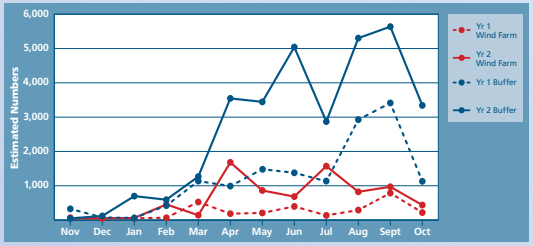

Figure 2: Monthly estimated gannet population of Neart na Gaoithe Development & Buffer Areas in Years 1 and 2

Between-year variation in distribution

The extent of between-year differences in distribution varied across species and seasons. Particularly large differences were noted for auk species during the post-breeding season (September and October), when auks occurred in large numbers, and these are illustrated below.

Between September and October of Year 1, guillemots were generally evenly spread at high densities across the Study Area apart from in the south-east of the Buffer Area (Figure 3). In contrast, in the same period of Year 2, guillemots were scarce throughout most of the eastern part of the Study Area including much of the Wind Farm Site where they had occurred in high densities the previous year (Figure 4).

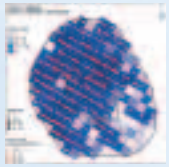

Figure 3: Guillemot density in the Neart na Gaoithe Study Area in September and October, Year 1

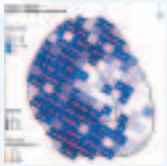

Figure 4: Guillemot density in the Neart na Gaoithe Study Area in September and October, Year 2

A similar difference in distribution pattern was observed for razorbills in the post-breeding season, with fewer birds in the Wind Farm Site in September and October of Year 2 compared to the same period in Year 1.

However, a very different pattern of distributional change was apparent for puffins between the two post-breeding seasons. Between September and October of Year 1, highest densities of puffins occurred in the eastern half of the Study Area (in contrast to guillemot and razorbill) (Figure 5). Over the same period in Year 2, puffins were generally evenly spread at moderate to high densities across the whole Study Area (Figure 6).

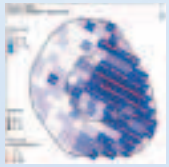

Figure 5: Puffin density in the Neart na Gaoithe Study Area in September and October, Year 1

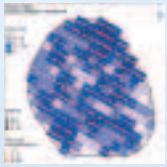

Figure 6: Puffin density in the Neart na Gaoithe Study Area in September and October, Year 2

Discussion

- The surveys provide adequate data to inform EIA and demonstrate that the Wind Farm Site and surrounding waters have high value for some seabird species.
- As expected, there is moderate to large annual variation in abundance and distribution in the baseline survey data, in both the Wind Farm Site and the surrounding 8 km buffer.
- Different food availability conditions between years caused by hydrodynamic features and weather are likely to be the explanation for the variability shown here (within and outside the Wind Farm Site).
- Bringing proxies correlating with ecological differences between years into the analysis are therefore necessary (Maclean *et al.*, 2012), to increase the power of detecting potential negative effects or to correct for other factors besides the wind farm (potentially yielding to false negative effects at the wind farm site as shown here).
- Also other factors like trends in breeding numbers and year to year differences in breeding performances of the different species should be taken into account when considering differences in densities and distribution patterns at sea.
- The large (8 km wide) buffer area surveyed around the wind farm site will enable the most statistically powerful BAG analyses available to be undertaken in future and, with correction for other factors, allow the effects of the wind farm on bird populations to be determined.

The application and ES for the offshore elements of the Neart na Gaoithe Wind Farm is currently been considered by Marine Scotland. A decision is expected in 2013. If consent is given for the development a construction and post-construction monitoring programme will be designed and the BAG approach applied. The Neart na Gaoithe team believe this will provide one of the best examples of a construction and post-construction monitoring plan so far implemented for offshore wind farms in the UK.

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