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The use of breeding seabird foraging ranges for assessing impacts to Special Protection Areas (SPAs) from wave and tidal renewable energy proposals.

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ABSTRACT

Wave and tidal renewable energy devices have the potential to impact diving birds through collision, disturbance and habitat loss. EU and UK legislation requires that these impacts are assessed through an Environmental Impact Assessment (EIA) and Habitats Regulations Appraisal (HRA). Under HRA, seabirds which are qualifying features of SPAs are protected both within and outwith the SPA and, therefore, potential impacts to breeding seabirds both within and outwith the SPA require assessment. During the breeding season, seabirds are known as central-place foragers, as they are fixed to a single geographical breeding location with a foraging range extending out to sea. The use of breeding season foraging ranges provides a suitable method for assessing geographical overlap, and thus connectivity, between SPA breeding seabird colonies and proposed wave and tidal renewable energy development sites. If connectivity is established, the next stage involves consideration of site characterisation survey results, information on impact pathways, and the sensitivity of the species to potential impacts. SPA breeding seabird populations are protected at all times and not just the breeding season. As such, any HRA will require assessment of SPA populations both during the breeding and non-breeding season. During the non-breeding season, however, most seabird species tend to range more widely and are not fixed to a single geographical location. We provide details of a GIS based analysis of breeding seabird foraging ranges to assess connectivity of SPAs with wave and tidal Areas for Lease. This method may also be used to assess connectivity for other protected seabird colonies, such as Sites of Special Scientific Interest (SSSIs), Marine Protected Areas, and for regionally important colonies, for assessment under the EIA. It may also be used to inform impact assessments for other marine developments, such as off-shore wind farms. This work provides a key resource to the consenting process and can be used by developers, consultants, government and their advisors in the assessment of environmental impacts of marine renewable developments.

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INTRODUCTION

Due to the high level of marine energy resource, and to meet targets to reduce carbon emissions, the Scottish and UK Governments are encouraging the rapid development of new marine technologies to generate electricity from wave and tidal power ("wet renewables") (HM Government 2010). However, the development of wet renewables may potentially impact seabird populations through the effects of collision, disturbance, and / or habitat loss (Langton *et al*., 2011).

Scotland holds internationally important populations of many seabird species (Mitchell *et al*., 2004). Many of these seabird populations are protected as Special Protection Areas (SPAs) and so are protected by law (Scottish Habitats Regulations). Seabirds which are qualifying features of SPAs are protected both within and outwith the SPA. This means that potential impacts to these protected seabird populations requires assessment through a Habitats Regulations Appraisal (HRA) both within and outwith the SPA.

A method for assessing spatial overlap, and thus theoretical connectivity, between proposed wet renewable development sites and SPA seabirds is presented in this paper. The method uses breeding seabird foraging ranges to generate an initial list of SPAs and qualifying seabird features, which can then be reviewed as the impact assessment proceeds.

METHODOLOGY

As seabirds are central-place foragers during the breeding season (Orians and Pearson, 1979), foraging ranges may be used to assess which SPA qualifying seabird features have connectivity with a proposed development site. A GIS based analysis was used to overlay breeding seabird foraging ranges from Thaxter *et al*. (2012), for a number of seabird species, with wave and tidal Areas for

Lease, awarded to developers through The Crown Estate leasing rounds. Foraging range metrics used include the mean, mean maximum, mean maximum +1 standard deviation, and maximum (table 1).

Table 1. Breeding seabird foraging range metrics (in kilometres), taken from Thaxter *et al.*, 2012. Mean maximum +1 standard deviation used when the value does not exceed the maximum foraging range.

Species	Mean	Mean Max	Mean Max +1 sd	Max
Red-throated diver	4.5	9		9
Northern fulmar	47.5	400		580
Manx shearwater	2.3	330		330
European storm petrel				65
Leach's storm petrel		91.7	119.2	120
Northern gannet	92.5	229.4	349.3	590
Great cormorant	5.2	25	35	35
European shag	5.9	14.5		17
Arctic skua	6.4	62.5		75
Great skua		86.4		219
Black-headed gull	11.4	25.5		40
Common gull	25	50		50
Herring gull	10.5	61.1		92
Lesser black-backed gull	71.9	141		181
Black-legged kittiwake	24.8	60	83.3	120
Sandwich tern	11.5	49		54
Roseate tern	12.2	16.6	28.2	30
Common tern	4.5	15.2	26.4	30
Arctic tern	7.1	24.2		30
Little tern	2.1	6.3	8.7	11
Common guillemot	37.8	84.2	134.3	135
Razorbill	23.7	48.5	83.5	95
Atlantic puffin	4	105.4	151.4	200

RESULTS

Species maps were produced (see figure 1 for Atlantic puffin example), together with an Excel spreadsheet, which can be used to produce a long list of SPA qualifying seabird features which have theoretical connectivity with each wet renewables Area for Lease.

The next stage is to determine the level of theoretical connectivity between an SPA qualifying seabird feature and an Area for Lease, and whether the proposed developed has the potential to have a likely significant effect on a qualifying feature (for further information on HRA and the stages involved please see http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/international-designations/natura-sites/habitats-regulations-appraisal/). For this the criteria in table 2 are recommended.

Figure 1. Breeding season foraging ranges for Atlantic puffins which are SPA qualifying features.

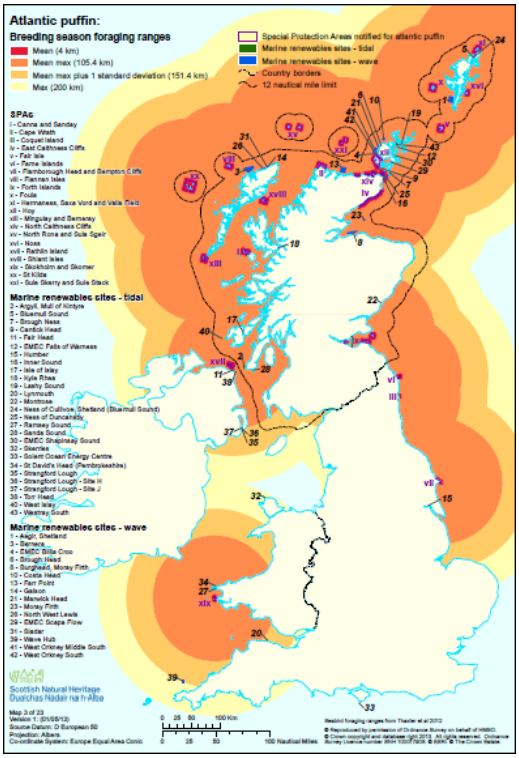

Table 2. Criteria used to categorise theoretical connectivity of SPA qualifying feature with Area for Lease.

Theoretical connectivity	Definition
High	Site within the mean foraging range
Moderate	Site within the mean maximum +1 SD
Low	Site within the maximum foraging range
No connectivity	Site further than the maximum foraging range
Unknown	No data available

CONCLUSIONS

The approach outlined provides an ecologically appropriate method for establishing theoretical connectivity between SPA qualifying seabird features and proposed wet renewables development sites. The use of this desk-based

approach should be considered at an early stage in the HRA, so that efforts can be focused on those SPA qualifying features for which the proposal is likely to have a significant effect. Once connectivity between the SPA qualifying feature and the Area for Lease is established, further consideration of site characterisation surveys, impact pathways and the sensitivity of the species to potential impacts is required.

The approach may also be used when establishing connectivity between proposed wet renewable development sites and other protected seabirds colonies, such as Sites of Special Scientific Interest (SSSIs), Marine Protection Areas (MPAs), and for regionally important populations. Assessment of potential impacts on these protected sites and regionally important populations is required under the EIA. It may also be used for other marine developments, such as offshore wind farms.

There are, however, a number of caveats when considering this approach:

1. For some species, e.g. great black-backed gull, there is no data available on foraging ranges. These species, however, still need to be considered in the HRA.
2. Foraging ranges may change as we learn more about species foraging behaviour.
3. It only includes breeding seabirds that are SPA qualifying features. Any HRA will also need to consider migratory or wintering species, breeding wildfowl and waders, and seabirds during the non-breeding season.

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