12 ORNITHOLOGY

12.1 The table below provides a list of all the supporting studies which relate to the Ornithology impact assessment. All supporting studies are provided on the accompanying CD.

Details of study	Location on supporting studies CD
Ornithological Technical Annex for Phase 1 of the MeyGen Tidal Energy Project (RPS 2011b)	OFFSHORE\Marine Wildlife\Ornithology
Benthic survey for Phase 1 of the MeyGen tidal stream energy project, Inner Sound, Pentland Firth (ASML, 2011)	OFFSHORE\Seabed interactions

12.1 Introduction

12.2 This section assesses the effects of the proposed Project on the ornithological interests of the site and surrounding area. The assessment was undertaken by RPS.

12.3 Scottish coastal waters support a wide diversity of seabirds, and the Pentland Firth and Orkney region is an area of international importance for seabird populations. The ornithological importance of the areas surrounding the Pentland Firth Inner Sound is not restricted to seabirds; the largest expanse of peatland in the UK is located in Caithness and Sutherland and encompasses much of the land immediately to the south and west of the Inner Sound. This area is important for breeding waders, raptors and divers.

12.4 This section provides a baseline description of the bird populations in the Inner Sound of the Pentland Firth and puts them into context of Scottish, UK, European and World-wide conservation.

12.2 Assessment Parameters

12.2.1 Rochdale Envelope

12.5 In line with the Rochdale Envelope approach, this assessment considers the maximum ('worst case') project parameters. Identification of the worst case scenario for each receptor (i.e. Environmental Impact Assessment (EIA) topic) ensures that impacts of greater adverse significance would not arise should any other development scenario be taken forward in the final scheme design. Table 12.1 describes the detail of the project parameters that have been used in this assessment and explains why these are considered to be worst case. The potential impacts from alternative Project parameters have been considered in Section 12.9.

Project parameter relevant to the assessment		'Maximum' Project parameter for impact assessment	Explanation of maximum Project parameter
Turbine	Number	86 turbines	The diving bird encounter model is based on a maximum volume of water swept by the turbine blades. This volume is based on number of turbines, rotor diameter and blade thickness. The maximum swept volume for the 86MW project is based on 86, 1MW turbines with 20m diameter rotors and blade thickness of 0.5m. The maximum swept volume of water is $(\pi(10^2))*86*0.5m$ = $13{,}509m^3$ ($157m^3$ per turbine).
	Layout	N/A	Turbine spacing does not influence the bird impact assessment or diving bird encounter model.
	Rotor diameter	20m	The diving bird encounter model is based on a maximum volume of water swept by the turbine blades. This volume is based on number of turbines, rotor diameter and blade thickness. The maximum swept volume for the 86MW project is based on 86, 1MW turbines with 20m diameter rotors and blade thickness of 0.5m.
	Blade thickness	0.5m	The diving bird encounter model is based on a maximum volume of water swept by the turbine blades. This volume is based on number of turbines, rotor diameter and blade thickness. The maximum swept volume for the 86MW project is based on 86, 1MW turbines with 20m diameter rotors and blade thickness of 0.5m. The maximum blade thickness is 0.5m. The blade thickness decreases down the length of the blade however for the purposes of the assessment the maximum width is used.
	Minimum clearance between sea surface and turbine blade tip	8m	The minimum clearance between the turbine blade tip and the sea surface is 8m. The minimum clearance is used to calculate the percentage of turbine deployment area/water volume taken up by turbines rotors.
	Clearance from blade tip to seabed	4.5m	The minimum clearance between the turbine blade tip and the seabed is 4.5m. The minimum clearance is used to calculate the percentage of turbine deployment area/water volume taken up by turbines rotors.
	Number of blades per rotor	N/A	This Project parameter does not influence the bird impact assessment. The number of turbine blades is not an input parameter to the bird encounter model.
	Rotation speed	N/A	This Project parameter does not influence the bird impact assessment. The turbine rotational speed is not an input parameter to the bird encounter model.
	Operational noise	36 x 2.4MW turbines	The 2.4 MW turbine produces the highest noise and an array of 36 turbines of 2.4MW produces higher noise emissions than an array of 86 turbines of 1MW.
	Decommissioning	All turbines removed at decommissioning	All turbines will be removed at decommissioning.
	Oil fluid inventory	1,500 litres	The tidal turbines will contain an inventory of fluids including oil, hydraulic fluid and coolant. Turbine inventories will be between 645 and 1,500 litres.
Turbine support structure	Maximum drill cuttings released into marine environment	86 monopile Turbine Support Structure (TSS)	The drilled monopile TSS will result in the maximum release of drill cuttings to the marine environment. Assuming the maximum number of 86 TSSs, the maximum amount of drill cuttings that can be generated from turbine support installations is $17{,}200m^3$ (total for 86 TSSs).
	Installation noise	Pin-pile TSS	Pin pile drilling produces higher noise output than monopole drilling based on available data. Pin pile source levels are 178 dB re 1 µPa at 1 m.
	Maximum amount of compressor lubricant released into the marine environment	86 monopile TSS	Monopile drilling operations will take approximately 4 hours per pile. A compressor is used to pump air into the drilled holes to lift cuttings clear. The lubricant will be discharged to sea along with the cuttings at a maximum rate of 5 litres per hour, i.e. $20m^3$ per monopile and $1{,}720m^3$ for all 86 installed over 3 years.

Project parameter relevant to the assessment		'Maximum' Project parameter for impact assessment	Explanation of maximum Project parameter
Cable landfall	Maximum drill cuttings released to marine) environment	29 Horizontal Directional Drill (HDD) bores, drilled from either Ness of Quoys or Ness of Huna	The majority of drill cuttings generated from the drilling of the HDD bores will be returned to shore and not discharged to sea; however it is estimated that the contents of the last 10m of each bore could be discharged to sea and the seabed breakthrough. The greatest potential volume of cuttings discharged to sea at breakthrough will result from last 10m of 29 boreholes of 0.6m diameter $82m^2$.
Vessels	Installation vessel physical presence	1 Dynamic Positioning (DP) vessel for the duration of the installation for year 1 and 2 2 DP vessels for year 3 installation	Installation activities will be carried out by a single DP vessel during year 1 and 2, all installation activities to be undertaken using a single DP vessel. If other smaller vessels used to undertake some of the work of the DP vessel, no concurrent multiple vessel activities will take place, i.e. no more than one vessel on site at any one time. Year 3 installation will require a maximum 2 DP vessels for TSS installation. These two vessels may be present on site at the same time during year 3.
	Installation vessel noise	Tug vessel noise	Noise data for DP vessels are currently unavailable. Of the vessel noise data available tugs represent the noisiest vessels and are used to represent the highest possible noise source during installation operations. Tug source levels are 172 dB re 1 µPa at 1 m.
	Maintenance vessel physical presence	1 DP vessel present every 2.8 days	Based on a maximum 86 turbine array, 1 DP vessel will be present a maximum of 130 times (i.e. single slack tide operation) per year i.e. the DP vessel present on site every 2.8 days.
	Maintenance vessel noise	Tug vessel noise	Noise data for DP vessels are currently unavailable. Of the vessel noise data available tugs represent the noisiest vessels and are used to represent the highest possible noise source during maintenance operations. Tug source levels are 172 dB re 1 µPa at 1 m.
Onshore Project components	Maximum onshore footprint	Power Conversion Centre (PCC) construction and HDD activities at Ness of Quoys or Ness of Huna; all potential cable corridors between PCC locations and SHETL substation proposed at Phillips Mains (see Figure 2.1) – maximum potential project footprints (at EIA commencement)	Onshore construction activities have the potential to impact onshore bird nesting/resting habitats and foraging areas. Impacts from all potential onshore infrastructure footprints have been considered in the bird impact assessment.

Table 12.1: Rochdale Envelope parameters for the ornithology assessment

12.2.2 Area of assessment

12.6 The focus of the impact assessment is potential impacts on birds using the Project area and adjacent waters. The variation in the area over which impacts occur and the area over which an impact may occur can vary significantly between species based on their ecology and range over which their populations can be found. Therefore, potential impacts have also been set in the context of a wider study area over which birds encountered in the Project area are thought to range.

12.3 Legislative Framework and Regulatory Context

12.3.1 EIA guidance

12.7 The Scottish Government has developed guidance for wave and tidal developers seeking consent for projects in Scottish waters (including the Renewable Energy Zone (REZ) out to 200nm). These guidelines give an overview of the potential impacts of the marine energy developments on birds, listing the following potential effects on birds as ones which should be considered:

- Collision risk;
- Entrapment risk;
- Disturbance as a result of noise;
- Pollution from routine and accidental discharges;
- Disturbance of breeding birds;
- Displacement of birds from foraging areas;
- Disturbance displacement to moulting and rafting/loafing birds; and
- Creation of resting or breeding habitat.

12.8 In addition to the above guidance, the Institute of Ecology and Environmental Management (IEEM) have developed guidance for ecological impact assessment in Britain and Ireland for the marine and coastal environment. Within the IEEM guidance, predicting and characterising impacts on species (e.g. extent, duration, magnitude and confidence in predictions) within various geographical contexts (e.g. national or regional populations) or designated sites is carried out on the basis of species distribution and status, and this procedure is followed here.

12.3.2 Legislation

12.9 In addition to the EIA Regulations, key legislation for ornithological interest includes:

- The Council Directive on the Conservation of Wild Birds 2009/147/EC (EU Birds Directive);
- Nature conservation (Scotland) Act 2004;
- Wildlife and Countryside Act 1981 (as amended); and
- Conservation (Natural Habitats, etc.) Regulations 1994 (as amended)

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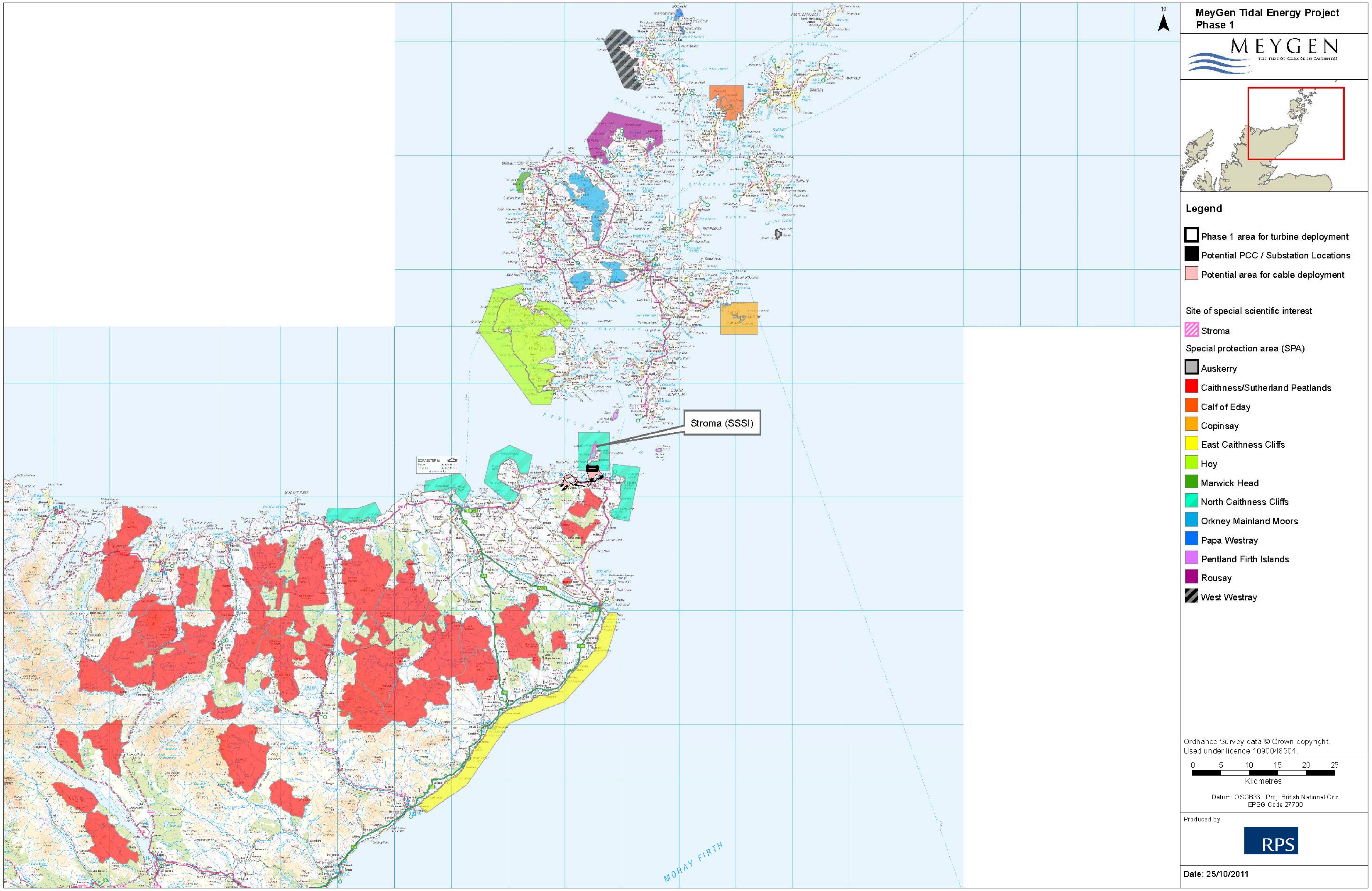

Figure 12.1: Special Protection Areas with species which may be connected with the MeyGen Tidal Energy Project site

EU Birds Directive

12.10 The EU Birds Directive 79/409/EEC (as amended) aims to provide a comprehensive scheme of protection for all wild bird species naturally occurring in the Union. To meet the requirements outlined in Article 4 of the Birds Directive, particular emphasis is given to the protection of habitat for endangered as well as migratory species (i.e. as listed under Annex I) via the establishment of a coherent network of Special Protection Areas (SPAs) comprising all of the most suitable territories for these species. Several of the bird species listed on Annex I of the Birds Directive occur within the Pentland Firth and the project area itself lies within the North Caithness Cliffs SPA (Figure 12.1).

12.11 In addition to the North Caithness Cliffs SPA, a further 26 SPAs on mainland Britain or offshore islands have the potential to interact with the Project site. Several of these SPAs may be relevant to the Project because they qualify on the basis of their breeding seabird populations, with some seabird species foraging widely over extensive areas, potentially including the Project site.

12.12 Although none of these additional 26 SPAs overlap with the Project area, and all except 3 are more than 10km distant, at least 20 of these can be considered as relevant because the proposed site falls within the mean maximum foraging ranges of some of the named qualifying seabird and diver species. The tables include both species which are listed as qualifying features and also those named as part of the breeding seabird assemblages for each SPA. In addition, for terrestrial bird species (including wildfowl), those SPAs in closest proximity to the Project site (notably Caithness & Sutherlands Peatlands and Caithness Lochs) are likely to be relevant because these lie within potential foraging distances of SPA species, whilst others which are further afield are unlikely to be of relevance because they lie beyond the likely foraging ranges of their qualifying SPA species.

12.13 Further details of the distance between each SPA and the Project area and the species for which each has been designated are provided in the Baseline Description (Section 12.5).

Wildlife and Countryside Act

12.14 Under the Nature Conservation (Scotland) Act 2004, and the Wildlife and Countryside Act (1981), Sites of Special Scientific Interest (SSSIs) in Scotland are designated by Scottish Natural Heritage (SNH), where the land is considered to be of special interest by reason of any of its natural features, such that they form a network of the best examples of natural features throughout Scotland, and support a wider network across Great Britain and the EU. Under the Nature Conservation (Scotland) Act 2004, SSSIs in Scotland are subject to notifications regarding operations requiring consent and have agreed management statements between SNH and the land owners or occupiers.

12.15 The western side of the island of Stroma is designated as a SSSI for its nationally important colonies of breeding seabirds, in particular of common guillemot, Arctic tern (*Sterna paradisaea*) and Sandwich tern (*Sterna sandvicensis*). This SSSI lies wholly within the North Caithness Cliffs SPA, however it is mentioned here because black guillemot (*Cepphus grylle*) is named as a component of the cliff nesting seabird colony. This species does not qualify for SPA status as it is classed as non-migratory.

12.4 Assessment Methodology

12.4.1 Scoping and consultation

12.16 Since the commencement of the Project, consultation on ornithology issues has been ongoing. Table 12.2 summarises all consultation relevant to ornithology. In addition, relevant comments from the EIA Scoping Opinion are summarised in Table 12.3, together with responses to the comments and reference to the Environmental Statement (ES) sections relevant to the specific comment.

Date	Stakeholder	Consultation	Topic/specific issue
11th August 2009	SNH	Meeting	Site visit and meeting to discuss bird and marine mammal survey methodology.
24th September 2009	SNH	Submission of document	Survey methodology.
17th November 2009	SNH	Submission of document	Revised survey methodology.
24th December 2009	SNH	Receipt of consultation	Confirmation on survey methodology changes.
7th April 2011	Marine Scotland and SNH	Pre-Scoping meeting	EIA surveys and studies required and the data. needs for each EIA study.
27th May 2011	Marine Scotland, statutory consultees and non statutory consultees	Submission of EIA Scoping Report	Request for EIA Scoping Opinion from Marine Scotland and statutory consultees and request for comment from non statutory consultees.
6th May 2011	Marine Scotland and SNH	Submission of document for comment	Submission of interim survey report summarising the results from first 18 months of survey.
6th June 2011	Marine Scotland and SNH	Meeting	Presentation of survey results from first 18 months of survey and discussion on EIA and cumulative impact assessment scope and HRA scope.
30th June – 2nd July 2011	Local stakeholders	Public Event - EIA Scoping	Public event to collate information/opinions on proposed EIA scope.
8th August 2011	Marine Scotland and SNH	Submission of document for comment	Submission of HRA Screening Report.
30th September 2011	Marine Scotland and SNH	Letter	Response to HRA Screening Report.
31st September 2011	Marine Scotland, The Highland Council, statutory consultees and non statutory consultees	Receipt of EIA Scoping Opinion	Receipt of response to EIA Scoping Report and other comments from non statutory consultees.
3rd October 2011	Marine Scotland	Project update meeting	Report on EIA progress including presentation of survey results.
2nd November 2011	Marine Scotland and SNH	Meeting	Discussion of assessment methodology; preliminary assessment results and HRA requirements.
6th – 7th December 2011	Local stakeholders	Public Event – pre application consultation	Public event to communicate the findings of the EIA to local stakeholders.
2nd March 2012	Marine Scotland and SNH	Meeting	Final meeting to close out HRA approach to the Project.

Table 12.2: Consultation undertaken in relation to ornithology

Name of organisation	Key concerns	Response	ES section within which the specific issue is addressed
SNH	Since the seabird and marine mammal surveys began in 2009 the lease area has changed. It is apparent that the surveys no longer cover the whole of the lease area. Given that most of the proposed lease area is within the North Caithness Cliffs SPA this is an important data gap. We strongly recommend that a strategy for surveying this area is adopted and discussed with SNH soon.	The current impact assessment is concerned only with Phase I of the Project. This comprises a smaller section in the centre of the Agreement for Lease area. SNH have confirmed that the survey data are satisfactory for this assessment (email communication, 20/10/2011).	Section 12.4.2 Field Survey
SNH	Regarding identification of SPAs, please refer to advice provided in our response to the EIA Scoping Report and HRA screening report (31/08/2011). We	Mean maximum foraging ranges[1] have been used to identify seabird colonies and SPAs for inclusion in the assessment. [NB: feedback on the initial	Impact Assessment Sections: 12.6, 12.7, 12.8 and

Name of organisation	Key concerns	Response	ES section within which the specific issue is addressed
	recommend using the meta-data on seabird foraging ranges available from the BirdLife International database to determine which qualifying species from which sites are included. For some seabird species, the meta-data is such that it allows the use of cumulative frequency plots to determine the foraging range at which 95% of the population will be included. If these data are not available, or of poor quality, then we recommend using the mean of the species maximum foraging range. Foraging ranges of each qualifying species should be plotted from the SPA to the lease area to determine which foraging ranges overlap with the lease area and, therefore, which qualifying species (and which SPAs) should be included at this stage of the HRA. Although this will initially produce a long list of SPAs, this will be refined through an iterative process as the results of survey work are presented by MeyGen, and as species sensitivity to potential impacts from the proposal are defined. Considering MeyGen Ltd has undertaken a large amount of survey work, they should be able to refine the SPA list by scoping out the qualifying species of sites which are not present in the survey results. It would be useful if this information/list, together with the justification for scoping in or out, could be presented at the forthcoming HRA meeting.	Habitats Regulations Appraisal (HRA) screening from MS and SNH drew attention to the fact that the mean maximum foraging range should be used as a guide rather than an absolute limit, and that SPAs located just beyond a species' mean maximum foraging range should also be considered for inclusion.]	12.11
Marine Scotland	From the EIA Scoping Report it is not clear what will be done with the bird survey data that has been collected since October 2009. Marine Scotland queries how the developer will utilise the image library from the aerial bird surveys currently being undertaken in the area by the Scottish Government and The Crown Estate? What analysis will be undertaken either of the data gathered by the applicant or the data collected by the Scottish Government and The Crown Estate? Are there any plans for design based analysis or will a more advanced form of analysis such as density surface modelling be used?	The final results of these surveys were made available too late for them to be incorporated into this assessment. Furthermore, consideration of preliminary versions of the report suggested that the spatial resolution of these surveys was unlikely to provide sufficient detail for the purposes of this assessment.	N/A
Marine Scotland	Information on how the survey results will be presented and how uncertainty will be estimated in the estimates of populations and distributions would be welcome as well as any information the developer may have with regards collecting the data required for the Appropriate Assessment.	These aspects will be considered within the Ornithology ES section and the Habitats Regulations Appraisal (HRA).	Section 12.5 Baseline Description; Ornithological Technical Annex (RPS, 2011b); HRA Report (MeyGen, 2011)
Royal Society for the Protection of Birds (RSPB)	Whilst adverse effects on birds arising through collision or other mechanisms identified on p.55 seem unlikely to be significant, there is great uncertainty about this as we lack the detailed knowledge to be gained from experience of the installation of such devices elsewhere, particularly in a high-energy, bird-rich site. It is known that guillemots and other diving seabirds do reach such depths and so could be affected. Consideration should also be given to the likelihood of pollution, from the devices themselves or from associated vessels as this could directly impact on birds or give rise to secondary effects through their foodstuffs.	These aspects will be captured within the Ornithology ES section Potential pollution events and their implications are considered in the ES.	Impact Assessment Sections: 12.6.2, 12.6.3, 12.7.2, 12.7.3, 12.7.5
RSPB	In addition to the North Caithness Cliffs SPA, other Natura sites which may be affected by the proposed development should also be considered in the EIA. The qualifying interest of the nearby Pentland Firth Islands – breeding Arctic terns – might be thought unlikely to be affected as these birds are shallow divers. A small area of sandbank has been identified within the lease area however, which may support sandeels, their principle food, so a systematic appraisal of the possibility of impact must be completed. We note, too, that spawning and nursery grounds for sprats occur within the study area: this is another important food for seabirds and the possibility of secondary impacts must be considered. The continuing run of poor seabird breeding seasons and consequent population declines give further reason for adopting a precautionary approach as any adverse impacts, however small, arising from new development would be additional.	An HRA Screening process has been undertaken and consultations undertaken with Marine Scotland and SNH on the HRA process and its application to the Project. This has informed the SPA sites and Project impacts that need to be considered from an HRA perspective.	Impact Assessment Sections: 12.7.6, 12.11; HRA Report (MeyGen, 2011)

Note:

1: The mean maximum foraging range for a species is defined as the mean of the maximum foraging distances from the range of studies and data sources held for that species by BirdLife International – http://seabird.wikispaces.com

Table 12.3: Scoping comments relevant to ornithology

Desk based study

12.17 Information regarding species specific seabird ecology was obtained from a wide range of sources and is cited within the text as appropriate. The main sources of seabird population estimates were the most recent national seabird census (commonly referred to as Seabird 2000, Mitchell *et al.,* 2004) and for updated data the Seabird Monitoring Programme online database (http://jncc.defra.gov.uk/page-4460), maintained by the Joint Nature Conservation Committee (JNCC).

12.18 The bird descriptions and impact assessment for the onshore aspects of the Project are entirely desk based, utilising Phase 1 habitat assessments, descriptions of the bird interests in the region and the JNCC SPA citations.

12.4.2 Field survey

12.19 Two independent field surveys were undertaken to obtain baseline bird information (but also incorporating marine mammals and basking sharks); boat based observations and land based observations. Both were conducted over a period of two years, between October 2009 and September 2011. At the outset of the survey programme there was no specific guidance on surveying for tidal turbine developments. Consequently, SNH were consulted during the initial development of the survey methods, and further consulted about refinements promoted after the preliminary surveys had been undertaken. Further details are provided in the relevant sections.

Boat based survey

12.20 Boat surveys were conducted across the entire Agreement for Lease (AfL) area as defined in October 2009 (covering 3.25km^2) and a surrounding 1km buffer (hereafter the boat based survey area). Water depths within the boat based study area vary between 31 and 47m below lowest astronomical tide, whilst tidal currents within some parts of the area can reach 5.0m/s during spring flood tides, although 2.0 – 3.5m/s is more typical. The buffer area was included because of the lack of a control site. In consultation with SNH it was decided that identification of an appropriate control site was not feasible due to the fact that the combination of physical and tidal features in the Inner Sound were unlikely to be well represented by any nearby areas of sea.

12.21 Boat surveys were conducted at monthly intervals between October 2009 and September 2011, except in October 2010 and December 2010, when surveys were not undertaken due to extended periods of unsuitable weather. Thus, a total of 22 boat surveys were undertaken (SNH advised that there was no requirement to provide additional surveys for those ones missed).

12.22 Boat surveys were conducted using modified European Seabird at Sea (ESAS) methods, and based on those developed for surveying proposed offshore wind farm developments (Tasker *et al.,* 1984; Camphuysen *et al.,* 2004; Maclean *et al*., 2009). The standard methods are appropriate to larger offshore survey areas, such as offshore wind farm developments, but were modified to account for the smaller scale of the study area.

12.23 Thus, a line-transect method was used but with the width of the surveyed area reduced from 300m to 200m on either side of the survey vessel, to minimise the chances of double counting individuals, which are increased on this site due to the shorter transect lengths involved (Figure 12.2). It was initially proposed to survey against the direction of flow to further reduce this risk; however the high flow speed meant that this was not possible. Nevertheless, because the transect traverses the main direction of flow approximately perpendicularly, the risk of double counting is considered to be low. Birds were recorded both on the sea surface and in flight, however given the nature of the proposed development, the baseline description section (Section 12.5) and impact assessment sections (Section 12.6, to Section 12.9) are based just on birds recorded on the water.

12.24 The initial survey route, used for the first two boat surveys, consisted of a 15km long step-shape with 90° turns, with primary transects running north – south and linking ones east – west. This route was difficult for the survey vessel to maintain due to the strong tidal flow. Therefore a revised route was trialled during the third survey, consisting of a 13km long saw-tooth profile. The proposed change was discussed with SNH prior to its trial and its use agreed. The new route was found to be more achievable and was used for the remainder of the surveys).

12.25 The survey area was based on the full extent of the Agreement for Lease (AfL) area as defined in October 2009. This AfL area was slightly modified towards the end of the two year survey period (see Section 4). While the boat survey route still sampled all of the AfL area, SNH raised concerns about the extent of coverage at the north west end of the site (Table 12.3). However, with regards to the Phase I area alone, these concerns were withdrawn. Therefore the survey data remains suitable for the Phase I site characterisation and impact assessment purposes.

12.26 The density of species recorded on the sea surface was estimated using Distance analysis (Thomas *et al*., 2010). Due to the comparatively small scale of the site, it was not possible to estimate densities just using observations made within the Project site. Hence, the densities reported here are those estimated for the entire boat survey area. Estimated monthly abundances for each species within the Project area were derived as the product of the area and the density.

12.27 An additional component of the boat surveys, not included in the standard ESAS methods, was the collection of data on dive duration for diving seabirds. This was undertaken from four locations ('stationary points') within the Inner Sound (Figure 12.2).

12.28 Surveys were planned to coincide with a range of tidal conditions, although constraints due to poor weather sometimes restricted the range of tides across which data were collected. The number of survey runs completed per day varied between summer and winter due to differences in day length, but no more than three of the four transects and two of the four sets of stationary point observations were obtained on any single day. The short day length during winter also precluded surveying across the complete tidal range over consecutive days, so that wherever possible surveys in consecutive months were undertaken during different states of tide. In addition, surveys alternated monthly between neap and intermediate tides, but surveys could not be completed during spring tide conditions because the strong tidal flow prevented stationary point observations being made. These conditions were however covered by land based surveys.

12.29 Further details on the methods employed are provided in the accompanying Ornithological Technical Annex (RPS, 2011b).

Land based survey

12.30 The proximity of the AfL area to land means that land-based vantage point (VP) surveys can provide a valuable complement to the boat surveys. Land based observations can be undertaken across a wider spread of time than is practical with boat-based surveys, thereby filling in potential gaps in the boat survey programme. Therefore, they are useful in providing more detailed information on seasonal, and other temporal, variation in abundance of bird species and in helping to assess the reliability of seasonal trends determined from the boat surveys.

12.31 As with the boat surveys, the methods for land-based-based VP surveys were developed in discussion with SNH. Methods were adapted from the VP surveys used for onshore wind farm developments (SNH, 2005), but with the focus on recording birds on the sea, although birds in flight were also recorded. Three locations were selected for VP surveys, which offered a range of viewpoints across the study area (Figure 12.2). Although the island of Stroma would have offered potentially suitable locations for VP surveys, all three locations had to be on the mainland because of the health and safety concerns associated with locating personnel onto a small uninhabited island.

12.32 VP surveys were undertaken from October 2009 to September 2011, with a total of 198 visits across all VPs made during this period. The target level of survey intensity was to achieve a minimum of six hours of observation at each of the three VPs in each month. This was typically spread across two, three hour periods, separated at each individual VP by at least seven days (although sometimes sessions were split into shorter periods). This ensured a wide spread of observations throughout each month. Some surveys were conducted from different VPs on the same day, but only sequentially, not concurrently.

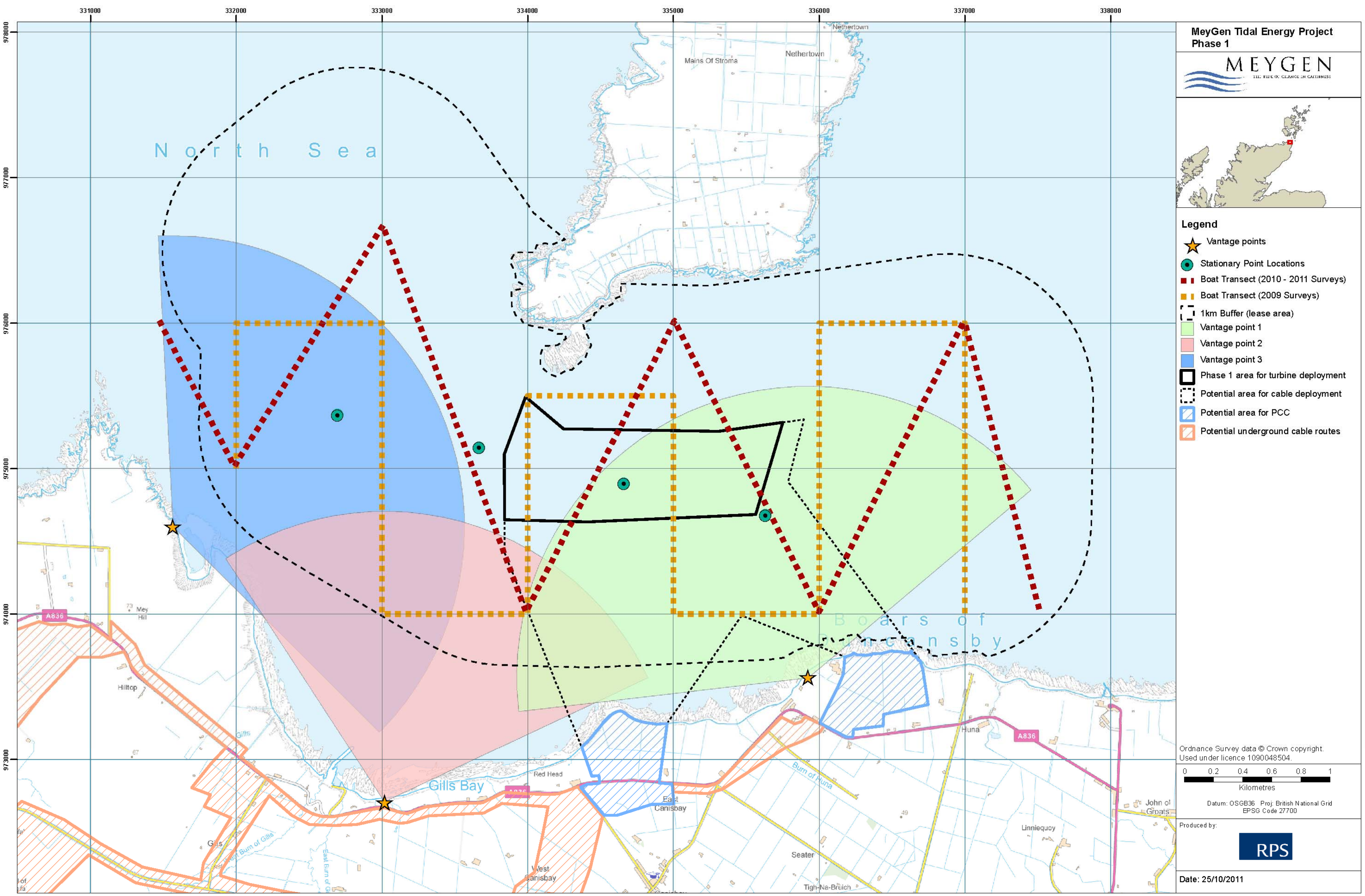

Figure 12.2: Boat survey route, static point locations and land based vantage point viewsheds for the MeyGen Tidal Energy Project. The orange line indicates the boat route originally used (2 surveys) which was then modified to the red route for all remaining ones

12.33 During each survey the viewshed (i.e. the visible area within which bird observations were recorded) was scanned systematically by a single observer and bird locations were recorded using a grid system. Each half-hour of a survey period was divided between different activities. Approximately 20 to 25 minutes were devoted to recording the positions of all birds observed on the water, recording species, number, grid cell and precise time of day. A further 5 to 10 minutes were spent recording snapshots of birds in flight. The latter activity was undertaken during two periods of approximately five minutes, and involved recording the species, number, distance from the observer (in 500m bands), flight height (as <2m, 2 to 10m or >10m) and precise time for any birds passing a fixed bearing.

12.34 Vantage point surveys were timed to provide information on patterns of bird behaviour through the tidal cycle and different seasonal periods. Of the six hours of observations undertaken at each VP per month, half were timed to occur around low tide, and half around high tide. Surveys were also spread between neap, intermediate and spring tides, with the aim of covering the full range of tide states within each season.

12.35 The counts from the land based surveys could not be used to generate bird density estimates in the same way as for those from boat surveys. This was because the decrease in detection rate with distance from the observer was confounded with likely changes in actual bird density with increasing distance from the shore. Thus, land based counts were expressed in terms of birds recorded per hour to provide an index of bird activity.

12.4.3 Impact assessment methods

12.36 Determination of potential impacts on seabird populations was achieved using a range of methods, some of which have been developed specifically with regard to diving seabirds and tidal turbines. Brief details are provided below, with more comprehensive descriptions provided in the Ornithological Technical Annex (RPS, 2011b, a copy of which is provided in the supporting studies CD).

12.37 The potential impacts considered in this assessment are:

- Disturbance and displacement of birds during the construction phase due to vessel presence and offshore construction activities;
- Accidental spillages of pollutants from construction and maintenance vessels;
- Disturbance and displacement during the operational phase due to maintenance activities (e.g. vessel traffic) and the presence of the turbines themselves;
- Increased annual mortality rates for diving species resulting from collisions with operating turbines
- Accidental spillages of pollutants from the turbines;
- Disturbance and displacement of birds during the decommissioning phase (expected to be similar in nature but smaller in magnitude to those during construction); and
- Cumulative impacts in combination with other projects in the region.

Displacement assessment methods

12.38 The potential extent, to which species will be displaced from the Project site due to various sources of disturbance, and the consequent impacts on their populations, is very difficult to predict. Some attempts have been made to estimate this for offshore wind farms (e.g. Horns Rev and Nysted, Denmark, Petersen *et al*., 2006; Southern Kalmar Sound, Sweden, Pettersen, 2005; Egmond aan Zee, the Netherlands, Lindeboom *et al*., 2011). However, the comparative infancy of tidal turbine installations, and the differences between such developments and offshore wind farms with regards to disturbance, means there is little in the way of equivalent methods for these technologies.

12.39 To explore the potential impacts of displacement on seabirds foraging in the vicinity of the turbines, population models were developed for each species considered to be at risk. The impact of displacement on the population of each of these species was modelled as a reduction in breeding success for the proposed lifetime of the Project. This was based on the assumption that each displaced bird will fail to breed. As the tidal turbines themselves could plausibly directly affect only individuals utilising the water column directly above the turbines, the number of individuals at risk of being displaced was estimated for the turbine deployment area (1.1km^2) using the peak breeding season density recorded during the boat surveys. Displacement impacts were considered between 0 and 100% of the birds estimated to be affected, although the worst case (complete displacement) forms the basis of the assessment.

Collision risk assessment methods

12.40 Wind turbine collision risk methods (e.g. Band, 2011) are well established and form a central component of wind farm impact assessments. The potential to adapt wind turbine methods was considered as a starting point for development of the tidal turbine collision model. Wind turbine collision risk modelling uses estimates of the density of birds flying at rotor height collected during site surveys, in combination with species specific variables (e.g. body length, wingspan, flight speed) and wind farm specific variables (e.g. number and dimensions of turbines) to estimate the number of possible transits through the turbine rotors during a given period of time. The probability that a single transit will result in a collision is calculated, and the product of the number of transits and the probability of collision provides an estimate of the number of collisions which would occur during the given period of time. However, this estimate does not include any allowance for avoiding action by birds. Therefore this value is adjusted to take account of avoidance (current research indicates that avoidance rates of ≥ 98% are appropriate).

12.41 The biggest challenges in developing a tidal turbine collision risk model based on this approach are the lack of data regarding the way birds move through the underwater environment (which would determine the number of potential transits and probability of a collision) and the range over which they may be able to perceive moving rotors (which would determine the levels of avoidance rate to use).

12.42 This is a reflection of the difficulty in studying natural seabird diving behaviour in the wild. The way in which diving birds move through their environment is little known, and thus it is not considered possible to estimate the number of rotor transits which may occur during a given period of time. For example, in the wind farm approach, flying birds are modelled on the basis that they pass horizontally through the plane of the rotor blade in a straight line. Diving birds hunting highly mobile prey (e.g. fish) are likely to move rapidly in three dimensions. It is therefore conceivable that whilst pursing prey a bird could pass through the swept volume of a tidal rotor in any direction (e.g. horizontally or vertically), and could potentially pass in and out of the rotor swept volume more than once. The collection of detailed data on how birds move around underwater with which to begin to estimate the rates of rotor transit for a tidal collision model will only become possible through the study of birds in relation to installed devices.

12.43 However, there is a requirement to attempt to make such assessments in advance in order that potential impacts can be assessed as far as possible. To estimate the potential impacts of mortality due to collisions with tidal turbines, a combination of population modelling and exposure time modelling has been developed (RPS, 2011c). SNH commissioned this work from RPS during 2010, as part of ongoing research to improve understanding of the potential environmental impacts of marine renewable energy. The work was overseen by SNH and the Marine Environment Spatial Planning Group (MESPG). MESPG is led by Marine Scotland and includes representatives from Highlands and Islands Enterprise, The Crown Estate, SNH, the JNCC and the renewables industry. During the development of the modelling approach, regular consultations were conducted with nominated officers at SNH, and the finished methodology was presented to MESPG in 2010 before the final report was delivered to SNH in early 2011. A workshop to peer review this modelling approach has recently been undertaken by SNH. While this workshop may lead to further refinements of the methods, the timetable for this process will extend beyond that available for the current application. Therefore, in the absence of alternative guidance (currently it is the only fully developed tidal turbine bird collision modelling approach), the approach developed by RPS and presented to SNH has been adopted here.

12.44 The method developed for assessing potential collisions, generates an estimate of the length of time (during a given period, e.g. one month) that individual birds of each species are predicted to spend within the total rotor swept volume of the proposed development (i.e. the rotor swept volume for all turbines combined). The number of individuals which would be predicted to be killed by collisions can be considered as the product of the collision rate (per unit of time), the population size and the estimated individual exposure time. As discussed, estimating a collision rate directly is not currently possible. However, re-arranging the variables above (exposure time, population size, number killed and collision rate) allows the calculation of the collision rate which would result in a particular number of deaths. Thus, by using the exposure time, population size and the predicted number of individuals which can be removed from the population before the growth rate becomes negative, a minimum collision rate which will lead to an impact on the population can be estimated.

12.45 Although it is not currently possible to state a threshold acceptability for collision rates with tidal turbines, what this approach does enable is the identification of collisions rates which, given a particular population size, are considered to be likely or unlikely to occur, thereby providing evidence as to whether impacts are significant or insignificant.

12.46 A brief summary of the method is provided below, with more details given in the Ornithological Technical Annex (RPS, 2011b). The modelling is based on the following stages:

- Development of a population model, from which thresholds of sustainable additional mortality can be estimated;
- Estimation of the time which individuals of a species spend within the volume of water occupied by the turbine rotors during a defined period (e.g. month, year), and
- Calculation of the collision rate which would be required, given the exposure time, to generate a level of mortality which would trigger a population decline.

12.47 The exposure time model makes the simplifying assumption that the rate of collisions is sufficiently small that it can be assumed to equal the probability of collision. It also assumes that the additional mortality accruing from the turbines is sufficiently small that its affect on the number of animals available in subsequent time periods can be ignored. Both of these assumptions will cause the number of collisions to be slightly over-estimated, thus rendering the approach precautionary. Whilst extending the model to incorporate changes in colony size throughout the year would be possible, this would require an estimate of monthly mortality (both natural and that due to collisions) to be included. Such estimates are not available.

12.48 Indeed, it is worth stressing that the model does not generate estimates of predicted collision mortality, but rather provides an approximate scale of risk for a given species associated with a range of mortality levels. In its present form there is no feedback between the two model components (exposure time and population model) since, as discussed earlier, there is currently no means to estimate tidal turbine mortality rates to feed into the population model. Thus, the population at risk is updated within the population model on an annual basis, irrespective of the variability in monthly rates of exposure time, and the likely variability in timing of collisions this implies.

12.49 The population models for each species have been developed using demographic data collected from published studies. The size of the initial population to use in the model was derived by combining estimates from breeding populations considered to be within range of the site. Published estimates for the mean maximum foraging ranges (e.g. Langston, 2010; BirdLife International, 2011) were used to determine which sites to include in these estimates.

Accidental pollution assessment methods

12.50 The potential impacts of accidental spillages of oil and other pollutants from the vessels involved in the construction and maintenance of the proposed development and the turbines themselves are assessed based on the likelihood of such events occurring and the potential consequences for seabirds in the Inner Sound. Section 24 of this ES provides the Accidental Events Impact Assessment, and the results presented in this section are used here in conjunction with published species specific values of seabird vulnerability to surface pollutants (Williams *et al.*, 1995) to generate predicted impacts.

12.4.4 Significance criteria

12.51 The EIA process and methodology are described in detail in Section 8. Each assessment section is, however, required to develop its own criteria for the 'sensitivity of receptor' and 'magnitude of impact' aspects since the definition of these will vary between different topics. For ornithology, the significance criteria used in this section is based on the methodology described in Section 8 but the sensitivity of the receptor and magnitude of impact are defined in Table 12.4 and Table 12.5 respectively.

12.52 The consequences of impacts are then considered by reference to the relevant criteria in the EIA Regulations. The significance of impacts in relation to the EIA Regulations are defined in Section 8, Table 8.2.

Sensitivity of receptor	Definition
Very High	▪ Bird species that forms part of a cited interest of an SPA or Ramsar site that may potentially interact with the Project at some stage of their life cycle. ▪ A bird species for which a significant proportion (more than 1%) of the international population is found within the Project site. ▪ In the context of a particular impact, species which are considered very likely to be negatively affected by that impact.
High	▪ Bird species that forms part of a cited interest of an SSSI that may potentially interact with the Project at some stage of their life cycle. ▪ A bird species for which a significant proportion (>1%) of the national population is found within the site. ▪ In the context of a particular impact, species which are considered likely to be negatively affected by that impact.
Medium	▪ Bird species that are listed on Annex I of the EU Birds Directive or on Schedule 1 of the Wildlife and Countryside Act 1981, requiring increased legal protection from disturbance during the breeding season. ▪ A species listed on the Birds of Conservation Concern (BOCC) Red list. ▪ Birds that are the subject of a specific action plan within the UK Biodiversity Action Plan. ▪ A bird species for which a significant proportion (more than 1%) of the regional population is found within the site, or at the extremity of a distributional range. ▪ In the context of a particular impact, species which may be negatively affected by that impact.
Low	▪ Any other species of conservation interest (e.g. Amber-listed species on the Birds of Conservation Concern not covered above). ▪ In the context of a particular impact, species which are considered unlikely to be negatively affected by that impact.
Negligible	▪ All other species of low Conservation Concern (e.g. Green-listed species). ▪ In the context of a particular impact, species which will not be negatively affected by that impact.

Table 12.4: Definitions for sensitivity of receptor

Magnitude of impact	Definition
Severe	▪ Would cause the loss of a major proportion (>80% population loss) or whole feature / population, or cause sufficient damage to a feature to immediately affect its viability. ▪ Irreversible. ▪ Impact highly likely to occur

Major	▪ Major effects on the feature / population, for example more than 20% population loss. ▪ Irreversibly alter the nature of the feature in the short-to-long term and affect its long-term viability. ▪ Impact likely to occur.
Moderate	▪ Effect leading to between 5-20% population loss. ▪ Effects that are detectable in short and long-term, but which should not alter the long-term viability of the feature/ population. ▪ Impact will possibly occur.
Minor	▪ Effects leading to 1-5% population loss. ▪ Either of sufficiently small-scale or of short duration to cause no long-term harm to the feature / population. ▪ Impact unlikely to occur.
Negligible	▪ A potential impact that is not expected to affect the feature / population in any way; therefore no effects are predicted (<1% population loss). ▪ Impact extremely unlikely to occur.
Positive	▪ An enhancement of an ecosystem or population parameter.

Table 12.5: Definitions for magnitude of impact

12.4.5 Data gaps and uncertainties

Seabird density estimation

12.53 The small spatial scale of the Project means that seabird density estimates cannot be robustly calculated for the Project area itself. This is a reflection of the limitations of analysis methods for seabird surveys, which generate variances around mean values using between transect line variation. With such a small site, it is not possible to accommodate sufficient transects to permit robust estimation. Thus the seabird densities provided in this assessment and used to estimate potential impacts have been calculated at the level of the entire survey area.

Connectivity between seabird breeding colonies and foraging locations

12.54 The origin of seabirds observed within the surveyed area cannot be determined from the boat and land surveys. The only reliable means to establish linkages between a proposed development site and breeding colonies is through the use of geo-location tags fitted to individual seabirds. An attempt was made during the 2011 breeding season to fit tags to black guillemots breeding on the island of Stroma (this was conducted by researchers at the Environmental Research Institute, Thurso). Unfortunately this pilot project failed to provide any useable data, and therefore linkages between the site and breeding colonies has been based on knowledge of foraging ranges (an approach agreed with Marine Scotland SNH).

Seabird diving behaviour and underwater swimming ability

12.55 As discussed in the collision methodology section, the behaviour and movement of seabirds whilst diving is little understood generally due to the difficulty of conducting studies of diving in the wild. These data are considered to be critical for the prediction of mortality rates. The absence of these data has led to the adoption of an alternative approach to collision assessment, whereby the minimum collision rate required to cause a threshold of population impact is derived. Given the current lack of knowledge on diving bird abilities this is considered to be the most appropriate method to adopt.

Terrestrial bird assessment

12.56 The baseline description and impact assessment for the onshore developments presented here is based on published information. Once the specific sites have been identified, targeted bird surveys will be conducted, to determine the distribution, habitat use and status of birds within the Project footprint and the surrounding area.

12.5 Baseline Description

12.57 Located between the northeast tip of the Scottish mainland and the Orkney archipelago, the Pentland Firth Inner Sound is within an area of international importance for seabird populations. This is evident from the wide array of SPAs that are located in this area and which hold large breeding populations of a wide range of seabird species.

12.58 Several SPAs may be considered relevant to the Project area (Table 12.6, Table 12.7). The Project area itself lies within the North Caithness Cliffs SPA, which was designated in 1996 and comprises five separate sections of maritime cliff (nr. Melvich, Scrabster, Dunnet Head, Stroma and Duncansby Head). In 2009 the boundary was amended to include seaward extensions of 2km to each sub-component of the SPA, in recognition that these areas of sea adjacent to the breeding colonies are important for essential activities such as preening, bathing, and displaying (SNH, 2008).

12.59 Additionally, there are at least a further 20 SPAs where potential impacts on qualifying seabird and diver species need to be considered because the Project area lies within the mean maximum foraging range of at least some of these species.

12.60 The species that are listed as qualifying features for each of these SPAs, along with those named as part of the breeding seabird assemblage for the SPA, are given in Table 12.6 and Table 12.7 along with their population estimates for the SPAs (as taken from the citation or more recent re-assessments where available). These tables show that there are a total of 18 species of seabird and diver listed as qualifying features or as part of the breeding seabird assemblage of those SPAs, with some of these species having substantial populations on individual SPAs, as well as across this suite of SPAs. Gannets have a very large foraging range (mean maximum range: 308km), thus in recognition of this fact additional SPAs located beyond Orkney have been included for this species. These are listed in Table 12.7. In addition, black guillemot are also named as a component of the cliff nesting seabird colony on the Stroma SSSI (which lies wholly within the North Caithness Cliffs SPA).

12.61 The ornithological importance of the areas surrounding the Pentland Firth Inner Sound is not restricted to seabirds. Thus, the largest expanse of peatland in the UK occurs in Caithness and Sutherland and encompasses much of the land immediately to the south and west of the Inner Sound. These peatlands are designated for a wide range of bird species, including golden eagle, hen harrier, short-eared owl, golden plover, dunlin, greenshank and red-throated diver.

12.62 Species associated with the North Caithness Cliffs SPA and/or some of the other SPAs listed in Table 12.6 and Table 12.7 for which significant impacts are identified will be subject to a Habitat Regulations Assessment (Section 12.11).

SPA name	Qualifying interests		Minimum distance from the Project (km)
	Name (season)	Number (pairs or individuals, year of citation)	
North Caithness Cliffs	Northern fulmar (breeding)	14,700 prs. (1985-1988)	0
	Peregrine falcon (breeding)	6 prs. (mid-1990s)	
	Kittiwake (breeding)	13,100 prs. (1985-1988)	
	Common guillemot (breeding)	38,300 ind. (1985-1988)	
	Razorbill (breeding)	4,000 ind. (1985-1988)	
	Atlantic puffin (breeding)	1,750 prs. (1985-1988)	
Caithness and Sutherland Peatlands	Black-throated diver (breeding)	26 prs (1986-96)	0.25
	Golden eagle (breeding)	5 prs (1986-96)	

SPA name	Qualifying interests		Minimum distance from the Project (km)
	Name (season)	Number (pairs or individuals, year of citation)	
	Golden plover (breeding)	1,064 prs (mid-1990s)	
	Hen harrier (breeding)	14 prs (1993-97)	
	Merlin (breeding)	54 prs (mid-1990s)	
	Red-throated diver (breeding)	89 prs (1993-94)	
	Short-eared owl (breeding)	30 prs (mid-1990s)	
	Wood sandpiper (breeding)	5 prs (1994-95)	
	Dunlin (breeding)	1,860 prs (1994)	
	Common Scoter (breeding)	27 prs (1996)	
	Greenshank (breeding)	256 prs (1994 - 1995)	
	Wigeon (breeding)	43 prs (1994)	
Caithness Lochs	Greenland white-fronted goose (wintering)	440 ind. (1993/94-1997/98)	2.3
	Greylag goose (Wintering)	7,190 ind. (1993/94-1997/98)	
	Whooper swan (Wintering)	240 ind. (1993/94-1997/98)	
Pentland Firth Islands	Arctic tern (breeding)	1,200 prs. (1992-1995)	8.9
Hoy	Peregrine (breeding)	6 prs. (mid-1990s)	11.2
	Northern fulmar (breeding)	35,000 prs. (1985-1988)	
	Great skua (breeding)	1,900 prs. (NA)	
	Kittiwake (breeding)	3,000 prs (1985-1988)	
	Great black-backed gull (breeding)	570prs. (1985-1988)	
	Arctic skua (breeding)	59 prs. (1985-1988)	
	Atlantic puffin (breeding)	3,500 prs. (NA)	
	Common guillemot (breeding)	13,400 prs (1985-1988)	
	Red-throated diver (breeding)	58 territories (1994)	
Switha	Barnacle goose (wintering)	1,120 ind. (1993-1997)	14.2
East Caithness Cliffs	Northern fulmar (breeding)	15,000 prs. (1985-1988)	22.3
	Great cormorant (breeding)	230 prs. (1985-1988)	
	European shag (breeding)	2,300 prs. (1985-1988)	
	Peregrine falcon (breeding)	6 prs. (1985-1988)	
	Herring gull (breeding)	9,400 prs. (1985-1988)	
	Great black-backed gull (breeding)	800 prs. (1985-1988)	
	Kittiwake (breeding)	32,500 prs. (1985-1988)	
	Common guillemot (breeding)	106,700 ind. (1985-1988)	
	Razorbill (breeding)	15,800 ind. (1985-1988)	
	Atlantic puffin (breeding)	1,750 prs. (1985-1988)	

SPA name	Qualifying interests		Minimum distance from the Project (km)
	Name (season)	Number (pairs or individuals, year of citation)	
	Northern fulmar (breeding)	15,000 prs. (1985-1988)	
Orkney Mainland Moors	Hen harrier (breeding and wintering)	28 females (breeding) 13 ind. (wintering) (1994-98)	29.6
	Red-throated divers (breeding)	18 prs. (NA)	
	Short-eared owl (breeding)	19 prs. (1993-95)	
Copinsay	Northern fulmar (breeding)	1,615 prs. (1985-1988)	31.0
	Kittiwake (breeding)	9,550 prs. (1985-1988)	
	Great black-backed gull (breeding)	490 prs. (1985-1988)	
	Common guillemot (breeding)	29,450 ind (1985-1988)	
Marwick Head	Kittiwake (breeding)	7,700 prs (1991)	48.5
	Common guillemot (breeding)	37,700 ind. (1991)	
Auskerry	European storm petrel (breeding)	3,600 prs. (1995)	51.1
	Arctic tern (breeding)	780 prs. (1992-95)	
Rousay	Northern fulmar (breeding)	1,240 prs. (1986 & 1997)	53
	Kittiwake (breeding)	4,900 prs. (1986 & 1997)	
	Arctic skua (breeding)	130 prs. (1992)	
	Arctic tern (breeding)	790 prs. (1991-1995)	
	Common guillemot (breeding)	10,600 ind. (1986 & 1997)	
North Sutherland Coastal Islands	Barnacle goose (wintering)	631 ind. (1992/93-1996/97)	65.0
Calf of Eday	Northern fulmar (breeding)	1,955 prs. (1985-1988).	65.3
	Kittiwake (breeding)	1,717 prs. (1985-1988).	
	Great black-backed gull (breeding)	938 prs. (1985-1988).	
	Common guillemot (breeding)	12,645 ind. (1985-1988).	
	Great cormorant (breeding)	223 prs. (1985-1988).	
West Westray	Northern fulmar (breeding)	1,400 prs. (1985-1988)	65.7
	Arctic skua (breeding)	78 prs. (1985-1988)	
	Arctic tern (breeding)	1,140 prs (1985-1988)	
	Kittiwake (breeding)	23,900 prs. (1985-1988)	
	Common guillemot (breeding)	42,150 ind. (1985-1988)	
	Razorbill (breeding)	1,946 ind. (1985-1988)	
East Sanday Coast	Turnstone (wintering)	1,400 ind. (1991-1994)	71.5
	Purple sandpiper (wintering)	840 ind. (NA)	
Papa Westray	Arctic tern (breeding)	1,950 prs. (1997)	77.4
Sule Skerry and Sule Stack	European storm petrel (breeding)	500 prs (1985-1988)	82.2
	Leach's storm petrel (breeding)	5 prs (1985-1988)	
	Common guillemot (breeding)	6,298 ind. (1985-1988)	
	European shag (breeding)	874 prs (1985-1988)	
	Atlantic puffin (breeding)	46,900 prs (1985-1988)	
	Gannet (breeding)	4,675 prs (2004)	
Strath Carnaig and	Hen harrier (breeding)	12 prs (2002-04)	88.2

SPA name	Qualifying interests		Minimum distance from the Project (km)
	Name (season)	Number (pairs or individuals, year of citation)	
Strath Fleet Moors			
Dornoch Firth and Loch Fleet	Bar-tailed godwit (Wintering)	1,300 ind. (1992-1996)	88.9
	Greylag goose (Wintering)	2,079 ind. (1992-1996)	
	Osprey (breeding)	20 prs. (early 1990s)	
	Wigeon (wintering)	15,022 ind. (1992-1996)	
Foinaven	Golden eagle (breeding)	6 active territories (2003)	89.1
Cape Wrath	Kittiwake (breeding)	9,700 prs. (1985-1988)	91.1
	Common guillemot (breeding)	13,700 ind. (1985-1988)	
	Razorbill (breeding)	1,800 ind. (1985-1988)	
	Atlantic puffin (breeding)	5,900 prs. (1985-1988)	
	Northern fulmar (breeding)	2,300 prs. (1985-1988)	

Table 12.6: Special Protection Areas (SPAs) and their qualifying interests within foraging range of the MeyGen Tidal Energy Project site

SPA name	Number of breeding pairs (year of count)	Distance from the Project (km)
Fair Isle	1,875 (2004)	129
North Rona & Sula Sgeir	9,225 (2004)	157
Noss	8,652 (2003)	202
Forth Islands	48,065 (2004)	271
Hermaness, Saxa Vord and Valla Field	15,633 (2003)	274

Table 12.7: UK SPAs designated for breeding gannet within mean maximum foraging range (308km)

12.5.1 Seabird populations in the Project area

12.63 Data recorded during the boat based surveys were used to generate estimates of bird densities within the survey area for each survey using observations of birds on the water, while data for birds observed on the sea surface obtained from the land based surveys were used to provide further information on seasonal and annual variation in relative abundance.

12.64 During the 22 boat surveys, a total of 13,248 individuals comprising 19 species were recorded on the sea within the transect area. During land-based surveys a total of 21,568 individuals were recorded during distribution scans, comprising 24 species and 2 species groups (Table 12.8).

Species (sensitivity based on conservation status indicated by colour: see Table 12.4 for explanations)	Species listed as SPA feature or component of SSSI feature (if not SPA feature)	Land based surveys		Boat based surveys (birds on sea)		
		Sum of maximum single survey counts (i.e. sum of survey counts)[1]	Maximum single survey count (i.e. peak day count)[2]	Total number of individuals recorded[3]	Peak density (birds/km²)[4]	Peak abundance in the turbine deployment area (1.1km²)[5]
Northern fulmar (*Fulmarus glacialis*)	SPA	1,935	300	2,156	13.12	16
Northern gannet (*Morus bassanus*)	SPA	1,162	500	162	0.99	1
Great cormorant (*Phalacrocorax carbo*)	SPA	38	3	1	-	-
European shag (*Phalacrocorax aristotelis*)	SPA	10,953	1,300	4,744	17.96	21
Common gull (*Larus canus*)	-	200	60	259	12.84	15
Great skua (*Stercorarius skua*)	SPA	1	1	39	0.47	<1
Arctic skua (*Stercorarius parasiticus*)	SPA	2	2	-	-	-
Black legged kittiwake (*Rissa tridactyla*)	SPA	333	110	14	0.12	<1
Herring gull (*Larus argentatus*)	SPA	-	-	61	0.75	<1
Iceland gull (*Larus glaucoides*)	-	1	1	-	-	-
Great black-backed gull (*Larus marinus*)	SPA	-	-	208	2.05	2
Unidentified gull	-	2,370	1,520	-	-	-
Arctic tern (*Sterna paradisaea*)	SPA	95	80	-	-	-
Common guillemot (*Uria aalge*)	SPA	56	12	815	23.92	27
Razorbill (*Alca torda*)	SPA	248	34	332	7.95	9
Atlantic puffin (*Fratercula arctica*)	SPA	138	30	690	12.48	14
Black guillemot (*Cepphus grylle*)	SSSI	482	55	2,504	15.87	18
Unidentified auk	-	1,150	400	-	-	-
Great northern diver (*Gavia immer*)	-	2	1	3	-	-
Red-throated diver (*Gavia stellata*)	SPA	109	14	27	0.3	<1
Red-breasted merganser (*Mergus serrator*)	-	31	6	-	-	-
Common eider (*Somateria mollissima*)	-	1,961	99	1,045	7.76	9
Wigeon (*Anas penelope*)	SPA	24	10	50	1.56	2
Greylag goose (*Anser anser*)	SPA	260	150	124	-	-
Grey plover (*Pluvialis*	-	-	-	14	-	-

Species (sensitivity based on conservation status indicated by colour: see Table 12.4 for explanations)	Species listed as SPA feature or component of SSSI feature (if not SPA feature)	Land based surveys		Boat based surveys (birds on sea)		
		Sum of maximum single survey counts (i.e. sum of survey counts)[1]	Maximum single survey count (i.e. peak day count)[2]	Total number of individuals recorded[3]	Peak density (birds/km^2)[4]	Peak abundance in the turbine deployment area (1.1km^2)[5]
squatarola)						
Common scoter (*Melanitta nigra*)	SPA	1	1	-	-	-
Gadwall (*Anas strepera*)	-	6	2	-	-	-
Goldeneye (*Bucephala clangula*)	-	5	3	-	-	-
Long-tailed duck (*Clangula hyemalis*)	-	6	3	-	-	-
Pintail (*Anas acuta*)	-	1	1	-	-	-

Notes:
[1] *The sum (across all surveys) of the peak count made during each 3 hour duration survey.*
[2] *The peak count recorded during the two years of surveys (i.e. the highest number observed within the survey area during any single 3 hour duration survey).*
[3] *Represents the total of number of bird observations recorded on the water during all boat surveys.*
[4] *Estimated by applying Distance analysis to the birds observed on the water recorded during each survey. The value reported here is the highest density recorded across all boat surveys.*
[5] *Represents the peak abundance of birds on the water within the turbine deployment area during a single survey. This was derived as the product of the peak density multiplied by the Phase 1 area.*

Table 12.8: Total number of birds recorded on the sea during land and boat based surveys between October 2009 and September 2011. Boat based density and abundance estimates calculated using Distance analysis of birds observed on sea surface in transects. For those species considered in this assessment, names are colour coded according to their defined sensitivity (see Table 12.4)

12.65 Among the 29 species recorded in total, several form part of the SPA citations in Table 12.6 and Table 12.7, either qualifying under (i) Article 4.1 of the Directive (2009/147/EC) by supporting populations of European importance listed on Annex I of the Directive; (ii) Article 4.2 of the Directive (2009/147/EC) by supporting populations of European importance of migratory species; or (iii) forming part of a seabird assemblage of international importance under Article 4.2.

12.66 Species sensitivity was evaluated by considering a range of criteria concerning the importance of both the numbers of birds on the site and/or the overall conservation status of the species, and whether the species is protected under certain legislation, or is a cited interest feature of a designated site of national or international importance. The sensitivity categories of the ornithological receptors are defined in Table 12.4. Thus, density and peak population data from the boat surveys were used, but at this stage ecological and behavioural characteristics that might affect the species' response to the Project and its construction and decommissioning were not evaluated.

12.67 Target species for assessment were chosen from the list of species listed within local SPAs and non-SPA seabird colonies by evaluating boat and land-based survey data and determining species occurrence in the study area. Individuals were assumed to originate from seabird colonies in the region, defined as those within the mean maximum foraging range of the Project site. This list primarily focussed on species which forage at sea at depths which could put them at risk of direct impact (either through displacement or collision). However, additional species which do not dive to such depths were included to reflect the potential for indirect impacts mediated through effects on prey species. Some species which were not recorded in large numbers were also included, for example, in acknowledgement of their wider conservation status.

12.68 The species selected which were observed during the boat surveys are listed in Table 12.9. Peak populations which exceed 1% of the national threshold are classified as nationally important populations; peak populations which exceed 1% of the regional population threshold are classified as regionally significant. Two additional species, only seen during the land based surveys (cormorant and Arctic tern) were also considered at potential risk and included in the baseline descriptions and impact assessment.

12.69 Although wigeon, common scoter and greylag goose are technically of very high sensitivity (Table 12.8), due to them being SPA qualifying species within potential foraging range of the development site, these species are not considered further for detailed assessment. Wigeon and common scoter are qualifying species of the Caithness and Sutherland SPA during the breeding season, however no observations of either species were made within this period. The infrequency of records and relatively small numbers of each species in the winter periods, compared to overall migratory numbers are insignificant, and so no effects are predicted. For greylag goose (qualifying for the Caithness Lochs SPA over winter), although occasional records were made during boat and land surveys of birds loafing on the sea, the species will not utilise the offshore Project area for foraging, and so no effects are predicted. All three species are however considered in relation to the potential terrestrial effects of the development on bird species.

Species (sensitivity based on conservation status indicated by colour: see Table 12.4 for explanations)	Estimated Peak Population in turbine deployment area		Number of individuals required to meet GB 1% Threshold[1]	Nationally Important Population as determined by 1 % threshold ?	Mean maximum foraging range (km)[2]	Regional Population (number of breeding birds within mean maximum foraging range[3])	Regionally Important Population?
	Winter (Oct-Apr)	Summer (May-Sep)					
Northern fulmar	15	7	9,975	No	311	396,698	No
Gannet	1	1	4,371	No	308	44,718	No
Cormorant	NA	NA	350	No	32	0	No
European Shag	21	16	5,200	No	16	628	Yes
Great skua	<1	<1	193	No	42	4,816	No
Arctic skua	NA	NA	43	No	40	1,582	NA
Common gull	15	<1	4,293 (winter) 963 (summer)	No	50	8,572	No
Herring gull	<1	<1	2,772 (winter) 4,500 (summer)	No	54	10,686	No
Great black-backed Gull	2	<1	342 (winter) 400 (summer)	No	40	5,460	No
Black legged Kittiwake	<1	<1	7,337	No	66	262,740	No
Arctic tern	NA	NA	530	No	12	1,508	NA
Common guillemot	3	27	13,224	No	61	278,874	No
Razorbill	4	9	1,645	No	31	6,971	No
Black guillemot	18	16	381	No	12	431	Yes
Atlantic puffin	14	12	11,614	No	62	4,088	No

Species (sensitivity based on conservation status indicated by colour: see Table 12.4 for explanations)	Estimated Peak Population in turbine deployment area		Number of individuals required to meet GB 1% Threshold[1]	Nationally Important Population as determined by 1 % threshold ?	Mean maximum foraging range (km)[2]	Regional Population (number of breeding birds within mean maximum foraging range[3])	Regionally Important Population?
	Winter (Oct-Apr)	Summer (May-Sep)					
Red-throated diver	<1	0	41	No	12	479	No
Eider	9	4	550 (winter) 624 (summer)	No	38	Unknown	Unknown

Notes:
[1] As determined using GB population estimates given by Baker et al. (2006) or Holt et al. (2011).
[2] Defined as the mean of the maximum foraging distances from the range of studies and data sources held by BirdLife International – http://seabird.wikispaces.com.
3 As determined using data from Mitchell et al. (2004) and the JNCC Seabird Monitoring Programme (http://jncc.defra.gov.uk).

Table 12.9: Estimated peak abundance of target species in the turbine deployment area, recorded during boat surveys compared to regional and national abundance thresholds

12.70 The monthly density for each of the target species derived using Distance analysis of birds observed on the sea surface during the boat surveys, averaged over the two years of surveys is presented in Table 12.10. This overview highlights the patterns of site use among the target species, with auks present at densities in the breeding season (although black guillemot are present in higher numbers through most of the year), the gulls, eiders and red-throated divers present in higher densities in winter (albeit at much lower overall levels), gannets present in very low densities in most months and shag present in higher densities throughout most of the year.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern fulmar	2.69	11.32	8.29	3.33	3.20	4.08	5.11	1.42	1.06	-	0.64	1.73
Northern gannet	0.28	-	0.15	0.79	0.09	0.40	0.13	0.02	0.25	0.81	0.10	-
European shag	9.27	12.59	14.43	8.18	7.70	7.16	9.05	10.08	8.68	3.56	12.36	2.18
Great skua	-	-	-	0.10	0.11	0.29	0.09	0.09	0.10	-	-	-
Common gull	0.06	6.44	0.07	0.04	-	0.04	-	0.05	-	-	0.13	-
Herring gull	0.37	0.43	0.46	-	-	-	-	0.04	-	-	0.32	0.06
Great black-backed gull	1.17	0.98	0.62	0.09	-	0.01	0.07	0.03	0.02	0.15	0.15	0.04
Black-legged kittiwake	0.02	0.07	0.06	0.04	-	0.02	0.02	-	0.02	-	0.02	0.05
Common guillemot	-	1.38	1.71	1.92	4.31	5.79	12.33	0.09	0.61	0.50	0.53	0.08
Razorbill	-	-	1.53	1.79	3.38	0.89	4.02	-	0.05	0.39	0.09	-
Black guillemot	6.76	11.62	13.78	13.17	11.33	7.32	7.54	6.16	1.52	0.17	4.04	4.95
Atlantic puffin	-	-	0.03	6.70	3.42	8.70	2.66	0.07	-	-	0.08	-
Red-throated diver	0.06	0.08	0.21	0.04	-	-	-	-	-	-	0.02	-
Eider	2.28	5.68	4.64	0.37	0.05	0.02	1.65	-	-	0.19	2.08	1.68

Key to shading:

(no shading)	< 2.0 birds/km2
(pale yellow)	2.01 – 6.0 birds/km2
(amber)	6.01 – 10.0 birds/km2
(orange)	>10.01 birds/km2

Table 12.10: Average monthly density of birds observed on the sea surface during boat surveys of the Project site

12.71 For each of the target species selected for inclusion in the impact assessment, population densities for the boat based survey area are presented below, together with data on the seasonal, annual and spatial distribution across this area. Land-based survey data are also presented to augment the boat data in providing information on seasonal and annual variation in species occurrence and abundance. While the seasonal trends for the boat data present the estimates for each survey, to aid clarity, the land based observations have been combined into a single monthly estimate across all years. The designated sites (SPAs and SSSIs) within foraging range for which each species is a qualifying feature are also indicated. The exact connection between the SPA populations of these species on designated sites and those using the Project area are examined in more detail in the HRA.

Northern fulmar

12.72 Northern fulmars (hereafter fulmar) are one of the most common seabirds all year round in northern Britain. Adults show no pronounced pattern of migration, but rather disperse from the colonies at the end of the breeding season and return to nest the following year (Mitchell *et al*., 2004). The highest numbers of fulmar in the north and west of Scotland, including Shetland, occurs between March and April and continues into July with high numbers of birds around nest sites at this time. Between August and November the distribution of fulmars extends southwards as birds disperse from their breeding colonies. In the months between December and February, the highest densities of fulmar remain in the vicinity of Shetland, Orkney and the Moray Firth (Stone *et al*., 1995). Fulmars feed at sea on a wide range of marine foods, notably zooplankton, small fish and offal from fisheries, with the importance of different food sources varying geographically and temporally, both within and between years (Mitchell *et al.* 2004). Most feeding is by surface-seizing whilst floating or swimming, and rarely by pursuit plunging during which they may reach depths of over 4m (Cramp & Simmons, 2004).

12.73 The European population of fulmar is between 2.8 and 4.4 million pairs, and is considered stable (Burfield & van Bommel, 2004). Great Britain supports over 500,000 pairs, or between 11% and 18% of the European total population, most of which breed in Scotland. Although the overall population is stable and appears to be undergoing continued range expansion, fulmar are recognised as a species of conservation concern in Britain as over 50% of the breeding population occurs within ten breeding sites (Eaton *et al*., 2009). Mitchell *et al*. (2004) recorded an overall increase of 4% in numbers across Caithness and Orkney since the late 1980s, but with some geographical variations in this trend, and with the increase driven largely by changes on Orkney.

12.74 Mitchell *et al*. (2004) recorded a total of 120,803 Apparently Occupied Sites (AOS) in Orkney, Caithness and the East Sutherland coast, whilst a further 23,200 were recorded on the northwest Sutherland coast (some of which will be in the vicinity of the MeyGen site) during the Seabird 2000 survey programme, compared to a total of 485,852 AOS in the whole of Scotland (of which 279,390 were in Shetland and Orkney). The Seabird Monitoring Programme database yields an estimate of 60,700 pairs in Orkney counted during the Seabird 2000 census (Mitchell *et al*., 2004).

12.75 The peak density of birds recorded on the survey area was 13.12per km^2. Boat surveys recorded fulmar activity on the survey area year round with only October 2009 and November 2010 surveys failing to record any birds. Numbers were highest between March and August when adults were attending nests, but with a marked pre-breeding peak, when birds have recently returned to their nesting sites. In terms of the distribution within the survey area, birds occurred throughout the site in most seasons, but with the greatest concentrations occurring in the western and northern parts of the area (Figure 12.3). Fulmar are qualifying interests of the following SPAs in the North of Scotland and Orkney region: North Caithness Cliffs, Hoy, East Caithness Cliffs, Copinsay, Rousay. Calf of Eday, West Westray and Cape Wrath (other SPAs may need to be considered in the HRA).

Northern gannet

12.76 Great Britain is home to over half of the world breeding population of northern gannet (hereafter gannet), which is estimated to be about 390,000 pairs (Mitchell *et al*., 2004). Gannets return to their breeding colonies from early January, tending to be a month or so later in the most northern British colonies; many British breeders having spent the autumn and early winter months in waters around southern Europe and north Africa. Colony attendance is variable until April when the first eggs are laid (Cramp & Simmons, 2004). Gannets are an opportunistic, generalist, predator that feed on a wide variety of prey, mostly surface schooling fish and squid, but also discards from trawlers (BirdLife International, 2011). They appear to focus foraging activities on bathymetric features probably associated with high primary productivity (e.g. deep-water depressions and sandbanks) and, when foraging, employ both short dives of a few metres only and longer dives (up to 30 seconds), taking them to depths of 20m or more (BirdLife International, 2011; Mitchell *et al*., 2004). Dive behaviour studies undertaken during the present surveys recorded an average dive duration of approximately seven seconds for gannet, but this was derived from only six observations.

12.77 Gannet is of conservation concern within the UK, being Amber listed (i.e. of moderate concern) in the UK's Birds of Conservation Concern (BoCC) (Eaton *et al*. 2009). This is on the basis of the international importance of the British population, which represents over 20% of the European breeding population. Furthermore, over half of the British gannet breeding population occurs at less than ten sites. The Scottish gannet population accounts for 70% of the GB population (Mavor *et al*., 2006).

12.78 Site Condition Monitoring of gannet colonies in north east Scotland has revealed significant increases in the breeding population, with an annual rate of increase of 8 % between 2001 and 2004 (Murray *et al*., 2006).

12.79 At a distance of 82km, Sule Stack is the closest breeding colony to the Project site. Numbers here were estimated as 5,137 apparently occupied nests (AONs) in 1998-2000 (Mitchell *et al*. 2004). Numbers at this colony have fluctuated in the last few decades, with a decline of 17% between the mid 1990s and mid 1980s, followed by a 5% increase from the mid 1990s to 1998-2000 (Mitchell *et al*., 2004).

12.80 The peak density of birds recorded on the survey area was 0.99 birds per km^2 (April 2010). Numbers estimated across the survey area were variable both throughout the year and across the two years of study. There were no readily discernible patterns in the distribution of gannet records across the survey area (Figure 12.4). Gannet are qualifying interests of the following SPAs in the North of Scotland region: Orkney and Shetland region: Forth Islands, Sule Skerry and Sule Stack, Fair Isle, North Rona and Sula Sgeir, Noss and Hermaness, Saxa Vord and Valla Field.

Great cormorant

12.81 The great cormorant (hereafter cormorant) is a species that occupies both marine and freshwater habitats. In the marine environment it is generally associated with sheltered coastal areas in estuaries, coastal bays and similar habitats, and generally avoids deep water and areas that are far offshore (BirdLife International, 2011). At sea, the species feeds primarily upon bottom-living fish over bare or vegetated substrates (e.g. flatfish, blennies and gadoids), but will also take schooling fish (e.g. sandeels).

12.82 The cormorant is listed as a species of low conservation concern in Europe, with an estimated 55,000 pairs, of which the UK number is an estimated 6,824 pairs (Mitchell *et al*., 2004), representing 12%. Just over half of these breed in Scotland, with Orkney (412 AON) and Caithness (107 AON) accounting for 14% of this total.

12.83 No cormorant were observed during the boat surveys of the Inner Sound, however they were observed on the sea on 30 occasions from the land based surveys, of which only five were between April and August (inclusive, taken as the breeding season, Snow and Perrins, 1998). It thus appears that the Inner Sound is not an important site for this species during the breeding season. Most observations were of individual birds (83% of records) with the largest flock observed comprising four birds. It is not possible to estimate a density for this species from the land observations because Distance analysis could not be applied to land-based data (due to the confounding effects of variations in bird density with distance from the shore and with distance from the observer). The only SPAs for which cormorant are a qualifying interest in the North of Scotland and Orkney region are East Caithness Cliffs and Calf of Eday (other SPAs may need to be considered in the HRA).

European shag

12.84 The European shag (hereafter shag) is a largely sedentary species that shows a strong preference for rocky coasts and islands with adjacent deep water. Primarily an inshore species, shags tend to forage over sandy and rocky seabeds, showing preferences for sheltered fishing grounds, such as bays and channels, although generally avoiding estuaries and shallow inlets (BirdLife International, 2011). Shags feed almost exclusively on fish, taking a wide range of benthic, demersal and pelagic species, but with sandeels predominating in most dietary studies at British colonies (BirdLife International, 2011). Other prey that are commonly taken include gadoids, gobies, flatfish and sea scorpions. Foraging often involves deep dives, and studies show a wide range of dive depths (e.g. 4m to 61 m at Sumburgh Head, Shetland), with mean dive depths of approximately 20m to 30m. Dive depths may also vary significantly between years at the same site (BirdLife International, 2011). Dive durations recorded during the present surveys differed between the breeding (May to July) and non-breeding periods, averaging 47 seconds and 96 seconds, respectively.

12.85 The shag is listed as a species of low conservation concern in Europe, with between 75,000 and 81,000 breeding pairs. The estimated number of pairs in the UK is 27,477 breeding pairs (Baker *et al*., 2006), comprising 38.3% of the bio-geographic population and 34.1% of the global population (Mitchell *et al*., 2004). This species is of moderate conservation concern (Amber-listed) in the UK due to its localised populations and recent breeding population decline.

12.86 Eighty percent of the breeding European shag population in Britain nests in Scotland. Of these birds, 3,008 AONs are estimated to occur in Orkney and Caithness. There are a further 880 AONs on the northwest Sutherland coast, some of which may occur within the vicinity of the Project site (Mitchell *et al*. 2004). Breeding birds in these areas are often resident year round, generally remaining close to colonies and foraging close to shore.

12.87 In keeping with the national trend, numbers of European shag have declined in both Orkney and Caithness over the last few decades, with declines of 26% and 57%, respectively, recorded in these areas between the mid 1980s and 1998-2000 (Mitchell *et al*., 2004).

12.88 The peak density of birds recorded on the survey area was 17.96 per km^2, with relatively high numbers of birds present on the survey area year-round. The lower abundance of birds recorded during the summer period coincides with birds attending nests and chicks at colonies. Birds were relatively evenly distributed across the survey area during the pre-breeding (February to April) and winter (November to January) periods, but showed a distinct concentration in the northern half of the area (and particularly in the areas immediately south of Stroma) during the breeding (May to July) and post-breeding (August to October) periods (Figure 12.5). The only SPAs for which shag are a qualifying interest in the North of Scotland and Orkney region are East Caithness Cliffs and Sule Skerry and Sule Stack (other SPAs may need to be considered in the HRA).

Common gull

12.89 The common gull is a widespread breeder across Europe and is equally adapted to breeding on exposed marine coasts as it is to inland sites, which may be close to or far from water (Cramp & Simmons, 2004). Seacoast breeding sites include small inshore rocky stacks, islands, cliff ledges and shingle banks, whilst the main prey taken by birds occupying marine environments are likely to comprise invertebrates (e.g. bivalves and crustaceans) and fish, with the latter being taken by direct predation, kleptoparasitism and scavenging. Predation of fish is largely by surface-seizing of prey, and plunge-diving is rare (Cramp & Simmons, 2004).

12.90 The European population is estimated to be in excess of 590,000 pairs (Burfield & van Bommel, 2004). There have been recent declines in numbers across much of north-west Europe and the population is classed as depleted, so that it has an unfavourable conservation status within Europe (Burfield & van Bommel, 2004). Within the UK, the species has increased in recent decades but is classed as of moderate conservation concern (Amber-listed) on the basis of it's unfavourable European conservation status, as well as the international importance of the UK wintering population is (Eaton *et al*., 2009).

12.91 Mitchell *et al*. (2004) estimated that there were 11,733 AONs in Orkney, Caithness and the East Sutherland coast, with the vast majority of these (11,141) being in Orkney. This represents almost 25% of the British breeding population. An estimated 453 AONs were recorded on the North Caithness coast. Numbers in Orkney and Caithness have increased over recent decades, with increases of 37% in Orkney and of 208% in Caithness between the mid 1980s and 1998 to 2000 (Mitchell *et al*., 2004).

12.92 Common gull were mostly recorded in low numbers during the winter, with a marked peak in February 2010 giving a density of 12.8 per km^2. This equated to a peak abundance of 176 individuals within the survey area. In no other month was the abundance greater than three individuals. The distribution of sightings across the Inner Sound indicates the presence of a few large flocks, as would be expected for wintering gulls (Figure 12.6). Common gull are not a qualifying feature for any of the SPAs or SSSIs in the North of Scotland and Orkney region.

Great skua

12.93 The British population of great skuas represents 61% of the northern hemisphere population of this species (with the northern hemisphere population representing the world population of the nominate subspecies of this polytypic species). The entire British population breeds in the far north of Scotland, and primarily in Shetland (Forrester *et al*., 2007). The species is migratory, typically wintering off Iberia and northwest Africa, with birds leaving their breeding areas in late summer and returning in March to April (BirdLife International, 2011). A wide range of prey is taken by great skuas, notably fish, discards from trawlers and other seabirds, and there may be considerable annual, seasonal and geographic variation in diet, whilst particular individuals may also specialise on particular prey-types. The main fish species in the diet include sandeels, whiting, haddock and herring, and these are taken by splash diving, surface seizing or kleptoparasitising other seabirds. During the breeding season, some birds may forage far offshore (possibly 50km to 100km from their breeding site), although others remain much closer to their breeding areas, whilst foraging is concentrated in offshore and pelagic zone outside the breeding season (BirdLife International, 2011).

12.94 Great skuas are of moderate conservation concern (Amber-listed) within the UK, on the basis of both the international importance of the population (exceeding 20% of the European population) and on its localised occurrence (at 10 or fewer sites). Mitchell *et al*. (2004) estimate there to be 9,600 apparently occupied territories (AOTs) in Britain; this count, however, was taken before the sandeel fishery collapse and is a peak number (Furness, 2007). Of these, 2,207 occurred on Orkney and five in Caithness. Numbers on Orkney have increased dramatically since the early 1970s (by 2,410%), but with most of that increase having occurred by the mid 1980s, since when there has been a 10% increase (Mitchell *et al*., 2004).

12.95 Great skuas are a summer visitor to Britain and spend their winters at sea, typically off Iberia (BirdLife International, 2011). Boat survey data reflect this, with birds recorded on the survey area between the months of April and September only, and a peak from June to August. A peak density of just 0.48 birds per km^2 was recorded on the survey area in 2011, when overall numbers were higher than in 2010. No discernible distributional patterns are apparent across the survey area, which is unsurprising given the scarcity of records overall (Figure 12.7). The only SPA for which great skua are a qualifying interest in the North of Scotland and Orkney region is Hoy (other SPAs may need to be considered in the HRA).

Arctic skua

12.96 The Arctic skua is a long-distance migrant, with small numbers wintering in the Northern Hemisphere. Individuals typically leave the breeding area in August, and returns in April-May (seabird.wikispaces.com).

12.97 In the breeding season, this species breeds in moorland or grassland. Individuals typically obtain food through kleptoparasitism on other seabird species, but can also take wader chicks, bird's eggs, insects and berries (BirdLife International, 2011). Birds generally do not have a specific foraging habitat; rather their foraging areas are determined by the opportunities for kleptoparastism, so the birds are commonly found around colonies of host species. Consequently, it is likely they obtain most of their prey without venturing far out to sea.

12.98 Arctic skua is listed as a species of low conservation concern in Europe, with an estimated 20,000-40,000 pairs, of which the UK number is an estimated 2,136 pairs (Mitchell et al., 2004), representing upwards of 5%. All of these breed in Scotland, with Shetland (1,120 AOT) and Orkney (720 AOT) accounting for 86% of this total. Caithness holds around 3% (71 AOT).

12.99 No cormorant were observed on sea during the boat surveys of the Inner Sound, however they were observed in flight on eight occasions between May and August 2010, with a single individual in June 2011. Only one bird was observed on land-based surveys, in May 2010. It thus appears that the Inner Sound is not an important site for this species during the breeding season. As would be expected, nearly all observations were of individual birds with two birds recorded simultaneously on one occasion. It was not possible to estimate an accurate density for this species from the boat or land observations as there were insufficient counts for Distance analysis. The only SPA within foraging range for which Arctic skua is Hoy.

MEYGEN
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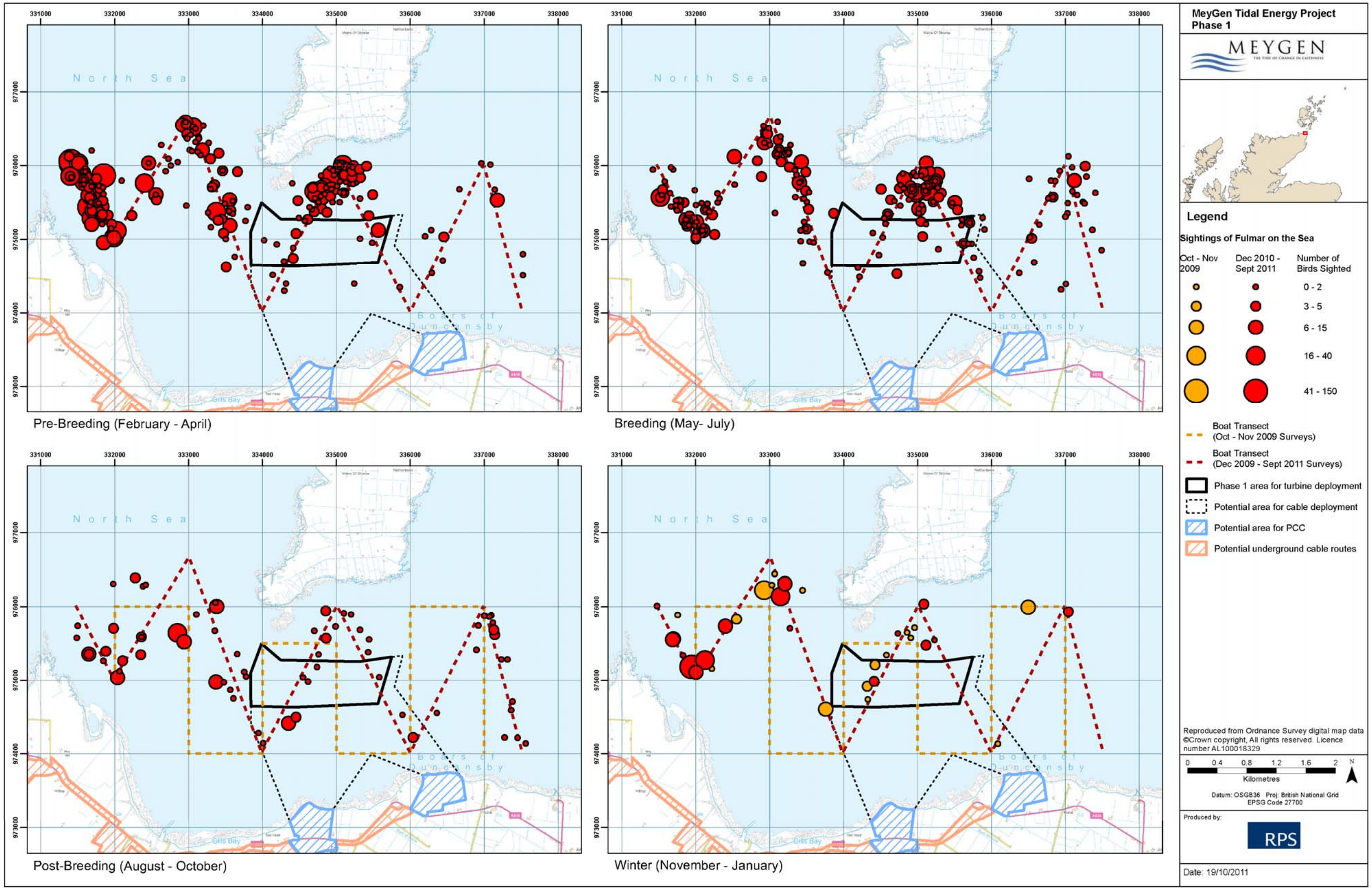

Figure 12.3: Boat based observations of northern fulmar recorded between October 2009 and September 2011

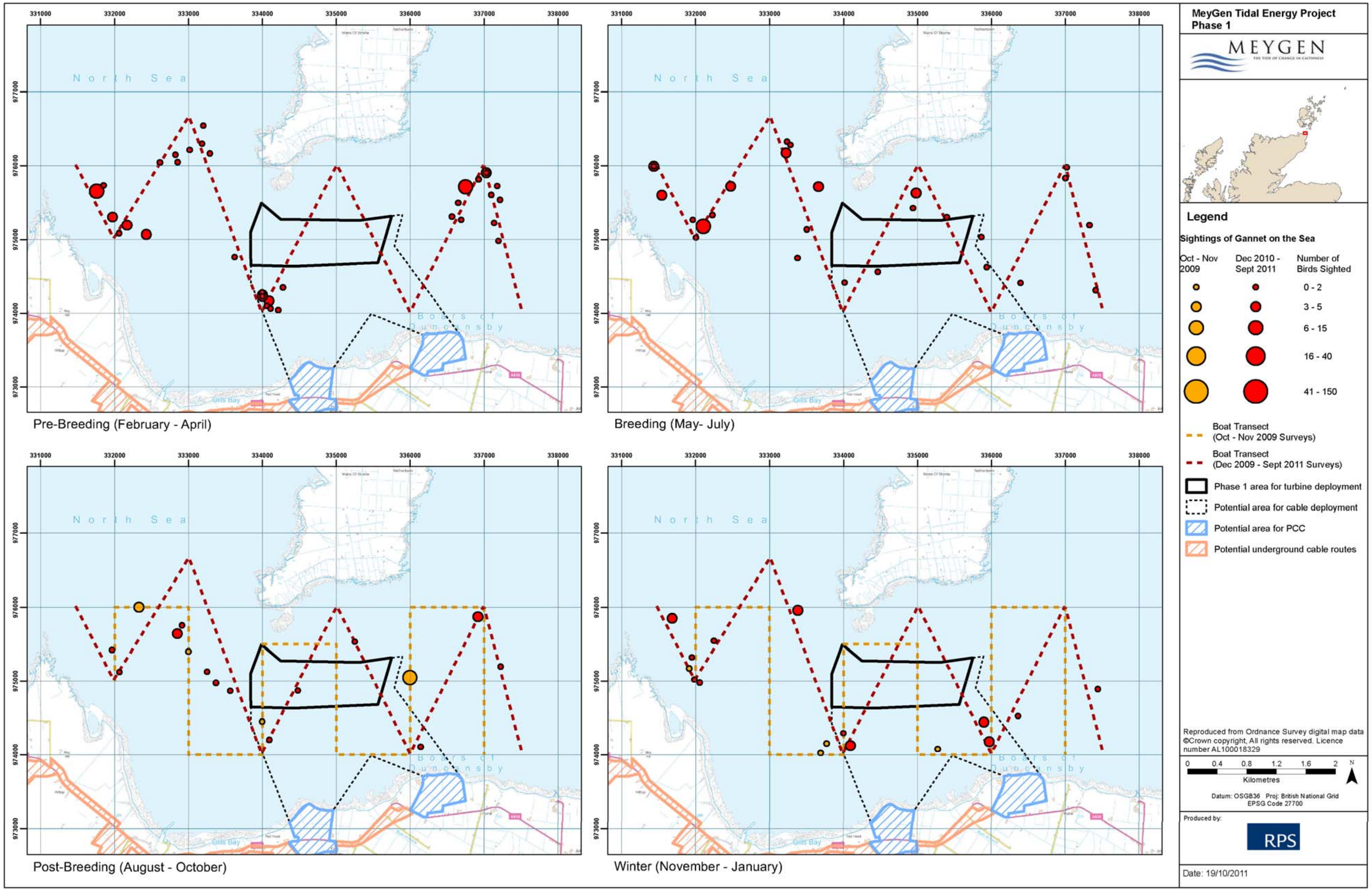

Figure 12.4: Boat based observations of northern gannet recorded between October 2009 and September 2011

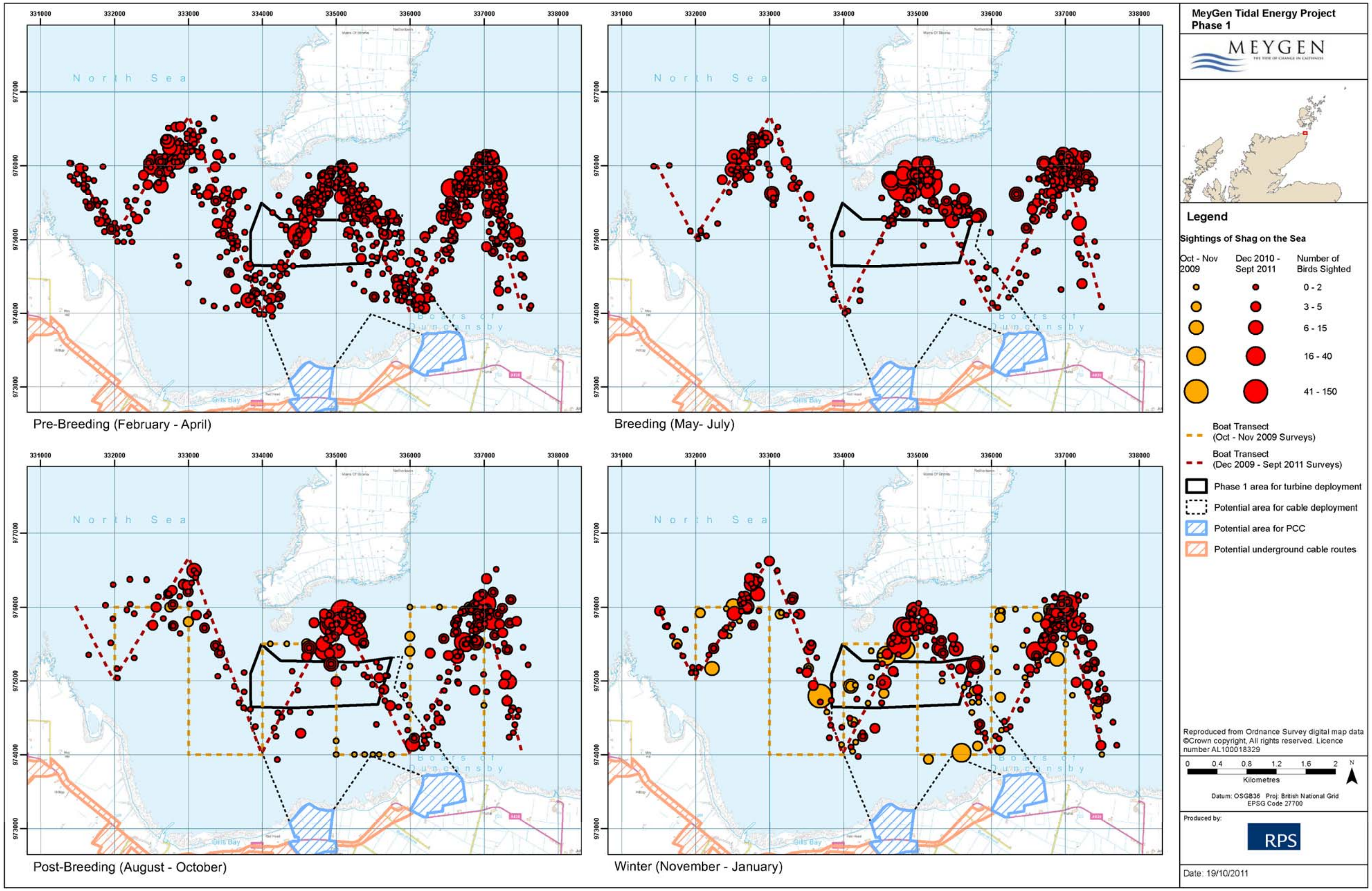

Figure 12.5: Boat based observations of shag recorded between October 2009 and September 2011

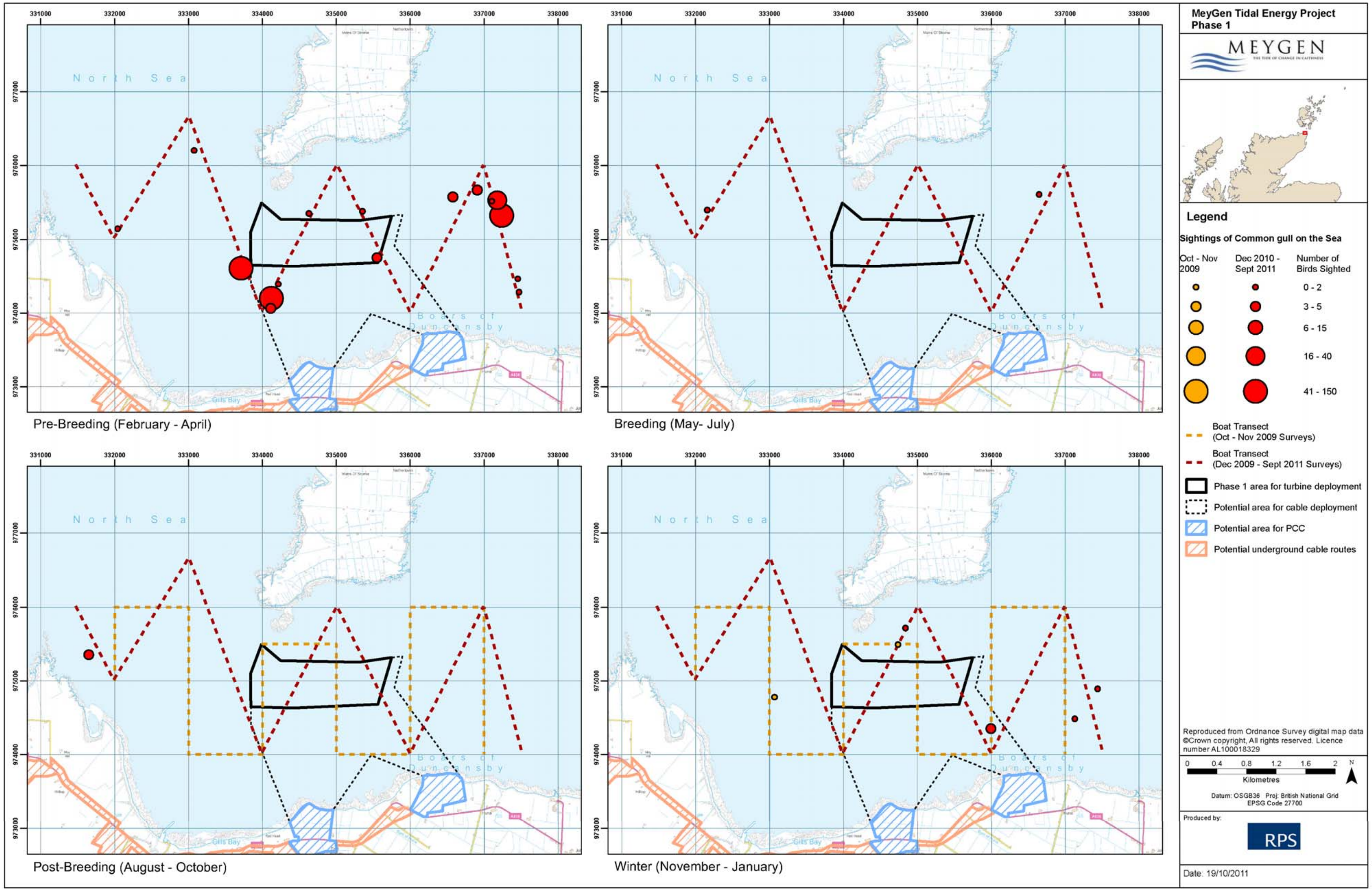

Figure 12.6: Boat based observations of common gull recorded between October 2009 and September 2011

Black-legged kittiwake

12.100 The European population of black-legged kittiwake (hereafter, kittiwake) of 2.1 to 3 million pairs has fluctuated over time and within different countries but has been provisionally evaluated as secure (Burfield & van Bommel, 2004). Kittiwakes are the most numerous breeding gull in Britain and Ireland with 415,995 pairs (Mitchell *et al*., 2004).

12.101 Kittiwakes are migratory, dispersing after the breeding season from coastal areas to the open ocean and returning to their breeding areas from January (BirdLife International, 2011). Breeding begins from mid-May to mid-June, with colonies located on high, steep, coastal cliffs with narrow ledges. The main foods of kittiwakes are marine invertebrates (e.g. squid and shrimps) and fish, with discards from trawlers also being taken. During the breeding season, small (15cm to 20cm) pelagic shoaling fish, such as sandeels, sprats and young herring, are of most importance. Prey are taken mainly from within a few metres of the sea surface, with surfaces-seizing and splash diving being the main foraging techniques employed. Thus, dive depths of >1m are considered unlikely (BirdLife International, 2011).

12.102 An estimated 131,000 birds breed in the North Caithness Cliffs SPA, with a further 40,410 breeding pairs recorded in the East Caithness Cliffs SPA, which between them account for nearly 10% of the kittiwake population in Great Britain and Ireland.

12.103 These high numbers are reflected in the distribution of kittiwakes between June and July, when the highest densities are found around the large breeding colonies in Orkney and the north and north east of Scotland (Stone *et al*., 1995). Outside the breeding season, the species is essentially pelagic as they disperse widely across the North Sea, although high densities remain in the Moray Firth between August and October (Stone *et al*., 1995). During the winter, it is likely that populations from many breeding localities mix together in the North Sea (Mitchell *et al*., 2004).

12.104 In recent years breeding colonies in the north east have experienced large declines in reproductive success. However, these declines have been least in those colonies in regions which do not border the North Sea (Mavor *et al*. 2004).

12.105 Kittiwakes have been recorded during boat surveys at low densities throughout most of the year. Peak sightings of birds in flight occurred between April and July, although the peak number of birds on the water was recorded in March (0.12 per km^2), equating to an estimated peak abundance of two individuals. There was no apparent pattern in the distribution of sightings across the study area (Figure 12.8). Kittiwake are qualifying interests of the following SPAs in the North of Scotland and Orkney region: North Caithness Cliffs, East Caithness Cliffs, Cape Wrath, Calf of Eday, Copinsay, Hoy, Marwick Head, Rousay and West Westray (other SPAs may need to be considered in the HRA).

Herring gull

12.106 Herring gulls are largely resident around the British coasts, showing limited short-distance movements between the breeding and wintering seasons. Rocky coastlines with cliffs, islets and offshore islands provide the preferred breeding habitats, although a range of other habitats (including buildings in urban areas) are used (Mitchell *et al*., 2004). As a predator, scavenger and kleptoparasite, the herring gull is an opportunistic feeder, taking a wide range of foods that may be obtained from terrestrial as well as marine habitats (e.g. earthworms, molluscs, crabs, fish, birds, waste from the fishing industry and landfill sites). When foraging at sea, food is obtained by a range of means, including surface-plunging, surface-seizing and shallow surface-diving (Cramp & Simmons, 2004).

12.107 Herring gulls are a species of low conservation concern in Europe, with a total population of between 660,000 and 900,000 breeding pairs. It is however a Red-listed species of conservation concern (i.e. of high concern) in the UK due to long-term declines in breeding and non-breeding populations. The UK population is approximately 139,200 pairs, or 12.1% of the global population (18% of bio-geographic population). Despite the increases in urban nesting, the total herring gull population is now at its lowest level since monitoring began in 1969/70. The Scottish breeding population was estimated at 71,659 breeding pairs in 2000 (Mitchell *et al*., 2004). However, the species is a Red-listed species of conservation concern in the UK due to long term declines in breeding and non-breeding populations. Despite the increases in urban-nesters, the total herring gull population is now at its lowest level since monitoring began in 1969/70.

12.108 The number of breeding pairs estimated within the mean maximum foraging range of the Project is 3,519 (JNCC Seabird Monitoring Programme database). Herring gulls were observed over winter in low numbers in the boat survey study area, with a peak density in February 2010 of 0.75 per km^2, equating to an abundance of 10 individuals in the boat survey area. No obvious spatial patterns were evident in the distribution of sightings (Figure 12.9). The only SPA in the North of Scotland and Orkney region for which herring gull are a qualifying species is East Caithness Cliffs (other SPAs may need to be considered in the HRA)

Great black-backed gull

12.109 An estimated 95,546 pairs of great black-backed gulls live along the edge of the Atlantic (Hagemeijer and Blair, 1997), with about 18,000 of those pairs residing in Britain (Mitchell *et al*., 2004). Of the British population, 85% breed in Scotland, with the majority of these populations occurring on Orkney, Shetland and the west coast (Lloyd *et al*., 1991), where there are extensive areas of the preferred breeding habitat of well-vegetated rocky coastline with stacks and cliffs. The species is resident within Britain & Ireland, and birds generally winter south of their breeding areas, with Scottish breeders making longer movements than those from more southerly locations (Cramp & Simmons, 2004). As for other large gull species, great black backed gulls are omnivorous, and rely to a large extent on both predation and scavenging for food. As such they take a wide range of foods, which often include substantial quantities of mammalian and avian prey, whilst they are also the most marine of the large gulls that breed in Britain and exploit discards from trawlers to a considerable extent (Mitchell *et al*., 2004).

12.110 An estimated 529 pairs breed within mean maximum foraging range of the Project (JNCC Seabird Monitoring Programme database), mostly in Orkney. The British breeding population does not migrate, but remains resident year round (Stone *et al*., 1995). Population declines of up to 30% have been recorded in the north of Scotland between 2003 and 2004, and complete colony failure occurred in several monitored locations in 1997 and 2003 (Mavor *et al*., 2004).

12.111 The peak density of foraging birds observed on the boat based study area was 2.05 per km^2 with an estimated peak winter abundance (January 2011) of 28 individuals in the boat survey area. Very few individuals of this species were seen during the breeding season (Figure 12.10). Great black-backed gull are qualifying interests of the following SPAs in the North of Scotland and Orkney region: East Caithness Cliffs, Calf of Eday, Copinsay and Hoy (other SPAs may need to be considered in the HRA).

Arctic tern

12.112 About 480,000 to 850,000 pairs of Arctic terns breed in Europe, with about 53,000 of these pairs nesting in Britain. The British breeding population constitutes 4.7% of the biogeographic population and 3.1% of the global population (Mitchell *et al.,* 2004). Of the British population, 47,306 pairs nested in Scotland, predominantly in Shetland and Orkney (Mitchell *et al.,* 2004). Arctic terns are notable long-distance migrants, returning to their British breeding grounds in May each year, where they nest on a range of habitats, such as wind-clipped heaths, shingle beaches and spits, rocky ground and small islands. Birds have a strongly inshore distribution during the breeding season, usually foraging within approximately 3km of their breeding colonies, although they may occasionally make much longer foraging trips (e.g. up to 50km away; BirdLife International, 2011). During migration they generally occur in the marine environment and often far offshore. Small fish, crustaceans and zooplankton comprise the bulk of the diet. Sandeels are particularly important during the breeding season in Britain, with saithe, herring and sprat amongst the other fish species recorded in the diet of British breeding birds (BirdLife International, 2011). Foraging is mainly by plunge-diving and surface-dipping, with dives unlikely to be deeper than 0.5m, although little information is available on diving depths (BirdLife International, 2011).

12.113 Although Arctic tern are not of concern in Europe or worldwide, they are of moderate conservation concern (i.e. Amber listed) in the UK due to recent population declines.

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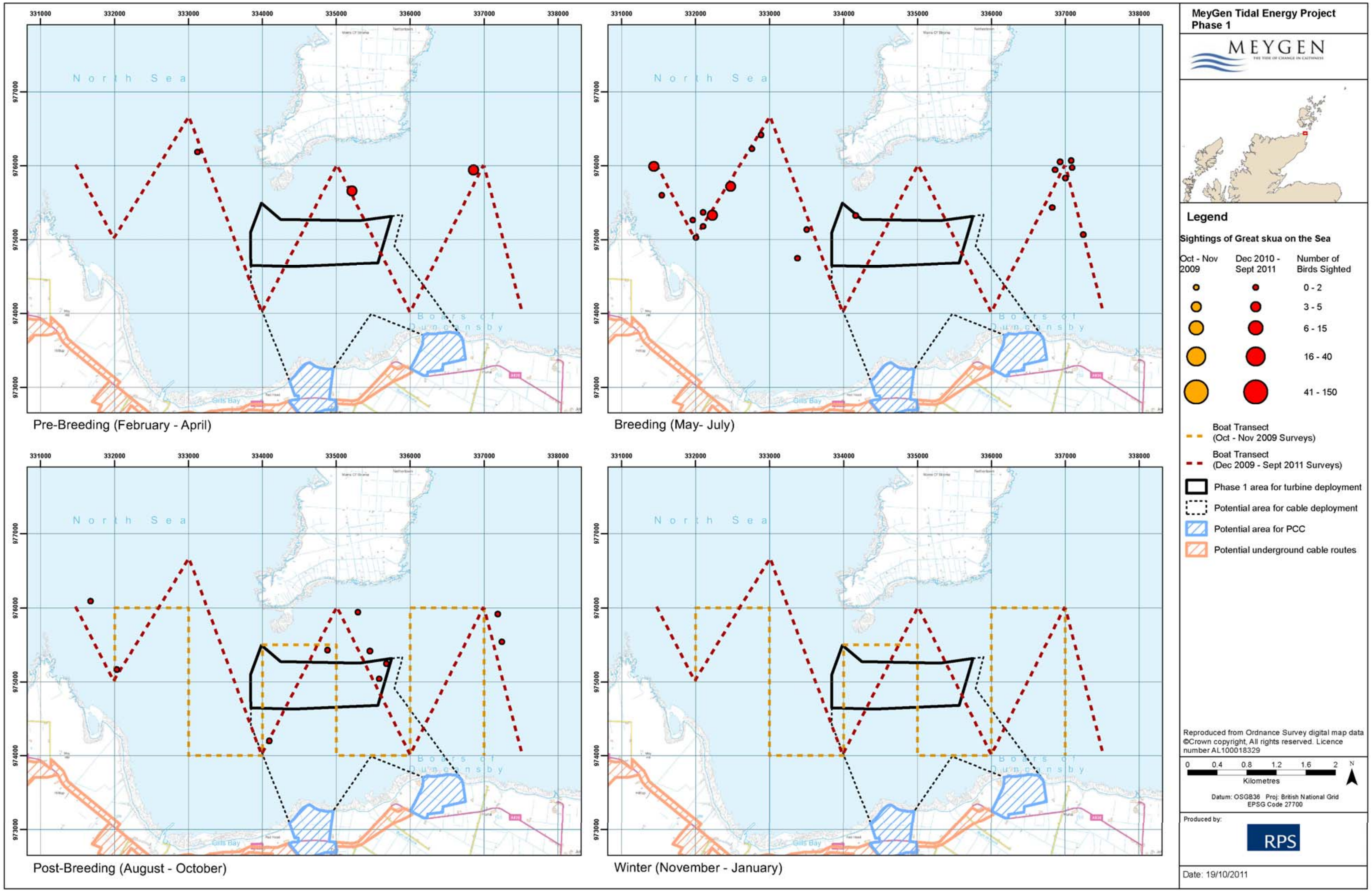

Figure 12.7: Boat based observations of great skua recorded between October 2009 and September 2011

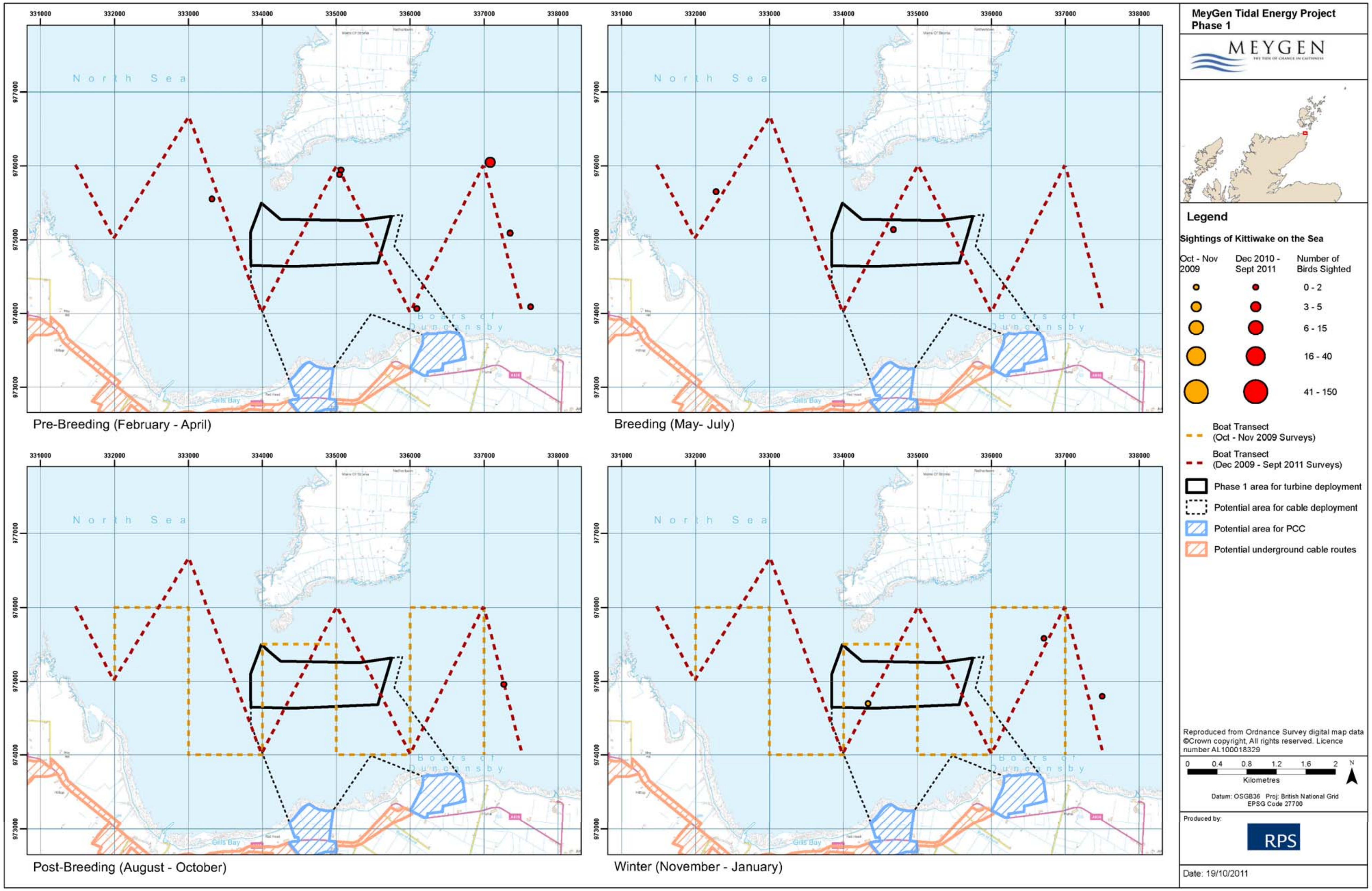

Figure 12.8: Boat based observations of black legged kittiwake recorded between October 2009 and September 2011

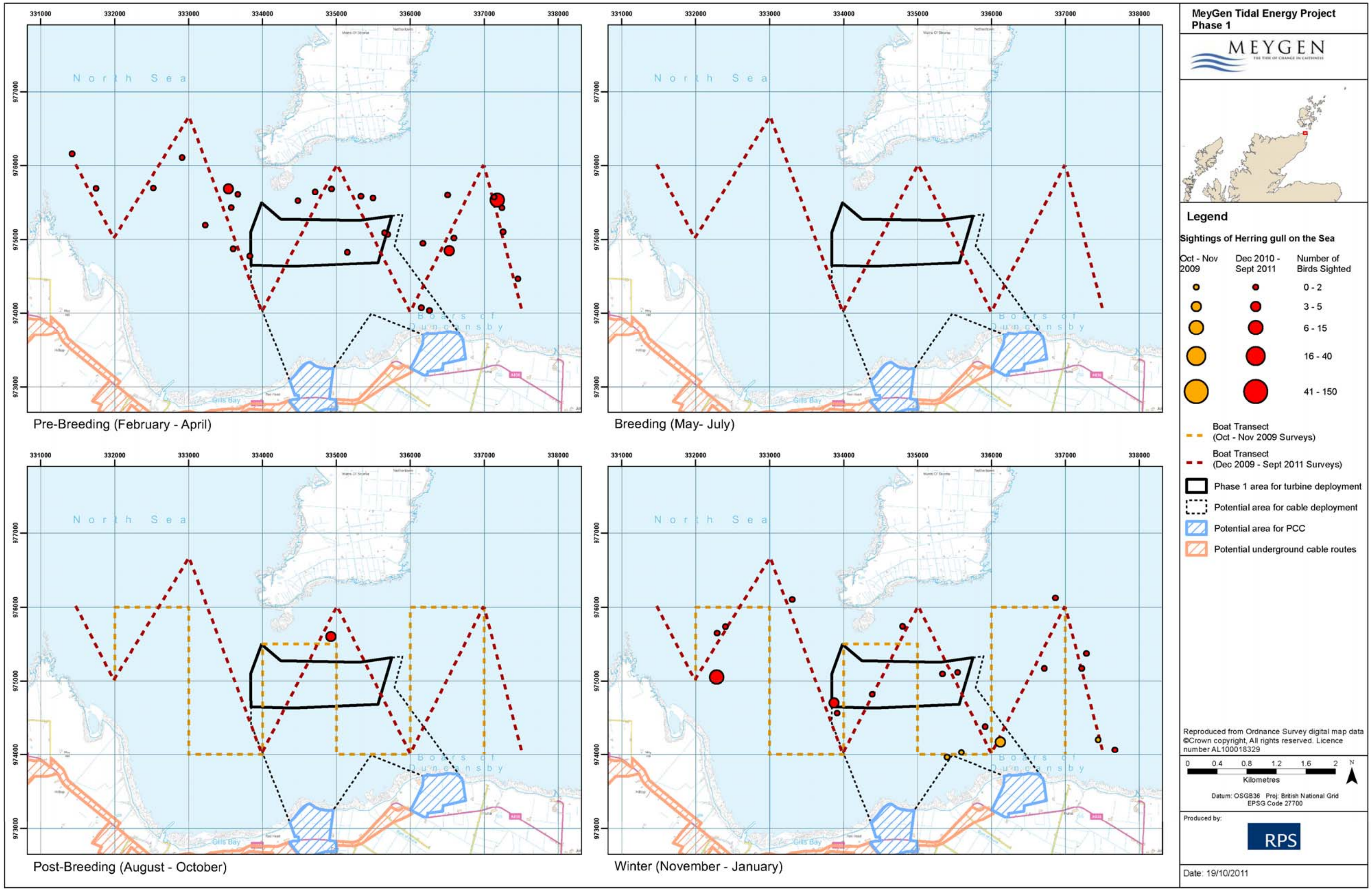

Figure 12.9: Boat based observations of herring gull recorded between October 2009 and September 2011

12.114 No Arctic tern were seen during the boat surveys, however they were observed on six occasions during May, June and July 2010 during the land based surveys. Flock sizes varied from 1 to 80, but it is not possible to estimate a density for this species from the land observations. It thus appears that the Inner Sound is used by this species at a low level during the breeding season. Arctic tern are the qualifying interests of the following SPAs in the North of Scotland and Orkney region: Pentland Firth Islands, Auskerry, Papa Westray, Rousay and West Westray (other SPAs may need to be considered in the HRA).

Common guillemot

12.115 Common guillemots return to their British breeding colonies in March or April each year, with many of the adults having wintered offshore usually within a few hundred kilometres of the colony. British breeding colonies are mainly on steep cliff faces, with most foraging during the breeding season occurring within 10km to 20km of the colony, although foraging distances of over 100km have been recorded (BirdLife International, 2011). Schooling pelagic fish (mostly sandeel, herring, sprat, capelin and gadoids) are the principal food of common guillemots, with crustaceans also important in some instances. Prey are caught by pursuit diving, with birds generally diving from the surface, typically to depths of less than 50m, but up to 200m on occasions (BirdLife International, 2011). Dive durations recorded during the present surveys averaged 35 seconds.

12.116 Common guillemot is considered to be a species of low conservation concern worldwide. Between 2 and 2.7 million pairs breed in Europe, with 1.3 million individuals in Britain, 1.1 million of which breed in Scotland. However, the species is of moderate conservation concern in the UK, as British common guillemots account for a third of the bio-geographic population (Mitchell *et al*., 2004).

12.117 An estimated 278,874 individuals breed within the mean maximum foraging range of the Project (JNCC Seabird Monitoring Programme database), of which 38,000 individuals breed within the North Caithness Cliffs SPA.

12.118 Data from boat surveys yielded a peak density estimate of 23.9 per km^2 which equated to an estimated peak abundance on the sea within the survey area of 328 birds. Peak numbers were observed between May and July inclusive with birds seen throughout the boat-based study area (Figure 12.11). Common guillemot are qualifying interests of the following SPAs in the North of Scotland and Orkney region: North Caithness Cliffs, East Caithness Cliffs, Cape Wrath, Sule Skerry and Sule Stack, Calf of Eday, Copinsay, Hoy, Marwick Head, Rousay and West Westray (other SPAs may need to be considered in the HRA).

Razorbill

12.119 Razorbills return to their British breeding colonies in April and May, with birds having wintered along the Atlantic coast of Europe, from southwest Norway to Iberia, and North Africa and into the western Mediterranean (Mitchell *et al*., 2004). British breeding colonies are mainly on rocky sea cliffs, with most foraging during the breeding season occurring within 15km of the colony, although foraging distances may be over 50km on occasions (BirdLife International, 2011). Razorbills generally forage in relatively shallow waters (<100m) which offer predictable feeding conditions, often over sandy seabeds and at upwellings or tidal fronts. As with common guillemots, they feed mainly upon schooling fish, with sandeel most important to British breeders, whilst herring, sprats and rockling (*Gaidropsarus* spp.) may also be important (BirdLife International, 2011). Fish are caught by pursuit diving from the surface, typically to depths of 5m to 30m, but possibly deeper than 100m on occasions (Bird Life International, 2011). Dive durations recorded during the present surveys differed between the breeding (May to July) and non-breeding periods, averaging 19 seconds and 40 seconds, respectively.

12.120 The European razorbill population is estimated to be between 430,000 and 760,000 breeding pairs, of which 23% (164,000) breed in Britain and approximately 139,186 of these birds breed in Scotland (Mitchell *et al*., 2004).

12.121 An estimated 6,971 individuals breed within the mean maximum foraging range of the Project (JNCC Seabird Monitoring Programme database). Densities calculated from boat survey data gave a peak of 7.95 per km^2, which equates to an estimated peak abundance of 109 birds in the boat survey area. While razorbills were recorded all year round, numbers peaked between April and July inclusive, indicative of the presence of breeding birds. There was no apparent pattern in the spatial distribution of observed birds (Figure 12.12). Razorbill are qualifying interests of the following SPAs in the North of Scotland and Orkney region: North Caithness Cliffs, East Caithness Cliffs, Cape Wrath and West Westray (other SPAs may need to be considered in the HRA).

Atlantic puffin

12.122 Atlantic puffins (hereafter puffins) are usually present at their British breeding colonies between April and early August, although birds in east coast colonies may begin arriving as early as late February (Mitchell *et al.,* 2004). Birds largely winter offshore, and often beyond the continental shelf into the pelagic zones. British breeding colonies generally occur on the grassy slopes above sea cliffs or on offshore islands, where nesting burrows can be dug, or else among boulder screes and at low densities in crevices on sheer cliffs (BirdLife International, 2011; Mitchell *et al*., 2004). Small to mid-sized schooling fish are the main food, with a wide range of species taken, whilst crustaceans, polychaetes and squid may be important in spring. Typical prey in Britain includes sandeel, sprat, capelin, whiting, haddock and herring, with sandeel generally preferred where they are available (BirdLife International, 2011). During the breeding season puffins appear to forage mainly in relatively shallow waters, and tidal fronts may provide important foraging areas. Little information is available on foraging ranges from breeding colonies but puffins appear to conduct most foraging within 10km, although foraging at much greater distances (>40km) may occur (BirdLife International, 2011). In common with other auks, puffins hunt by pursuit diving, typically to depths of <30m, but deeper than 60m on some occasions (BirdLife International, 2011). Dive durations recorded during the present surveys averaged 40 seconds.

12.123 The European population of puffin is thought to be between 5.7 and 7.3 million pairs, of which about 580,700 pairs nest in Britain, comprising 9.6% of the global population (Mitchell *et al*., 2004).

12.124 In Scotland an estimated 493,042 pairs breed, with an estimated 4,088 pairs breeding within the mean maximum foraging range of the Project (JNCC Seabird Monitoring Programme database). The Atlantic puffin is listed as a species of moderate conservation concern in the UK, due to localised populations and population declines in Europe.

12.125 The peak period for puffins recorded during the boat surveys was between April and July, with a peak density of 12.5 per km^2 recorded in April 2010. This equated to a peak abundance in the boat survey area of 171 birds. Birds were recorded throughout the boat survey area (Figure 12.13). Atlantic puffin are qualifying interests of the following SPAs in the North of Scotland and Orkney region: North Caithness Cliffs, East Caithness Cliffs, Cape Wrath, Sule Skerry and Sule Stack and Hoy (other SPAs may need to be considered in the HRA).

Black guillemot

12.126 In contrast to the other British auks, black guillemots show little dispersal from their British breeding sites in winter, tending to remain within 2km of the shore (Mitchell *et al*., 2004). Breeding sites are generally small rocky islands and low-lying stretches of rocky coast, where nests occur in crevices or under boulders. During the breeding season, birds feed mainly in shallow (<35m), inshore, waters usually <5km from breeding sites, and often over hard-bottomed areas or ledges. Overall, black guillemots take a wider range of prey than other Atlantic auks. Benthic fish (e.g. butterfish) are often the main prey, but species such as sandeel are also important, as are crustaceans, annelids and molluscs (BirdLife International, 2011). Much foraging by black guillemots probably occurs near the sea bottom, but at relatively shallow depths (e.g. 10 to 30m), with birds recorded at depths of up to 50m (BirdLife International, 2011). Dive durations recorded during the present surveys averaged 57 seconds.

12.127 Black guillemot is a widespread breeding species in coastal areas of northern Europe, which comprise 50% of the species' global breeding range (Burfield & van Bommel, 2004). The European breeding population is in excess of 130,000 pairs, but the species is considered to have an unfavourable conservation status on the basis of a moderate population decline during 1990 to 2000 (Burfield & van Bommel, 2004). Within the UK, where numbers appear to be relatively stable, the black guillemot is of moderate conservation concern (Amber-listed) due to its unfavourable conservation status in Europe (Eaton *et al*., 2009).

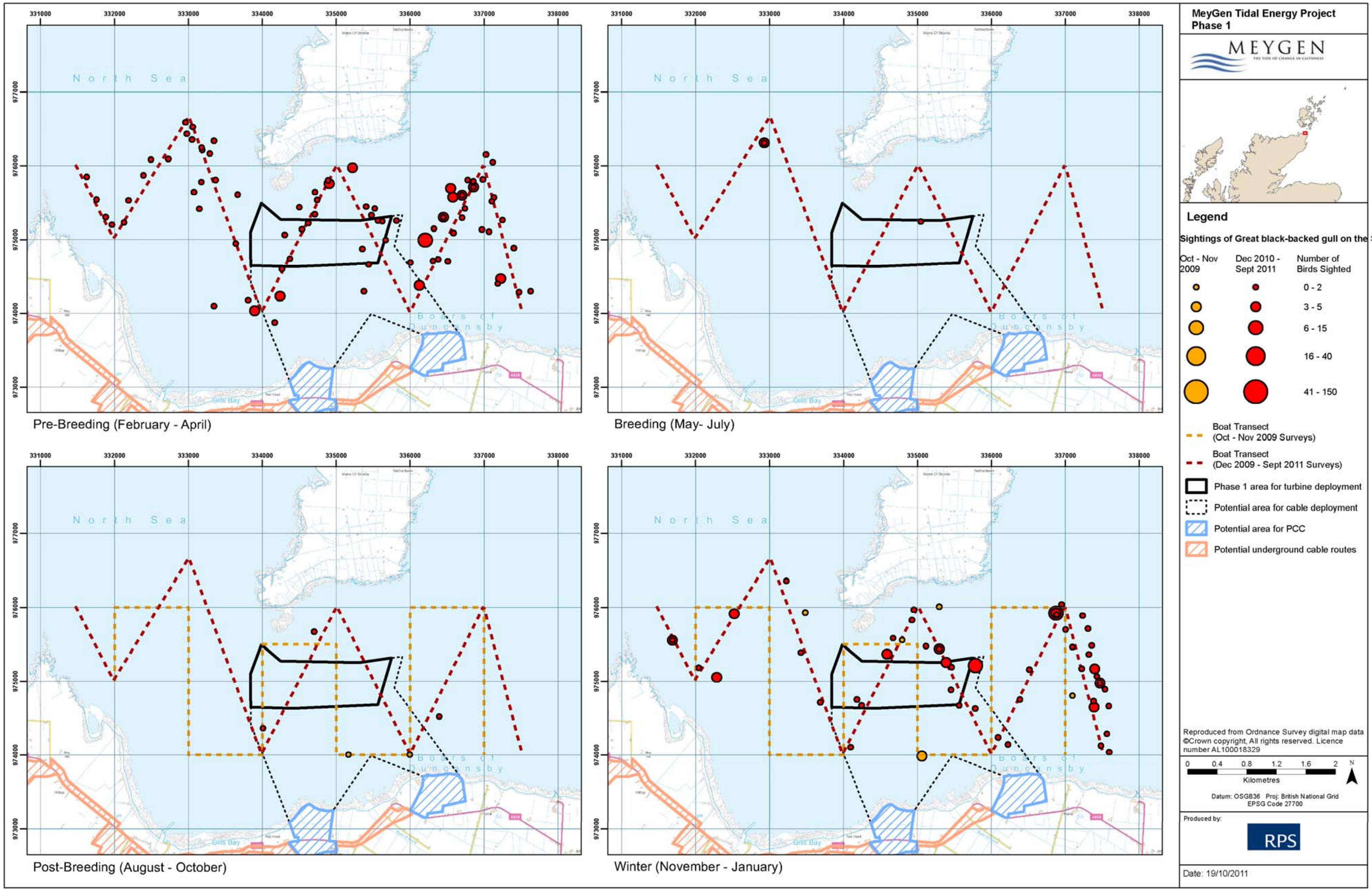

Figure 12.10: Boat based observations of great black-backed gull recorded between October 2009 and September 2011

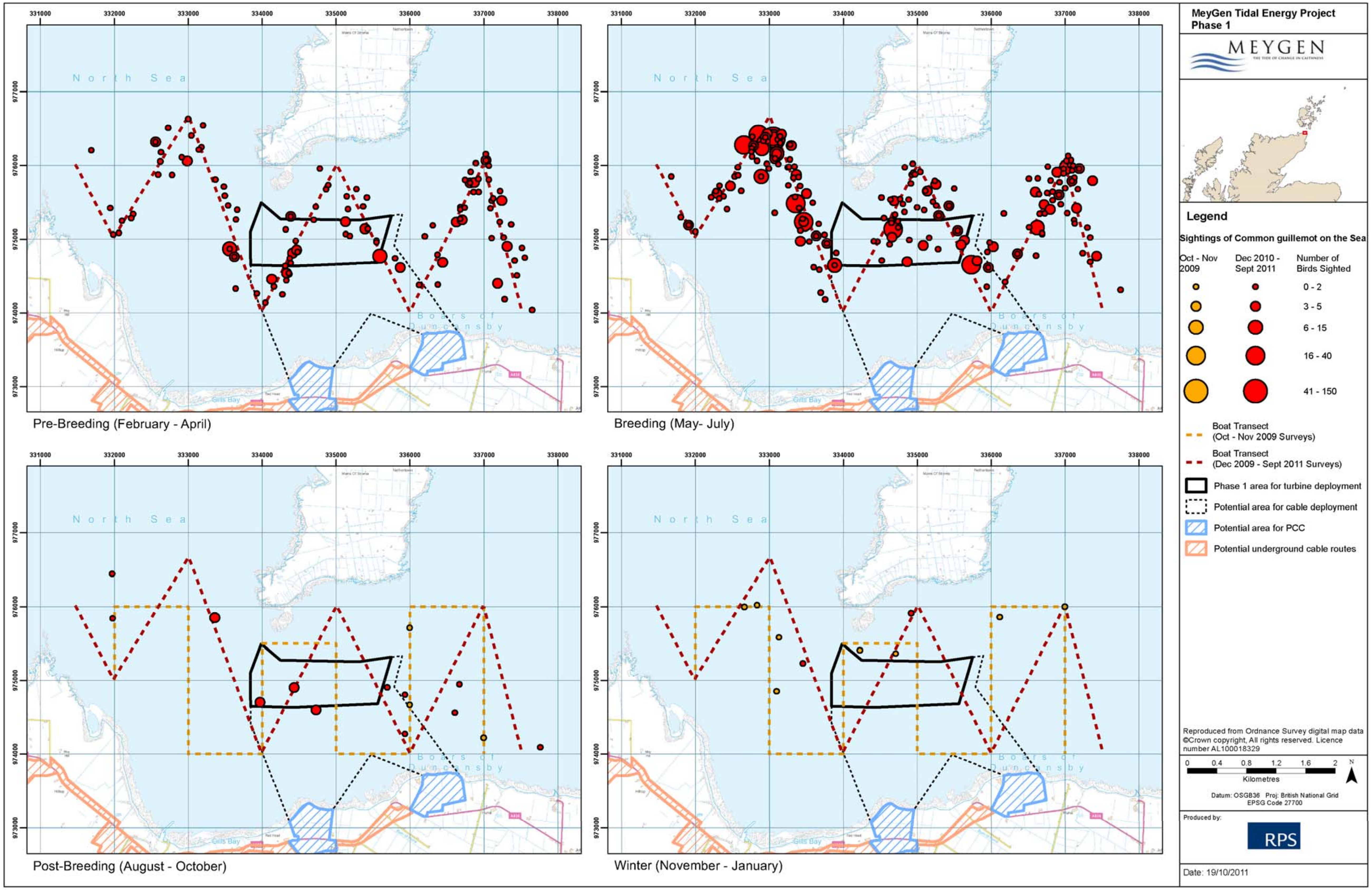

Figure 12.11: Boat based observations of common guillemot recorded between October 2009 and September 2011

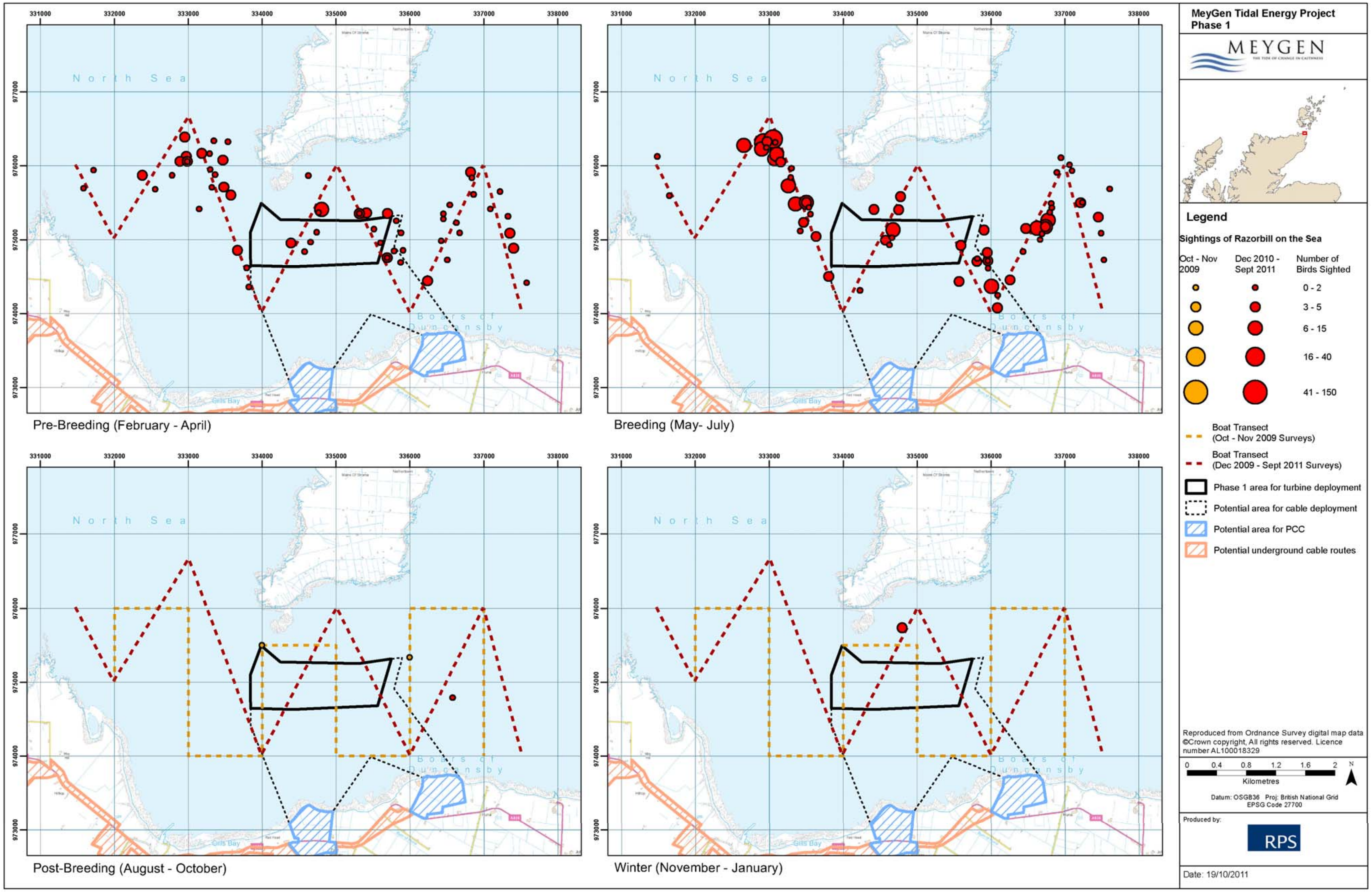

Figure 12.12: Boat based observations of razorbill recorded between October 2009 and September 2011

12.128 There were an estimated 7,067 pre-breeding individual black guillemots (the count unit used for this species) in Orkney and Caithness in 1998 to 2000 (Mitchell *et al*., 2004). Of the 1,247 pre-breeding individuals recorded in Caithness, 1,104 were associated with East Caithness and 143 with the North Caithness coast area (within which the MeyGen site lies). Numbers in Orkney and Caithness declined by 19% between the mid 1980s and 1998-2000 (Mitchell *et al*., 2004).

12.129 Black guillemot were recorded on every boat survey, although numbers were highest during the pre-breeding and breeding seasons, dropping to very low numbers in September and October. The peak density recorded in the boat surveys was 15.9 per km^2 recorded in March 2010. This equated to a peak abundance in the boat survey area of 217 birds. Birds were recorded throughout the boat survey area (Figure 12.14). This species is not a qualifying feature for any of the SPAs in the north of Scotland and Orkney region, but it is identified as a component of the cliff nesting seabird colony of the Stroma SSSI.

Red-throated diver

12.130 Red-throated divers are strongly migratory and dispersive, with British breeders returning to breeding areas from March onwards (Forrester & Andrews, 2007; BirdLife International, 2011). Birds generally nest on small lochs on inland heathland and blanket bog habitats, commuting to tidal estuaries and inshore marine areas (usually within 2km of the nest site) to feed (Forrester & Andrews, 2001; BirdLife International, 2011). Birds occur further offshore outside the breeding season. A wide range of fish species may be taken, including herring, sprat and sandeel, whilst marine worms, copepods and crustaceans have also been recorded in the diet. Prey are captured by pursuit diving from the surface, with most dives undertaken in shallow waters of <20m to 30m depth (BirdLife International, 2011).

12.131 The red-throated diver is a widespread breeder across much of northern Europe, where less than a quarter of the global population occur (Burfield & van Bommel, 2004). The species has an unfavourable conservation status in Europe due to large declines during the latter part of the 20th century, although numbers appear to have remained relatively stable since then. Within Britain the species is of moderate conservation concern (Amber-listed) on the basis of its unfavourable status in Europe (Eaton *et al*., 2009). The entire UK breeding population of 4,146 adult birds occurs within Scotland, where numbers increased by approximately 34% between 1994 and 2006 (Dillon *et al*., 2009).

12.132 Although no population figures are available for Caithness and Sutherland specifically, there are an estimated 189 adult birds present within the Caithness and Sutherland Peatlands SPA during the breeding season (Dillon *et al*., 2009). This will include the vast majority of birds occurring on the breeding grounds in Caithness and Sutherland, and within the vicinity of the Project area. A further 280 adult birds are present in Orkney during the breeding season (Dillon *et al*., 2009). Although numbers in Orkney were estimated to have undergone a small decline (3.2%) between 1994 and 2006, numbers in Caithness are likely to have increased during the same period (given that an overall increase of 14% was recorded in mainland Scotland).

12.133 Red-throated divers were recorded between November and April on the boat surveys, with a peak in late winter (March 2010) of 0.3 per km^2. This equated to a peak abundance in the boat survey area of four birds. It therefore does not appear that breeding birds use the survey area for foraging. Most observed birds were seen near to the coast, with very few recorded in the middle of the Inner Sound (Figure 12.15). Red-throated diver are a qualifying interest of the following SPAs in the North of Scotland and Orkney region: Caithness and Sutherland Peatlands, Hoy and Orkney Mainland Moors (other SPAs may need to be considered in the HRA).

Common eider

12.134 The common eider (hereafter eider) may use a wide range of foraging habitats (e.g. open shallow water overlying rocky substrates or kelp beds, and sheltered bays with sandy substrates), which are generally close (<1km) to the shore. Benthic invertebrates are the main food; most notably intertidal and subtidal molluscs (e.g. common mussels) but also crustaceans and echinoderms (BirdLife International, 2011). Their prey is obtained by surface diving and, in shallow water, by head-dipping and up-ending, and dive depths will generally be <10m, although they are capable of diving to depths of 42m to feed (BirdLife International, 2011).

12.135 Eiders breed in coastal areas of north-west and northern Europe, where more than 50% of the global population is found (Burfield & van Bommel, 2004). The large European population (estimated to be in excess of 840,000 pairs) is considered to have a secure status, and is therefore of low conservation concern. There are an estimated 31,200 breeding pairs of eider within the UK, where the species is of moderate conservation concern (Amber-listed) due to a decline of 25 - 50% in numbers over the past 25 years (Baker *et al*., 2006; Eaton *et al*., 2009).

12.136 An estimated 6,000 adult eider occur in Orkney, and a further 4,500 in Caithness and Sutherland, with birds in both areas considered to be largely sedentary so that numbers are similar throughout the year (Forrester *et al*., 2007). There are insufficient data to estimate the proportion of the Caithness and Sutherland population that occurs within the vicinity of the MeyGen site, whilst data on population trends specific to those areas are also lacking.

12.137 Eider were almost exclusively observed between November and March on the boat surveys, with a peak in late winter (February and March 2010) of 7.8 per km^2. This equated to a peak abundance in the boat survey area of 106 birds. There was no apparent pattern to the spatial distribution of birds observed (Figure 12.16). Eider are not a qualifying feature for any of the SPAs or SSSIs in the north of Scotland and Orkney region.

Onshore habitats and the associated bird community

12.138 The proposed onshore infrastructure comprises the temporary HDD site, PPC and underground cables to the grid connection. An onshore area approximately of $7km^2$ was surveyed (extended phase 1 habitat survey) and assessed for this ES, although the eventual onshore infrastructure footprint will not cover this whole area and is expected to occupy no more than approximately $3.5km^2$ of land. Actual buildings and associated infrastructure (e.g. car parking) may comprise no more than $0.5km^2$ of land, with the remaining affected areas being underground cables.

12.139 The habitats affected by the proposed onshore developments are largely grassland and dry heath, with smaller areas of woodland, scrub and wet heath and bog, as determined by extended Phase 1 habitat surveys (Xodus, 2011). The proposed sites for the buildings (PCC) occur entirely on grassland habitats with the exception part of the Ness of Quoys PCC option. This covers an area of approximately $0.085km^2$ of mixed wet heath, acid grassland and modified bog habitat (Xodus, 2011). These habitats may provide important breeding and foraging habitats for terrestrial bird species, and so the onshore element of the Project may affect bird populations associated with neighbouring SPAs. The Caithness and Sutherland Peatlands SPA and Caithness Lochs SPA are the most likely to be affected by any such impacts that may occur on terrestrial bird populations (Table 12.6).

12.140 In terms of the provision of foraging habitat for SPA qualifying species, the onshore Project site is unlikely to be of particular importance because it forms part of a much larger expanse of similar habitat, which extends along much of the north Caithness coast. Thus, there is no reason to suspect that such potential foraging habitat is limiting in this area. Golden plover may have traditional feeding fields that are used year after year, but again it is highly unlikely that this would represent a major issue on this site. Although the site is just 0.25km from the Caithness and Sutherland Peatlands SPA (and well within the distance that nesting golden plover may fly to access feeding fields, which occasionally may be up to approximately 10km, O'Connell *et al*., 1996), it is in such close proximity to the north-eastern fragment of the SPA only (Figure 12.1). The site is over 18km from the main extent of this SPA and so well beyond the likely distance that the vast majority of the nesting golden plover on this SPA will commute to feeding fields.

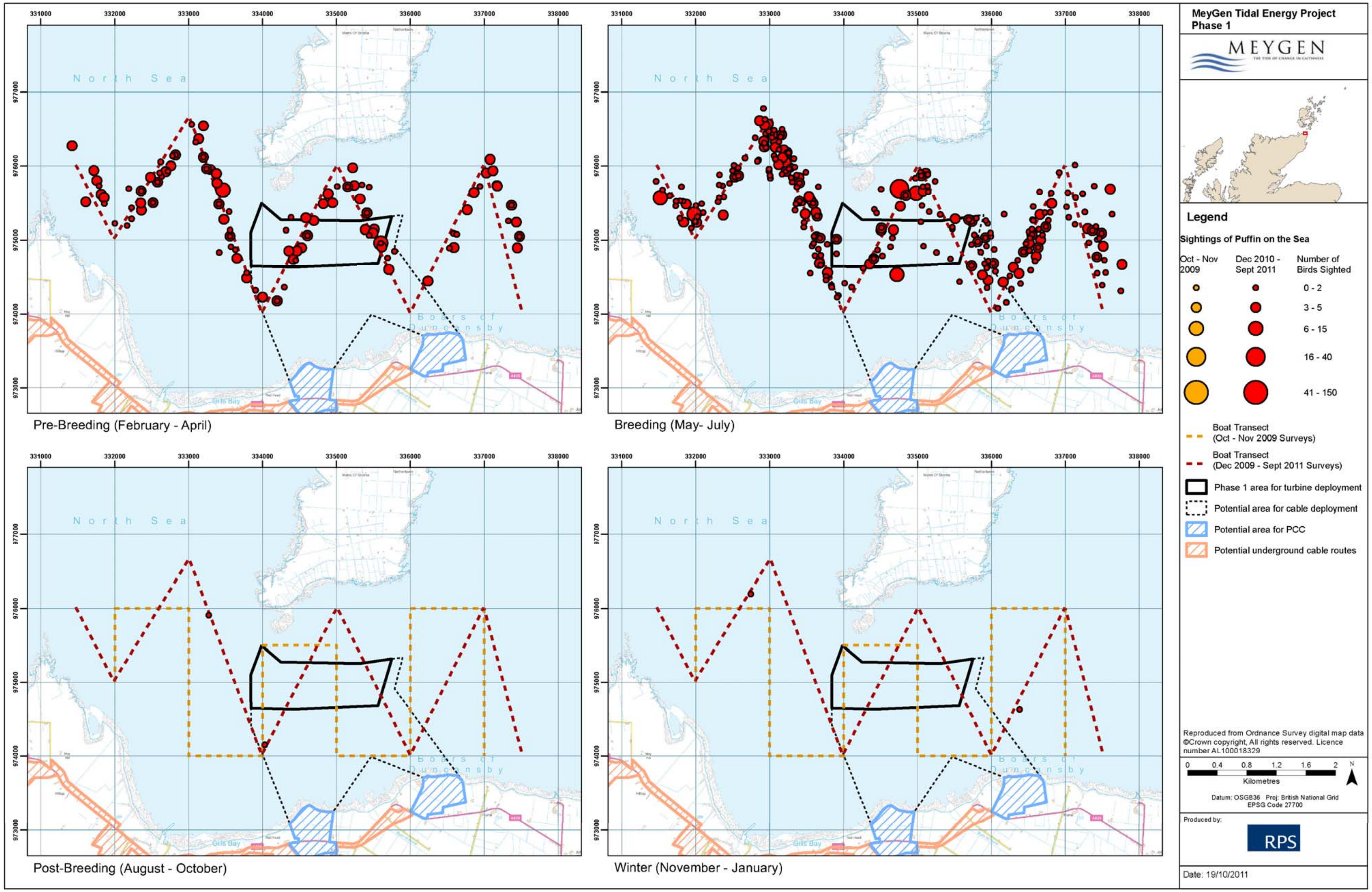

Figure 12.13: Boat based observations of Atlantic puffin recorded between October 2009 and September 2011

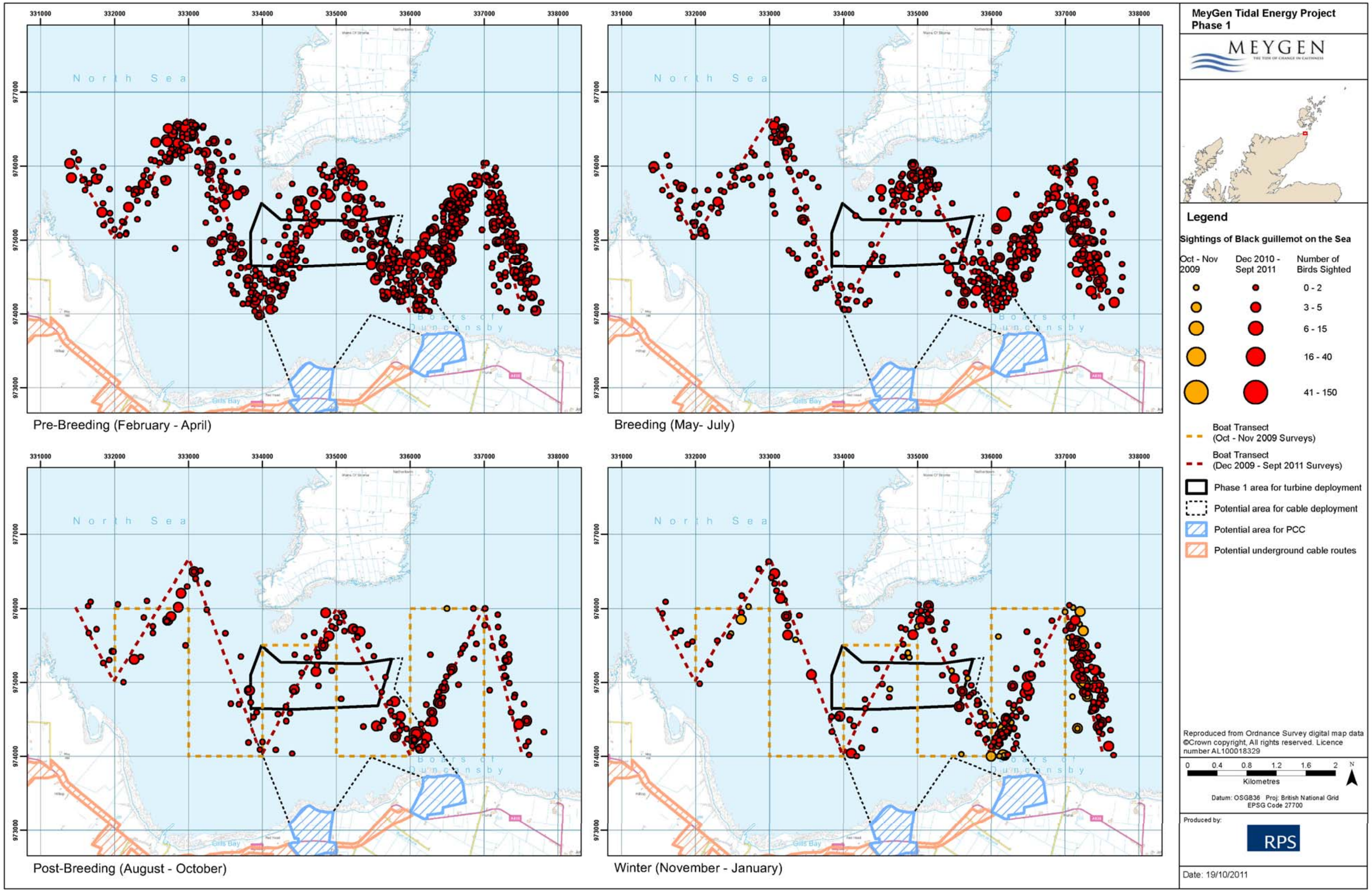

Figure 12.14: Boat based observations of black guillemot recorded between October 2009 and September 2011

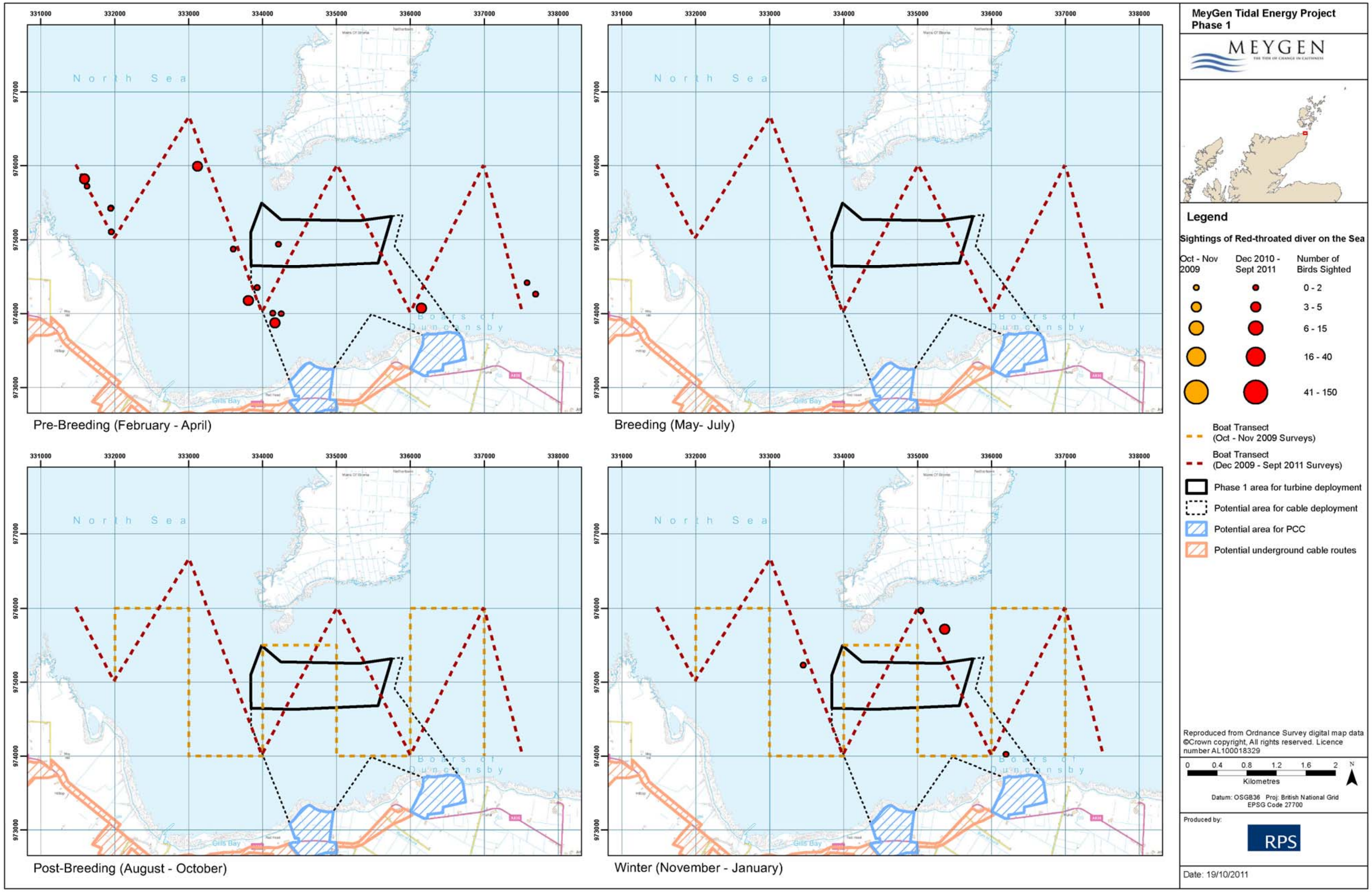

Figure 12.15: Boat based observations of red-throated diver recorded between October 2009 and September 2011

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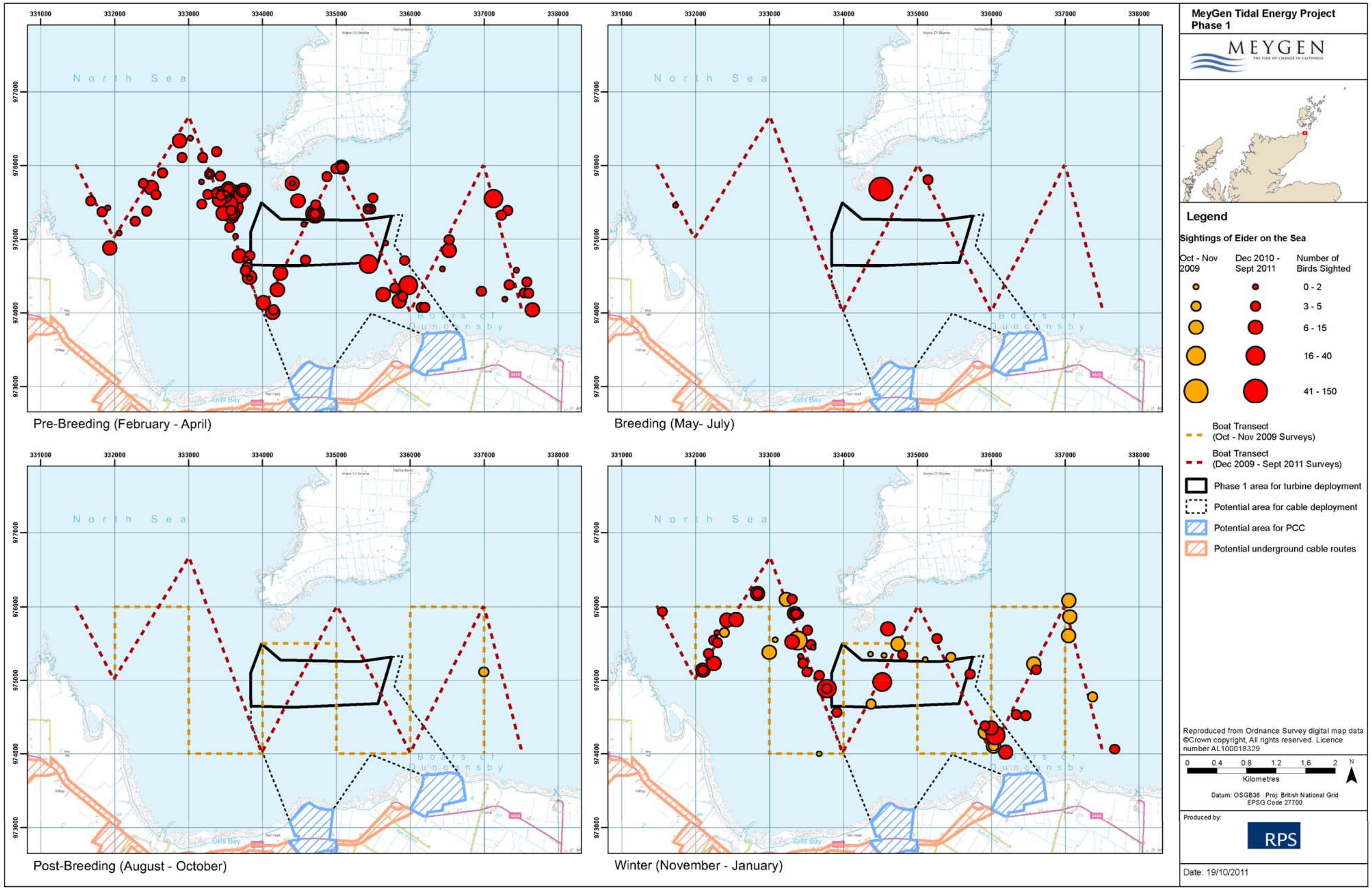

Figure 12.16: Boat based observations of eider recorded between October 2009 and September 2011

12.6 Impacts during Construction and Installation

12.141 Potential effects on birds associated with the construction phase of the Project include:

- Disturbance / displacement due to increased boat traffic;
- Disturbance / displacement due to offshore construction activities; and
- Indirect impacts of sub-structure installation on the local habitat conditions and prey stocks.

12.142 These impacts are considered in more detail below.

12.6.1 Impact 12.1: Disturbance / displacement due to increased boat traffic

12.143 Disturbance from increased boat traffic could affect seabirds and divers within the Project area in a number of ways. As a worst case scenario, such activity could cause complete avoidance of the Project area and its surrounds by certain species, so causing displacement from potentially important foraging and loafing areas. This could lead to birds being forced to forage in areas of lower prey availability, or increase competition for resources at other locations. Other, less severe, effects may involve frequent disturbance whilst foraging, or flushing of birds in response to the boat traffic. The consequences of such disturbance and displacement effects may include reduced foraging efficiency, greater energy expenditure and elevated stress levels. Although it is conceivable that such effects can potentially lead to population level impacts by reducing reproductive rates or increasing mortality rates, this is only likely to occur if the Project area provides important resources (e.g. abundant prey species), which are unavailable in other locations to which the species has access, and if the Project area is heavily used at critical times in the year (e.g. during the breeding season).

12.144 For each sensitive receptor species, the impact of disturbance from increased boat traffic was evaluated on the basis of:

- Knowledge of the sensitivity of each bird species based on their likely vulnerability to disturbance from boat traffic taken from several different sources, notably Ronconi & St. Clair (2002), Garthe and Hüppop (2004), King *et al*. (2009) and Furness & Wade (2012);
- The magnitude of disturbance that is expected to take place; and
- The likelihood of a temporal overlap of construction traffic and each species' presence in the Project area.

12.145 Table 12.11 provides assessment of the impact specific species sensitivity, magnitude, consequence and significance of boat traffic during construction and decommissioning. Assessment of consequence and significance for each species followed the methods set out in Section 8.

Impact significance

Species	Sensitivity to boat traffic (see notes)	Impact magnitude	Rationale	Consequence	Significance
Red-throated diver	High[1]	Negligible	Only present outside breeding season and in very low numbers.	Minor	Not Significant
Fulmar	Low[1]	Negligible	Attracted to boat traffic.	Negligible	Not Significant
Gannet	Low[1]	Negligible	Mostly ignore vessels, show occasional attraction.	Negligible	Not Significant
Cormorant	High[1]	Negligible	Mostly present outside breeding season and in low numbers.	Minor	Not Significant
Shag	Medium[1]	Minor	Any displacement expected to be limited to small area.	Minor	Not Significant
Eider	Medium[1]	Negligible	Mainly present outside breeding season.	Negligible	Not Significant
Great skua	Low[1]	Negligible	Not habitat limited.	Negligible	Not Significant
Arctic skua	Low[1]	Negligible	Not significantly disturbed by vessels; not habitat limited at local scale.	Negligible	Not Significant
Kittiwake	Low[1]	Negligible	Not habitat limited.	Negligible	Not Significant
Common gull	Low[2]	Negligible	Not habitat limited.	Negligible	Not Significant
Great black-backed gull	Low[1]	Negligible	Not habitat limited.	Negligible	Not Significant
Herring gull	Low[1]	Negligible	Not habitat limited.	Negligible	Not Significant
Arctic tern	Low[1]	Negligible	Not significantly disturbed by vessels; not habitat limited at local scale.	Negligible	Not Significant
Guillemot	Medium[1]	Minor	Not significantly disturbed by vessels; not habitat limited at local scale.	Minor	Not Significant
Razorbill	Medium[1]	Minor	Not significantly disturbed by vessels; not habitat limited at local scale.	Minor	Not Significant
Black guillemot	Medium[1,4]	Minor	Not significantly disturbed by vessels. Any displacement expected to be limited to small area.	Minor	Not Significant
Puffin	Low[1]	Minor	Not significantly disturbed by vessels; not habitat limited at local scale.	Minor	Not Significant

Notes:
1 – Garthe and Hüppop (2004)
2 – King et al. (2009)
3 – Ronconi & St. Clair (2002)
4 – Furness & Wade (2012)

Table 12.11: Details of species sensitivity and vulnerability to disturbance from boat traffic and predicted significance of impacts

12.146 Overall, the sensitivity of receptors to disturbance by boat traffic varies between low and high and the magnitude of the impact is assessed as negligible or minor for all species. This is based on a combination of the time of year when construction vessels are expected to be present (spring to autumn) and the time of year each species has been recorded on site (Table 12.10) and the short term and localised nature of the predicted impacts.

MITIGATION IN RELATION TO IMPACT 12.1
▪ No specific mitigation measures are proposed as no significant impact predicted. Operational monitoring will be implemented in order to confirm the impact predications made here (see Section 12.12).

12.6.2 Impact 12.2: Release of drill cuttings and fluid

12.147 Details of the predicted worst case release of drill cuttings and lubricating fluids (compressor lubricant) released during TSS piling and HDD drilling operations are provided in Section 10 (Impact 10.2). No significant impacts on benthic communities were identified. The volumes of discharge predicted to occur are considered to be sufficiently small and will be rapidly dispersed and are only temporary in nature that they will have no impact on any of the bird species present.

Sensitivity	Impact magnitude	Consequence	Significance
Very high	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 12.2
▪ No specific mitigation measures are proposed as no significant impact predicted. Operational monitoring will be implemented in order to confirm the impact predications made here (see Section 12.12).

12.6.3 Impact 12.3: Accidental spillage from vessels

12.148 The discussion around this impact focuses on the potential impacts associated with the release of a large inventory of fuel oil from a vessel. This is considered to be the worst case potential accidental pollution impact. Other smaller inventories of polluting substances may potentially be released during the course of the Project. These impacts and their potential consequences are discussed further in accidental events (Section 24)

12.149 The total oil inventory for the large DP installation vessels is likely to be in the region of 6,000,000 to 8,000,000 litres of marine diesel stored in a number of separate tanks. The worse case spill from a single tank rupture is likely to be in the region of 600,000 litres of marine diesel released into the marine environment.

12.150 Oil spills can have a number of environmental impacts. Actual effects will vary depending on a wide range of factors including the volume and type of oil spilt and the sea and weather conditions at the time of the spill. Effects will also be dependant on the presence of environmental sensitivities in the path of the spill.

12.151 To determine the magnitude of impact and the associated significance, the vulnerability of each species to surface pollutants is combined with the impact magnitude estimated in the Accidental Events section (Section 24). For a total loss of inventory these are presented in Table 12.12 and for a partial loss in Table 12.13. In these assessments seasonality is taken into account in the determination of impact magnitude through consideration of the peak period of bird presence in the Inner Sound, since most vessel presence (and hence spillage risk) will occur during the spring to autumn period. The predicted magnitude includes consideration of the likelihood of accidental spillage, defined here for both a total and partial loss of inventory as extremely unlikely to occur.

Impact significance

Species	Sensitivity to surface pollutants[1] (see notes)	Impact magnitude	Rationale	Consequence	Significance
Red-throated diver	Very high	Negligible	Only present outside breeding season and in very low numbers.	Minor	Not Significant
Fulmar	Medium	Negligible	Peak density in winter.	Negligible	Not Significant
Gannet	High	Negligible	Present in very low numbers.	Minor	Not Significant
Cormorant	High	Negligible	Present in very low numbers.	Minor	Not Significant
European shag	Very high	Negligible	Present throughout year.	Minor	Not Significant
Eider	Medium	Negligible	Mainly present in winter.	Negligible	Not Significant
Great skua	Very high	Negligible	Mainly present in summer.	Minor	Not Significant
Arctic skua	Very high	Negligible	Mainly present in summer.	Minor	Not Significant
Kittiwake	Medium	Negligible	Present in very low numbers.	Negligible	Not Significant
Common gull	Medium	Negligible	Present in very low numbers, peaks in winter.	Negligible	Not Significant
Great black-backed gull	High	Negligible	Present in very low numbers, peaks in winter.	Minor	Not Significant
Herring gull	Medium	Negligible	Present in very low numbers, peaks in winter.	Negligible	Not Significant
Arctic tern	Medium	Negligible	Occasional presence during summer.	Negligible	Not Significant
Guillemot	High	Negligible	Numbers peak in summer.	Minor	Not Significant
Razorbill	High	Negligible	Numbers peak in summer.	Minor	Not Significant
Black guillemot	Very high	Negligible	Present throughout year.	Minor	Not Significant
Puffin	High	Negligible	Numbers peak in summer.	Minor	Not Significant

Notes:
[1] Vulnerability to surface pollutants was derived from the Oil Vulnerability Index of Williams et al. (1995).

Table 12.12: Details of species sensitivity and vulnerability to surface pollutants and the significance of any impacts, in relation to a total loss of inventory

Species	Sensitivity to surface pollutants[1] (see notes)	Impact magnitude	Rationale	Consequence	Significance
Red-throated diver	Very high	Negligible	Only present outside breeding season and in very low numbers.	Minor	Not Significant
Fulmar	Medium	Negligible	Peak density in winter.	Negligible	Not Significant
Gannet	High	Negligible	Present in very low numbers.	Minor	Not Significant
Cormorant	High	Negligible	Present in very low numbers.	Minor	Not Significant
European shag	Very high	Negligible	Present throughout year.	Minor	Not Significant
Eider	Medium	Negligible	Mainly present in winter.	Negligible	Not Significant
Great skua	Very high	Negligible	Mainly present in summer.	Minor	Not Significant
Arctic skua	Very high	Negligible	Mainly present in summer.	Minor	Not Significant
Kittiwake	Medium	Negligible	Present in very low numbers.	Negligible	Not Significant
Common gull	Medium	Negligible	Present in very low numbers, peaks in winter.	Negligible	Not Significant
Great black-backed gull	High	Negligible	Present in very low numbers, peaks in winter.	Minor	Not Significant
Herring gull	Medium	Negligible	Present in very low numbers, peaks in winter.	Negligible	Not Significant
Arctic tern	Medium	Negligible	Occasional presence during summer.	Negligible	Not Significant
Guillemot	High	Negligible	Numbers peak in summer.	Minor	Not Significant
Razorbill	High	Negligible	Numbers peak in summer.	Minor	Not Significant
Black guillemot	Very high	Negligible	Present throughout year.	Minor	Not Significant
Puffin	High	Negligible	Numbers peak in summer.	Minor	Not Significant

Notes:
[1]*Vulnerability to surface pollutants was derived from the Oil Vulnerability Index of Williams et al. (1995).*

Table 12.13: Details of species sensitivity and vulnerability to surface pollutants and the significance of any impacts, in relation to a partial inventory loss

MITIGATION IN RELATION TO IMPACT 12.3

- Although no significant impacts have been identified, due to the high/very high sensitivity of some species mitigation measures have been identified.
- All vessels associated with Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have onboard SOPEP's.
- All vessels associated with Project operations will carry onboard oil and chemical spill mop up kits.
- Where possible vessels with a proven track record for operating in similar conditions will be employed.
- Vessel activities associated with installation, operation, routine maintenance and decommissioning will occur in suitable conditions to reduce the chance of an oil spill resulting from the influence of unfavourable weather conditions.

12.6.4 Impact 12.4: Disturbance / displacement due to underwater noise

Direct impacts on birds

12.152 Construction works may involve noisy and potentially disturbing activities such as drilling piles. This will be expected to disturb birds through above-sea noise, which could result in temporary displacement effects. However, a lack of specific information on the response of many species to noise, in particular the type, duration and severity of the impact and the potential to which birds may habituate, makes predictions very difficult. Factors to take into account include:

- The activity the birds are engaged in (e.g. foraging, loafing or moulting), which will determine the extent to which alternative locations are readily available;
- The duration of occupancy of the site and the time of year (construction activity is not anticipated to occur all year round); and
- The origin of the birds potentially affected.

12.153 Very little is known about how diving birds may respond directly to underwater noise. As species which have hearing adapted primarily for use in air, it is expected that hearing sensitivity underwater will generally be low, in comparison to that for marine mammals, for example.

12.154 It is anticipated that construction will occur during the spring, summer and autumn to take advantage of more benign weather conditions, thus for bird species recorded predominantly in the winter (red-throated diver, eider, gulls), direct impacts of negligible magnitude (Table 12.14).

12.155 For cormorant, common guillemot, razorbill and puffin, with large foraging ranges, and also for Arctic tern, the Project site is not considered to represent a foraging location of high importance. Thus for these medium sensitivity species direct impacts of construction activity will be of minor magnitude (Table 12.14).

12.156 For the medium sensitivity species, black guillemot and shag, predicted impacts of minor magnitude were assessed (Table 12.14).

12.157 In relation to direct impacts, gannet are considered unlikely to respond adversely to noise and other construction activity. Overall therefore, this low sensitivity species is considered likely to experience an impact of negligible magnitude (Table 12.14).

Indirect impacts via effects on prey species

12.158 There is also the potential that for some species the impact of construction activity (especially drilling) would occur indirectly through impacts upon the distribution of prey species. However, Kongsberg (2012) report that underwater drilling tends to be a low noise level operation, at least compared with other activities. In a relatively noisy environment such as the Inner Sound, it may be assumed that the drilling noise will propagate over only short distances before it falls below background noise levels. The modelling undertaken for the Inner Sound confirms this, with drilling noise falling to background noise levels at a range of 0.5km from the noise source. The source level for drilling activities is considerably below the level at which lethal injury to fish might occur and it is therefore unlikely that any marine animals will be killed by the underwater noise from pile drilling. For construction activities Kongsberg (2012) reported that no behavioural reactions are likely to manifest in hearing generalist fish. They are the most insensitive of generic species to the man-made noises that may be generated by the Project. Drilling noise is sufficiently low that hearing generalists and specialist fish would need to be less than 1m from the source of the drilling activity to elicit any behavioural response. When exposed to vessel noise, mild behavioural avoidance may occur out to a maximum distance of approximately 14m (Kongsberg, 2012). Hearing specialists would need to be less than 1m from the source of the drilling activity to elicit a strong behavioural response.

12.159 Construction activities are therefore not expected to cause fish to re-distribute more than a few metres away from the sources of disturbance. Such short range and temporary displacement of fish from the immediate area is predicted to be of little consequence to foraging birds. Furthermore, any effects on the distribution of fish are likely to be limited to the spring, summer and autumn periods.

12.160 Therefore, in an analogous way to the direct impacts of underwater noise, indirect impacts (via effects on prey) on bird species present mainly in the winter period of negligible magnitude are predicted (Table 12.14).

12.161 Again, analogous to direct impacts of underwater noise, and given that the Project area is not considered to represent a foraging location of high importance for cormorant, common guillemot, razorbill and puffin, with large foraging ranges, and also for Arctic tern, the indirect impacts (via effects on prey), are predicted to be of minor magnitude (Table 12.14).

12.162 Opportunistic scavenging species such as great skua, fulmar and gannet may benefit from foraging opportunities created by construction works. As such, the magnitude of construction related impacts on these species, were assessed as negligible (Table 12.14).

Impact significance

Species	Sensitivity to construction activity	Impact magnitude	Rationale	Consequence	Significance
Red-throated diver	Medium	Negligible	Only present outside breeding season and in very low numbers.	Negligible	Not Significant
Fulmar	Low	Negligible	Flexible and wide ranging foraging pattern.	Negligible	Not Significant
Gannet	Low	Negligible	Flexible and unlikely to respond to noise.	Negligible	Not Significant
Cormorant	Medium	Negligible	Mainly present outside breeding season.	Negligible	Not Significant
European shag	Medium	Minor	Any displacement expected to be limited to small area.	Minor	Not Significant
Eider	Medium	Negligible	Mainly present outside breeding season.	Negligible	Not Significant
Great skua	Low	Negligible	Flexible foraging pattern.	Negligible	Not Significant
Arctic skua	Low	Negligible	Flexible foraging pattern.	Negligible	Not Significant
Kittiwake	Low	Negligible	Unlikely to respond to noise.	Negligible	Not Significant
Common gull	Low	Negligible	Mainly present outside breeding season.	Negligible	Not Significant
Great black-backed gull	Low	Negligible	Mainly present outside breeding season.	Negligible	Not Significant
Herring gull	Low	Negligible	Mainly present outside breeding season.	Negligible	Not Significant
Arctic tern	Low	Negligible	Unlikely to respond to noise.	Negligible	Not Significant
Guillemot	Medium	Minor	Possible short range displacement.	Minor	Not Significant
Razorbill	Medium	Minor	Possible short range displacement.	Minor	Not Significant
Black guillemot	Medium	Minor	Possible short range displacement.	Minor	Not Significant
Puffin	Medium	Minor	Possible short range displacement.	Minor	Not Significant

Table 12.14: Details of species sensitivity and vulnerability to overall (i.e. direct and indirect) construction impacts and the significance of any impacts

MITIGATION IN RELATION TO IMPACT 12.4
▪ No specific mitigation measures are proposed as no significant impact predicted. Operational monitoring will be implemented in order to confirm the impact predications made here (see Section 12.12).

12.6.5 Impact 12.5: Effects of onshore infrastructure construction activities on terrestrial birds

12.163 The species which could potentially be affected by construction of the onshore infrastructure for the onshore Project include ones of very high sensitivity (with regards to their conservation status, e.g. hen harrier and golden plover). Construction activity may disturb breeding birds within the immediate vicinity of the site. However, the heath and bog habitats at the onshore Project site upon which breeding birds are likely to be reliant are of relatively small extent and are fragmented by the more extensive grasslands. Whilst it is feasible that nesting golden plover, dunlin and greenshank could occur on the onshore Project site, blanket bog is the preferred nesting habitat of all three of these species (Ratcliffe, 1990), and only small areas (<14ha in total) of modified bog occur within the assessment area over which phase 1 habitat mapping was undertaken. Therefore, if they are present, numbers will be small and of little consequence relative to the breeding populations of these three species found across the Caithness and Sutherland Peatlands SPA.

12.164 Wintering wildfowl species listed for the Caithness Lochs SPA are Greenland white-fronted goose, greylag goose (Icelandic breeding population) and whooper swan. These species could potentially forage at low intensity within the areas of onshore development. However, the proposed development sites are unlikely to be of particular importance since they from part of a much larger expanse of similar habitat which covers much of the north Caithness coast. Therefore, the potential impact on these species of the loss of habitat due to the onshore developments is considered to be negligible.

12.165 Construction impacts will be of a temporary nature, and it is apparent that SPA species are unlikely to be dependent on the habitats within the affected area. In addition, the areas of the onshore Project are small and hold very small areas of key habitats relative to their availability in the surrounding areas, so even under a highly unlikely worst-case scenario only very small proportions of the SPA populations could be at risk of impact.

12.166 Breeding waterfowl species that form part of the SPA (wigeon and common scoter) are very unlikely to be affected by onshore construction activities as no suitable breeding habitat is located within any potential disturbance zone. Breeding birds are unlikely to forage within the development area.

Sensitivity	Impact magnitude	Consequence	Significance
Very high	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 12.5
▪ Although no significant impacts are predicted, once specific onshore Project areas are known, further, targeted investigation will be undertaken to ascertain the status, distribution and habitat use of birds within the Project footprint and surrounding environment.

12.7 Impacts during Operations and Maintenance

12.7.1 Impact 12.6 Disturbance / displacement due to maintenance activity

12.167 Disturbance due to maintenance activity is expected to be of a similar nature to that discussed in relation to vessel traffic discussed above (Impact 12.1). However, since maintenance activity will be at a lower intensity and frequency than during the construction period (although it could occur sporadically over a long-term period), the impacts will all be of lower negligible magnitude.

Sensitivity	Impact magnitude	Consequence	Significance
Very high	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 12.6
▪ No specific mitigation measures are proposed as no significant impact predicted. Operational monitoring will be implemented in order to confirm the impact predications made here (see Section 12.12).

12.7.2 Impact 12.7: Accidental spillage from vessels

12.168 The vessels to be used for during operations and maintenance operations will be smaller than those used during construction and installation and will therefore have similar inventories, of oil. The likelihood of spillage, mitigation measures and residual impacts are the same as those described for vessel spillage during construction (Impact 12.3).

12.7.3 Impact 12.8: Accidental leakage of pollutants from turbines

12.169 The tidal turbines will contain an inventory of fluids including oil, hydraulic fluid and coolant. The impact from loss of fluids from the tidal turbines will be limited. Leaks will be localised to the immediate vicinity of the turbine and will be rapidly dispersed in the tidal conditions present in the Inner Sound. The quantities and types of fluids to be used will also be a limiting factor to the overall impact, based on the candidate technologies being considered, turbine inventories will be 645 to 1,500 litres. The fluids will be mostly water based, biodegradable and have low aquatic toxicity.

12.170 To determine the magnitude of impact and the associated significance, the vulnerability of each species to surface pollutants (although note that these were derived for oil based pollutants, Williams *et al.*, 1995) is combined with the impact magnitude estimated in the Accidental Events section (Section 24). These are presented in Table 12.15. In this assessment seasonality is taken into account in the determination of impact magnitude through consideration of the peak period of bird presence in the Inner Sound.

Impact significance

Species	Sensitivity to surface pollutants[1] (see notes)	Predicted magnitude	Rationale	Consequence	Significance
Red-throated diver	Very high	Negligible	Only present outside breeding season and in very low numbers.	Minor	Not Significant
Fulmar	Medium	Negligible	Peak density in winter.	Negligible	Not Significant
Gannet	High	Negligible	Present in very low numbers.	Minor	Not Significant
Cormorant	High	Negligible	Present in very low numbers.	Minor	Not Significant
European shag	Very high	Negligible	Present throughout year.	Minor	Not Significant
Eider	Medium	Negligible	Mainly present in winter.	Negligible	Not Significant
Great skua	Very high	Negligible	Mainly present in summer.	Minor	Not Significant
Arctic skua	Very high	Negligible	Mainly present in summer.	Minor	Not Significant
Kittiwake	Medium	Negligible	Present in very low numbers.	Negligible	Not Significant
Common gull	Medium	Negligible	Present in very low numbers, peaks in winter.	Negligible	Not Significant
Great black-backed gull	High	Negligible	Present in very low numbers, peaks in winter.	Minor	Not Significant
Herring gull	Medium	Negligible	Present in very low numbers, peaks in winter.	Negligible	Not Significant
Arctic tern	Medium	Negligible	Occasional presence during summer.	Negligible	Not Significant

Species	Sensitivity to surface pollutants[1] (see notes)	Predicted magnitude	Rationale	Consequence	Significance
Guillemot	High	Negligible	Numbers peak in summer.	Minor	Not Significant
Razorbill	High	Negligible	Numbers peak in summer.	Minor	Not Significant
Black guillemot	Very high	Negligible	Present throughout year.	Minor	Not Significant
Puffin	High	Negligible	Numbers peak in summer.	Minor	Not Significant

Notes:
1 – Vulnerability to surface pollutants was derived from the Oil Vulnerability Index of Williams et al. (1995)

Table 12.15: Details of species sensitivity and vulnerability to inventory leakage from turbines and significance of any impacts

MITIGATION IN RELATION TO IMPACT 12.8

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- Only recognised marine standard fluids and substances will be used in the turbine hydraulic systems.
- Hydraulic fluids will be mostly water based, biodegradable and be of low aquatic toxicity.
- Project specific emergency response procedures will be implemented and include contingency arrangements in the unlikely event of a pollution incident.

12.7.4 Impact 12.9: Displacement due to the presence of the turbines

12.171 The worst case impact assessed as a potential consequence of birds being displaced by the presence of the turbines was that those individuals affected would be forced to forage in alternative locations which would not provide sufficient prey to enable those birds to successfully breed. Since the minimum distance between sea surface at Lowest Astronomical Tide (LAT) and the rotor tips will be 8m, only those species of bird which dive to 8m or more to forage are considered to be at risk of displacement impacts due to the presence of the turbines (diving depths from BirdLife International, 2011). Since potential impacts were only considered to affect reproduction, only those species recorded during the breeding season were assessed: gannet, cormorant, shag, common guillemot, razorbill, puffin and black guillemot. This assessment was focussed on just the turbine deployment area (1.1km^2) since this is the maximum extent of disturbance reasonably expected due to the turbines. Sensitivity was derived from a combination of the numbers seen in the turbine deployment area and the size of the estimated population at risk.

12.172 Very few gannets were seen foraging in the survey area during the breeding season (peak count 1 individual). Compared to the potential population from which they could be drawn (approximately 177,000 within a mean maximum foraging range of >300km, Mitchell *et al.,* 2004), this species was not considered at risk of impacts due to displacement. Therefore this low sensitivity species is considered to be at risk of a negligible magnitude impact (Table 12.16).

12.173 No cormorants were not observed during the boat surveys and the land based surveys recorded this species at low levels, with no more than three individuals observed on any one survey. Very few birds were observed during the breeding season, therefore this species was not considered at risk of impacts due to displacement. Therefore this low sensitivity species is considered to be risk of a negligible magnitude impact (Table 12.16).

12.174 Similarly, very few common guillemot were seen foraging in the survey area during the breeding season (peak count 27 individuals). Compared to the potential population from which they could be drawn (approximately 279,000, JNCC Seabird Monitoring Programme database), this species was not considered at risk of impacts due to displacement. Therefore this medium sensitivity species is considered to be at risk of a negligible magnitude impact (Table 12.16).

12.175 For the remaining species of diving birds (shag, razorbill, puffin and black guillemot) the impact on the breeding populations of displacement of the peak abundance of breeding adults was determined using population modelling (for further details of the models see the Ornithology Technical Annex; RPS, 2011b. For the purposes of this assessment it was assumed that displaced individuals fail to breed. The population at risk for each species was estimated using the Seabird Monitoring Programme (SMP) database (downloaded November 2011 from: http://jncc.defra.gov.uk/smp/) and the estimated foraging range (BirdLife International, 2011).

12.176 The estimated breeding population of shag within mean maximum foraging range (16km) of the site is 628 individuals. The peak abundance of breeding birds on the survey area was 14. If all of these individuals failed to breed the predicted population growth rate will fall from 3.3% year^{-1} to 3.1% year^{-1}. Therefore, this medium sensitivity species was assessed as being at risk of an impact of negligible magnitude (Table 12.16).

12.177 The estimated breeding population of razorbill within mean maximum foraging range (31km) of the site is 6,971. The peak abundance of breeding birds on the survey area was 5 individuals. If all of these individuals failed to breed the predicted population growth rate will be unchanged. Therefore, this medium sensitivity species was assessed as being at risk of an impact of negligible magnitude (Table 12.16).

12.178 The estimated breeding population of puffin within mean maximum foraging range (62km) of the site is 4,088. The peak abundance of breeding birds on the survey area was 8 individuals. If all of these individuals failed to breed the predicted population growth rate will fall from 3.19% year^{-1} to 3.18% year^{-1}. Therefore, this medium sensitivity species was assessed as being at risk of an impact of negligible magnitude (Table 12.16).

12.179 The estimated breeding population of black guillemot within mean maximum foraging range (12km) of the site is 455 individuals. The peak abundance of breeding birds on the survey area was 7 individuals. If all of these individuals failed to breed the predicted population growth rate will fall from 1.36% year^{-1} to 1.2% year^{-1}. Therefore, this medium sensitivity species was assessed as being at risk of an impact of a negligible magnitude (Table 12.16).

Impact significance

Species	Sensitivity (based on numbers in survey area)	Impact magnitude	Consequence	Significance
Gannet	Low	Negligible	Negligible	Not Significant
Cormorant	Low	Negligible	Negligible	Not Significant
European shag	Medium	Negligible	Negligible	Not Significant
Guillemot	Medium	Negligible	Negligible	Not Significant

Species	Sensitivity (based on numbers in survey area)	Impact magnitude	Consequence	Significance
Razorbill	Medium	Negligible	Negligible	Not Significant
Puffin	Medium	Negligible	Negligible	Not Significant
Black guillemot	Medium	Negligible	Negligible	Not Significant

Table 12.16: Details of species sensitivity to displacement impacts due to the turbines and the significance of any impacts

MITIGATION IN RELATION TO IMPACT 12.9
▪ No specific mitigation measures are proposed as no significant impact predicted. Operational monitoring will be implemented in order to confirm the impact predications made here (see Section 12.12).

12.7.5 Impact 12.10: Collision risk to diving birds

12.180 Only species of bird recorded during the breeding season, which dive to depths of 8m or more (minimum distance between sea surface at LAT and rotor tips) are considered at risk of collision impacts. These species are; gannet, shag, common guillemot, razorbill, puffin and black guillemot. This assessment was undertaken for the worst case 86, 1MW turbines. The full details of the exposure time modelling and the population modelling on which these assessments are based is provided in the Ornithology Technical Annex (RPS, 2011b). In its current form, the modelling process does not include behavioural and ecological factors which might be expected to influence the likelihood of collisions between diving birds and tidal turbines (e.g. maximum bird swim speed, ability of birds to detect turbines underwater, probability that a single transit through a spinning rotor blade will result in a collision, etc.). These have been omitted since little is known at present about how diving birds may interact with tidal turbines. Thus, in the exposure time model the entire volume of water in which a rotor is located represents equivalent levels of exposure to collision. Consequently this approach is considered highly precautionary in its outputs. For species which are estimated to be at relatively high risk of impacts due to exposure to turbines, foraging behaviour and ecology have also been taken into account in order to determine the expected impact magnitude and significance. This was not considered necessary for those species with relatively low estimated exposure risks (e.g. species which don't dive to more than 8m). In addition to the above list of species, one additional deeper diving species was assessed; cormorant. None were seen during the boat surveys, therefore no density estimates can be calculated for this species in the survey area, which precludes assessment using the exposure model. However, since a few were observed during the land surveys a qualitative assessment is provided for this species. Sensitivity was derived from a combination of the numbers seen in the turbine deployment area and the size of the estimated population at risk.

12.181 An estimated 90,600 individual gannet breed within the mean maximum foraging range of the turbine deployment area. Using observed monthly density estimates derived from the boat surveys and published diving information it was estimated that the individual annual exposure time on the site was 0.000053s. Given this level of exposure, to generate an additional rate of mortality sufficient to trigger a population decline, the predicted collision rate would need to be 91 collisions between gannets and the turbines for every second that the regional population spends at rotor depths within the turbine deployment area. With a peak site abundance of 1, such a collision rate is considered very unlikely. Therefore, this low sensitivity species was assessed as being at risk of an impact of a negligible magnitude (Table 12.17).

12.182 No cormorants were observed during the boat surveys, therefore it is not possible to estimate the density of birds within the turbine deployment area, thus it is also not possible to undertake a quantitative assessment of the potential exposure time. While this species can dive to depths at which collisions with tidal turbines are possible (Grémillet *et al.,* 1999), given the very low abundance on the site, particularly during the breeding season, this low sensitivity species is assessed as being at risk of an impact of a negligible magnitude (Table 12.17).

12.183 An estimated 628 shag breed within this species' mean maximum foraging range of the turbine deployment area. Using observed monthly density estimates derived from the boat surveys and published diving information it was estimated that the individual annual exposure time on the site was 42.3s. To generate an additional rate of mortality sufficient to trigger a population decline, there would need to be 0.0008 collisions between shags and the turbines for every second that the regional population spends at rotor depths within the turbine deployment area (this equates to approximately 1 collision every 21 minutes). With a peak site abundance of 21 individuals, such a collision rate is considered possible. Shag forage on both pelagic and benthic species, and are strongly associated with the sandy sediments which are home to sandeels, their primary prey (BirdLife International, 2011). Sandeels have been found to represent 90% of their diet by weight (BirdLife International 2011). Suitable habitat for sandeels is restricted to the edges of the Inner Sound, while the turbine deployment area itself comprises scoured bed rock with only limited patches of thin sediment. It therefore seems unlikely that the turbine deployment area is an important foraging area for shags. In addition, this species forages exclusively by day, which will increase the likelihood that the birds will detect and be able to avoid the turbines. Therefore, given the foraging ecology of this medium sensitivity species, the risk of an impact was assessed as being of a minor magnitude (Table 12.17).

12.184 An estimated 71,000 common guillemot breed within this species' mean maximum foraging range of the turbine deployment area. Using observed monthly density estimates derived from the boat surveys and published diving information it was estimated that the individual annual exposure time on the site was 0.032s. To generate an additional rate of mortality sufficient to trigger a population decline, there would need to be 1.6 collisions between common guillemots and the turbines for every second that the regional population spends at rotor depths within the turbine deployment area. With a peak site abundance of 27 individuals, such a collision rate is considered highly unlikely. Therefore, this medium sensitivity species was assessed as being at risk of an impact of negligible magnitude (Table 12.17).

12.185 An estimated 6,971 razorbill breed within this species' mean maximum foraging range of the turbine deployment area. Using observed monthly density estimates derived from the boat surveys and published diving information it was estimated that the individual annual exposure time on the site was 0.023s. To generate an additional rate of mortality sufficient to trigger a population decline, there would need to be 0.7 collisions between razorbills and the turbines for every second that the regional population spends at rotor depths within the turbine deployment area. With a peak site abundance of 9 individuals, such a collision rate is considered unlikely. Therefore, this medium sensitivity species was assessed as being at risk of an impact of a negligible magnitude (Table 12.17).

12.186 An estimated 4,088 puffin breed within this species' mean maximum foraging range of the turbine deployment area. Using observed monthly density estimates derived from the boat surveys and published diving information it was estimated that the individual annual exposure time on the site was 0.95s. To generate an additional rate of mortality sufficient to trigger a population decline, there would need to be 0.028 collisions between puffins and the turbines for every second that the regional population spends at rotor depths within the turbine deployment area (this equates to approximately 1 collision every 36 seconds). With a peak site abundance of 14, such a collision rate is considered unlikely. Therefore, this medium sensitivity species was assessed as being at risk of an impact of a negligible magnitude (Table 12.17).

12.187 An estimated 445 black guillemot breed within this species' mean maximum foraging range of the turbine deployment area. Using observed monthly density estimates derived from the boat surveys and published diving information it was estimated that the individual annual exposure time on the site was 19.5s. To generate an additional rate of mortality sufficient to trigger a population decline, there would need to be 0.0006 collisions between black guillemots and the turbines for every second that the regional population spends at rotor depths within the turbine deployment area (this equates to approximately 1 collision every 26 minutes). With a peak site abundance of 16, such a collision rate is considered possible. Black guillemot primarily forage at the seabed in shallow inshore waters. In Scottish waters they have been found to favour rocky vegetated habitats, reflecting the preferences of their main prey species, butterfish *Pholis gunnellus* (BirdLife International, 2011). While the benthic survey of the Inner Sound (ASML, 2011) found the turbine deployment area to consist of scoured bedrock, to the south large swathes of kelp forest were recorded, of the type favoured by butterfish. In addition, black guillemot are considered to favour moderate current speeds of 0.3-0.7m/s for foraging (BirdLife International, 2011), which is considerably lower than the current speeds experienced in the turbine deployment area. It therefore seems likely that individuals of this species will spend comparatively little time foraging in the vicinity of the turbines and the turbine deployment area itself is not considered likely to represent an important foraging area for this species. Therefore, this medium sensitivity species was assessed as being at risk of an impact of a minor magnitude (Table 12.17).

Impact significance

Species	Sensitivity (based on numbers in the survey area)	Impact magnitude	Consequence	Significance
Gannet	Low	Negligible	Negligible	Not Significant
Cormorant	Low	Negligible	Negligible	Not Significant
European shag	Medium	Minor	Minor	Not Significant
Guillemot	Medium	Negligible	Negligible	Not Significant
Razorbill	Medium	Negligible	Negligible	Not Significant
Puffin	Medium	Negligible	Negligible	Not Significant
Black guillemot	Medium	Minor	Minor	Not Significant

Table 12.17: Details of species sensitivity to collision impacts due to the turbines and the significance of any impacts

MITIGATION IN RELATION TO IMPACT 12.10

- No specific mitigation measures are proposed as no significant impact predicted. Operational monitoring will be implemented in order to confirm the impact predications made here (see Section 12.12).

12.7.6 Impact 12.11: Indirect effects on birds

12.188 Bird species which forage in the Inner Sound may be at risk of effects due to impacts from operational turbines on their prey.

12.189 The fish baseline description (Section 13) indicates that very few fish species considered to be important prey for the seabird species present in the Project area (e.g. sandeel, herring, butterfish, etc.) are present in significant numbers. The potential for significant collision risk impacts on the fish species present was assessed as minor or negligible, although it was noted that while this is based on the best information available, there is currently a lack of empirical evidence on how fish may respond to tidal turbines.

12.190 It appears plausible to assume therefore, that the Project will not significantly reduce the availability of fish prey within the area (e.g. through elevated mortality), although it is possible that fish will relocate from the immediate area of the turbines. As such, the Project may lead to local re-distribution of fish and those species which prey on them. This effective displacement of seabirds is considered unlikely to have an impact on their populations (see results of the displacement assessment above; Impact 12.9).

12.191 A potential additional consequence of prey displacement may also be to reduce the risk of diving bird collisions with the turbines. However, there is also the possibility that the support structures will provide sheltered areas which fish are able to utilise, thereby increasing the prevalence of fish within the Project area. This could potentially lead to increased seabird foraging within the Project area, with a consequent increase in collision risk. At this stage it is not possible to determine whether fish abundance will increase or decrease within the Project area, therefore the indirect impacts on foraging seabirds may be negative or positive. Since there is no evidence to indicate that the Project site provides foraging opportunities of a critical nature within the region, the impacts are considered unlikely to be more than negligible in magnitude.

12.192 The substrate within the Project area comprises scoured rock, with localised patches of very thin layers of sediment (ASML, 2011). These are not considered to represent suitable habitat for the shellfish prey of species such as eider, therefore no indirect impact is considered for these species.

Sensitivity	Impact magnitude	Consequence	Significance
Very high	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 12.11

- No specific mitigation measures are proposed as no significant impact predicted. Operational monitoring will be implemented in order to confirm the impact predications made here (see Section 12.12).

12.7.7 Impact 12.12: Effects of operation of onshore infrastructure on terrestrial birds

12.193 Terrestrial birds could conceivably be impacted through loss of habitat resulting from the presence of buildings constructed for the Project. The Caithness and Sutherland Peatlands SPA and Caithness Lochs SPA are the most likely to be affected by any such impacts that may occur to terrestrial bird populations. Of the qualifying species for these two SPAs, hen harrier, merlin, short-eared owl, golden plover, dunlin and greenshank all depend heavily upon heath and bog habitats for nesting (Pearce-Higgins *et al*., 2009). The mix of heath, grassland and scrub could also provide foraging habitats for these raptors, whilst breeding golden plover (and to a lesser extent dunlin) depend heavily on grasslands for foraging, as do wintering geese (Bibby, 1986; Pearce-Higgins *et al*., 2003; Arroyo *et al*., 2009; Madsen *et al*., 1999).

12.194 The heath and bog habitats at the Project site are of relatively small extent and are fragmented by the more extensive grasslands. The proposed sites for the buildings (PCC) occur entirely on grassland habitats with the exception of part of the Ness of Quoys PCC option. This covers an area of approximately 0.085km^2 of mixed wet heath, acid grassland and modified bog habitat (Xodus 2011a). However, these are unlikely to be suitable for ground nesting raptors because these species generally require extensive areas of these habitats for nesting (Redpath *et al*., 1998). Whilst it is feasible that nesting golden plover, dunlin and greenshank could occur on the Project site, blanket bog is the preferred nesting habitat of all three of these species (Ratcliffe, 1990), and only small areas (<14ha in total) of modified bog occur. Therefore, if they are present, numbers will be small and of little consequence relative to the breeding populations of these three species found across the Caithness and Sutherland Peatlands SPA. Breeding wigeon and common scoter are very unlikely to be affected by operational infrastructure, as no suitable nesting or foraging habitat will be lost. The potential impacts on wintering wildfowl from the Caithness Lochs SPA (Greenland white-fronted goose, greylag goose and whooper swan) are considered to be very small, given the extensive areas of suitable habitat within the region.

12.195 Thus, permanent habitat loss is likely to mainly affect habitats of lesser importance to bird populations (e.g. grassland), with other areas of dwarf shrub heath and one small area of modified bog in the development area overlapping with the potential cable routes, where habitat loss will be temporary only. In addition, it is apparent that SPA species are unlikely to be dependent on the habitats within the affected area, and the areas of the Project are considered to be comparatively small, so that only very small proportions of the SPA populations are at risk of impact. Therefore the impacts of the onshore infrastructure on these very high sensitivity species are assessed as of negligible magnitude.

Sensitivity	Impact magnitude	Consequence	Significance
Very high	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 12.12

- Once specific onshore Project areas are known, further, targeted investigation will be undertaken to ascertain the status, distribution and habitat use of birds within the Project footprint and surrounding environment. The results of the survey will be used to confirm the impact assessment.

12.8 Impacts during Decommissioning

12.196 The potential impacts during decommissioning are expected to be, at worst of the same nature and magnitudes as those during the construction period. The impacts considered during construction which would also be applicable during decommissioning include:

- Disturbance / displacement due to increased boat traffic;
- Accidental spillage of inventories from vessels; and
- Disturbance / displacement due to offshore decommissioning activities.

12.197 None of the impacts predicted for these activities during construction and installation are not considered significant.

12.9 Potential Variances in Environmental Impacts

12.198 The impact assessment above has assessed the worst case Project options with regards to impact on birds. This section provides a brief overview of the potential variances between the worst case Project option assessed and alternative Project options.

12.199 For the collision risk assessment, a worst case of 86, 20m rotor turbines was used. The installation of smaller rotor (16 or 18m diameter) turbines or a lower number of higher capacity turbines would reduce the assessed risk of collision for diving bird species. This is generally a safe assumption - in normal collision risk modelling the reduction in rotor diameter outweighs increases in collision risk due to slightly faster rotational speeds associated with smaller turbines.

12.200 In terms of construction noise impacts, the installation of the gravity base TSSs would generate less noise during installation, due to there not being a requirement to drill, this installation method would not release drill cuttings or fluids into the marine environment during installation. Although diving bird species are not considered to have hearing adapted for underwater, the use of 86 turbines of 1MW during operation will result in a lesser noise impact than if 36 turbines of 2.4MW are used.

12.201 The assessment of displacement due to turbine presence considers the exclusion of species able to dive to turbine depths within the whole of the turbine deployment area (1.1km^2). The turbine array will take up a much smaller area than assessed and therefore impacts are likely to be significantly reduced.

12.202 All onshore and offshore construction activities will not conducted in parallel. Activities will concentrate on specific areas before moving to the next phase of construction, therefore construction will not be spread across the whole project area at any given time and disturbance and displacement impacts are likely to be lower than assessed.

12.10 Cumulative Impacts

12.10.1 Introduction

12.203 MeyGen has in consultation with Marine Scotland and The Highland Council identified a list of other projects (MeyGen, 2011) which together with the Project may result in potential cumulative impacts. The list of these projects including details of their status at the time of the EIA and a map showing their location is provided in Section 8; Table 8.3 and Figure 8.1 respectively.

12.204 Having considered the information presently available in the public domain on the projects for which there is a potential for cumulative impacts, Table 12.18 below indicates those with the potential to result in cumulative impacts from an ornithological perspective. The consideration of which projects could result in potential cumulative impacts is based on the results of the project specific impact assessment together with the expert judgement of the specialist consultant.

Project title	Potential for cumulative impact	Project title	Potential for cumulative impact	Project title	Potential for cumulative impact
MeyGen Limited, MeyGen Tidal Energy Project, Phase 2	✓	SHETL, HVDC cable (onshore to an existing substation near Keith in Moray)	×	OPL, Ocean Power Technologies (OPT) wave power ocean trial	×
ScottishPower Renewables UK Limited, Ness of Duncansby Tidal Energy Project	✓	Brough Head Wave Farm Limited, Brough Head Wave Energy Project	✓	MORL, Moray Offshore Renewables Ltd (MORL) offshore windfarm	✓
Pelamis Wave Power, Farr Point Wave Energy Project	✓	SSE Renewables Developments (UK) Limited, Costa Head Wave Energy Project	✓	SSE and Talisman, Beatrice offshore Windfarm Demonstrator Project	✓
Sea Generation (Brough Ness) Limited, Brough Ness Tidal Energy Project	✓	EON Climate & Renewables UK Developments Limited, West Orkney North Wave Energy Project	✓	BOWL, Beatrice Offshore Windfarm Ltd (BOWL) offshore windfarm	✓
Cantick Head Tidal Development Limited, Cantick Head Tidal Energy Project	✓	EON Climate & Renewables UK Developments Limited, West Orkney South Wave Energy Project	✓	Northern Isles Salmon, Chalmers Hope salmon cage site	×
SSE, Caithness HVDC Connection - Converter station	×	ScottishPower Renewables UK Limited, Marwick Head Wave Energy Project	✓	Northern Isles Salmon, Pegal Bay salmon cage site	×
SSE, Caithness HVDC Connection - Cable	×	SSE Renewables Developments (UK) Limited, Westray South Tidal Energy Project	✓	Northern Isles Salmon, Lyrawa salmon cage site	×
RWE npower renewables, Stroupster Windfarm	×	EMEC, Wave Energy test site (Billia Croo, Orkney)	×	Scottish Sea Farms, Bring Head salmon cage site	×
SSE, Gills Bay 132 kV / 33 k V Substation Phase 1: substation and overhead cables (AC)	×	EMEC, Tidal energy test site (Fall of Warness, Orkney)	×	Northern Isles Salmon, Cava South salmon cage site	×
SSE, Gills Bay 132 kV / 33 k V Substation Phase 2: HVDC converter station and new DC buried cable	×	EMEC, Intermediate wave energy test site (St Mary's Bay, Orkney)	×	Scottish Sea Farms, Toyness salmon cage site	×
SHETL, HVDC cable (offshore Moray Firth)	×	EMEC, Intermediate tidal energy test site (Head of Holland, Orkney)	×	Northern Isles Salmon, West Fara salmon cage site	×

Table 12.18: Summary of potential cumulative impacts

12.205 The following sections summarise the nature of the potential cumulative impacts for each potential project phase:

- Construction and installation;
- Operations and maintenance; and
- Decommissioning.

12.10.2 Potential cumulative impacts during construction and installation

12.206 The Ness of Duncansby Tidal Energy project is the only project that may potentially be constructed at the same time as the MeyGen Tidal Energy Project, Phase 1. However, cumulative impacts arising from coincident installation are not anticipated as the majority of impacts are expected to be localised (e.g. increased turbidity) and therefore very unlikely to generate significant cumulative impacts on birds.

12.207 The Pentland Firth is subject to relatively high levels of ship movements and it is therefore considered that the additional vessel activity related to the construction of these energy developments will not constitute a significant cumulative impact. Given the rare nature of accidental inventory spillage events, the likelihood for cumulative impacts (i.e. accidental events occurring in the same time period at one or more projects) for seabirds is considered extremely remote and therefore not significant.

12.208 The potential for a cumulative impact of tidal and wave energy devices on prey availability for bird species is likely to depend on the extent to which foraging occurs within development areas, the extent of construction impacts on fish prey species, the extent to which construction activities coincide across sites (and the proximity of such activity) and on the type of prey taken by the different bird species. Fish will be expected to relocate away from sources of disturbance, thus limiting effects on stocks but requiring that species dependent on them also relocate. Overall the likelihood of construction causing fish mortality is considered to be very low and therefore no significant indirect cumulative impacts due to construction are predicted.

12.209 Construction of the onshore infrastructure is unlikely to overlap with the construction of any other onshore developments, and thus no cumulative impacts are predicted.

12.10.3 Potential cumulative impacts during operations and maintenance

12.210 It is possible for cumulative impacts to arise from operations and maintenance of the Project in combination with the operation and maintenance of other marine renewable projects in the Pentland Firth. The main impacts will be disturbance and displacement due to vessel operations and the installed devices themselves and potential mortality due to collisions with moving parts.

12.211 With regards to disturbance caused by vessel traffic, in the context of the existing level of ship movements through the Pentland Firth, it is not considered that maintenance activities will constitute a significant cumulative impact.

12.212 Displacement is defined here as the prevention of individuals from a seabird species from undertaking their normal behaviour within areas previously utilised, due to the presence of a novel stimulus. For the purposes of this assessment, the novel stimulus is considered to be the energy devices themselves (and associated structures) but does not include the related vessel traffic (e.g. maintenance vessels). For devices located wholly underwater (such as the proposed tidal turbines) the zone of impact is limited to the turbine deployment area, as it seems probable that beyond this birds will be unaware of their presence. Devices which are visible on the surface (e.g. wind turbines and wave energy devices) may also displace birds from a surrounding region. No significant impacts are identified with regards to displacement from the MeyGen Project area alone, in large part due to the very low numbers of individuals at risk of such effects. Since other proposed developments are likely to generate impacts of a similar magnitude the likelihood of a cumulative displacement effect is considered to be very small and of no significance.

12.213 The marine renewable projects considered most likely to contribute to a cumulative collision impact with the Project are the other proposed tidal projects within the Pentland Firth region; Ness of Duncansby, Brough Ness and Cantick Head. Wave energy projects were excluded from this list on the basis that the technologies proposed to harvest wave energy will be located at the surface, will be more visible and will have less rapidly moving parts. Therefore, these devices are considered to constitute a much lower collision risk to diving seabirds.

12.214 Currently each of the tidal developments plan to use a different form of turbine; Cantick Head intend to use devices with enclosed blades, Brough Ness intend to use twin turbines mounted to a fixed tower and Ness of Duncansby is expected to use open turbines (similar to those to be used for the MeyGen Project). It is plausible that each of these devices will present different potential collision risks to diving seabirds, complicating attempts to estimate cumulative impacts.

12.215 Gannet and cormorant are determined to be at negligible risk of significant impacts from underwater collisions, since the rates of collision required to trigger population level impacts are considerably higher than the peak number observed on the MeyGen survey area. Therefore, any potential additional risk from other developments is considered very unlikely to lead to a significant cumulative effect. While gannets are also at risk of collision with offshore wind turbines, the very low numbers observed on the MeyGen survey area exclude this as a potential cumulative impact with collisions with tidal turbines.

12.216 Common guillemot, razorbill and puffin were assessed to be at minor risk of collision impacts from the Project and there is therefore the potential for significant combined impacts with other tidal projects. However, the populations of these species within foraging range of the various sites are large, and the peak number of individuals assessed as being at risk of collision on the MeyGen Project area were very small, therefore the likelihood of a significant impact is assessed as being small.

12.217 Shag and black guillemot have smaller local populations and were seen more frequently on the MeyGen survey area. Therefore these species are considered to be at the greatest risk of population impacts due to collisions. Two of the other tidal developments under consideration, Brough Ness and Cantick Head, are located 11km from the MeyGen Project site which is near the upper range of the mean maximum foraging range for both these species. While this does not rule out the possibility that individuals from the same population may forage across all three sites, the probability of this is considered to be low, therefore the potential for a cumulative collision impact in combination with these two projects is considered sufficiently small to be insignificant.

12.218 The Ness of Duncansby site is located 3km from the MeyGen site and therefore there is a higher probability that individuals from the same population may be present on both sites, leading to a potential for cumulative impacts on the same populations. However, given the seabed conditions expected to be present at sites of high tidal flow such as these (scoured bedrock), and the favoured current speeds (which are much lower than those present at either location), it seems highly unlikely that either of these two locations (i.e. Inner Sound and Ness of Duncansby) represents prime habitats for favoured prey of either species (e.g. sandy substrates for sandeels and vegetation for butterfish). Therefore the likelihood that either of these species will use the turbine deployment areas for foraging, particularly during periods of turbine operation, is considered to be small. Therefore no significant cumulative impact is predicted for either of these species.

12.219 Based on the findings of the fish assessment baseline description (Section 13) very few fish prey species are expected to be present in significant numbers in the Inner Sound and seabed habitats present in the site are unsuitable for fish spawning. Since this is assumed to be a consequence of the strong tidal flow within the site, it seems likely that similar conditions will be found within the other proposed tidal development sites. Hence, all of the tidal sites are considered to provide sub-optimal foraging opportunities for seabird species preying on benthic invertebrates (e.g. eider).

12.220 Fish present in the water column may be displaced by the presence of the tidal turbines, or alternatively the support structures may provide them with areas of shelter. Thus it is possible that the devices may lead to either a decrease or an increase in fish abundance at the site. Variations in local conditions between developments will also be expected to influence the probability of changes in fish abundance. It should be noted however that any reduction in abundance would only be expected to occur within the immediate vicinity of the turbines themselves, and this would be unlikely to be reflected in changes in abundance at a wider scale. Currently it is not possible to determine how tidal turbines may affect fish densities, however there is no compelling evidence that significant indirect cumulative impacts on foraging seabirds will result from the installation of the marine renewable developments under consideration.

12.10.4 Potential cumulative impacts during decommissioning

12.221 Although it is possible that a number of the impacts which may occur during decommissioning (e.g. noise emissions, vessel traffic), there is limited scope for these to act cumulatively with other developments since it is highly unlikely that the other developments within the region would be decommissioned at the same time. Therefore no significant cumulative impacts of decommissioning are predicted.

12.10.5 Mitigation requirements for potential cumulative impacts

12.222 No mitigation is required over and above the Project specific mitigation.

12.11 Habitat Regulations Appraisal

12.223 For projects which could affect a Natura site, a competent authority (in this case Marine Scotland for offshore and The Highland Council for onshore) is required to determine whether the Project will have a likely significant effect on the qualifying interests of any Special Protection Areas (SPAs) and any Special Areas of Conservation (SACs). Depending on the outcome of this determination, the competent authority will undertake an Appropriate Assessment of the implications of the Project for the Natura site's conservation objectives. The responsibility for provision of information with which to inform the Appropriate Assessment rests with the applicant.

12.224 The Project lies within part of the seaward extension of the North Caithness Cliffs SPA, which given the presence of qualifying species from this SPA in the site, automatically triggers the requirement for an Appropriate Assessment. Due to the distances over which bird species for which SPAs are designated can travel, there has been a need to investigate the Likely Significant Effects on a number of SPA sites. This assessment is presented in a separate HRA report (see HRA document on the supporting studies CD, MeyGen, 2012).

12.12 Proposed Monitoring

12.225 Potential impacts on birds have been assessed as being negligible or minor. Although the results conclude that the Project does not pose a significant risk to birds, MeyGen recognises that due to the emerging nature of the tidal energy industry there is uncertainty about some potential impacts especially where these have yet to be verified by operational monitoring in the industry.

12.226 Where impacts cannot be fully quantified (e.g. turbine collision risk), MeyGen is committed to developing a bird monitoring program. This program will be based on the 'Survey, Deploy and Monitor' strategy in accordance with Scottish Government policy (currently available in draft).

12.227 MeyGen has recognised that being the first application for a commercial scale tidal stream project in Scotland and the first from The Crown Estate's Pentland Firth and Orkney Waters leasing round, has meant that there is potential for the Project to form part of an industry wide strategic monitoring program that will benefit future projects as well.

12.228 Where strategic monitoring is appropriate, MeyGen would look to a collaborative effort between the Project, wider industry, regulators and stakeholders to take this forward in the most efficient way for the interest of the Project and future projects elsewhere in Scotland and the UK.

12.229 As part of this EIA and the MeyGen commitment to post-installation monitoring, the draft SNH survey and monitoring guidance (MacLeod *et al*. 2011, Sparling *et al*. 2011) has been reviewed. Although this guidance does not, and cannot, give specific details of what ornithology monitoring should take place, based on the general approaches described and on current knowledge of the site (obtained from the extensive baseline surveys), it is likely that the monitoring programme could include some or all of the following:

Disturbance and displacement (birds at sea)

- Targeted boat or land-based observations of all bird species to determine how area use or behaviour may have changed over time. Critical periods of the year are the breeding season; and
- Collection of underwater noise measurements of the candidate prototype tidal turbines. The data collected will be used to validate the underwater noise modelling completed to inform the impact assessment.

Collision risk (birds at sea)

12.230 MeyGen believes that understanding diving bird behaviour around tidal turbines and the risk of collisions occurring is fundamental for the industry to progress. It is therefore proposed that this potential impact is considered as strategic research and therefore monitoring approaches should be developed in cooperation with regulators, stakeholders and other developers. Monitoring could include:

- Installation of one or more active monitoring systems on one or more tidal device to better understand the near-field response of bird species to operating tidal devices; and
- Other strategic research such as expanding current research on the extent of connectivity between the site and local breeding colonies. Fitting individual birds with geo-locating tags and dive data loggers will provide information on this and would also contribute to collision risk monitoring.

12.231 MeyGen will work with the regulator (Marine Scotland) and its advisory bodies (e.g. SNH) to agree the details of appropriate monitoring and will ensure that the monitoring programme is aligned with industry best practice. Methods for assessing disturbance and displacement impacts and collision risk can potentially be linked with similar effort required for Section 11 Marine Mammals and Section 13 Fish Ecology.

12.232 Where monitoring indicates that specific mitigating measures may be reasonably required, MeyGen is committed to put these in place.

12.233 With regards to the onshore aspects of the Project, once the final onshore development areas are known, a pre construction bird survey will be undertaken, the scope of which will be agreed with SNH.

12.13 Summary and Conclusions

12.234 During the MeyGen commissioned surveys of the Pentland Firth Inner Sound conducted between October 2009 and September 2011, 28 species of seabird, seaduck or diver were recorded. Many of these are qualifying interests for SPAs within the region and are thus afforded European protection status. The seabirds observed make use of the Inner Sound for a range of activities (e.g. loafing, foraging) and different species have shown different seasonal trends in site presence and abundance. Species recorded on the sea surface during the boat surveys which were present predominantly over winter were; common gull, herring gull, great black-backed gull, red-throated diver and eider. Species recorded on the sea surface during the boat surveys which were present in greatest numbers during the breeding season were; great skua, common guillemot, razorbill and puffin. Of the remaining species recorded on the sea surface during the boat surveys, gannet and kittiwake were seen in most months, albeit at very low densities, while fulmar, shag and black guillemot were seen in most months at higher densities. Cormorant and Arctic tern were observed occasionally during the land based observations, cormorant predominantly during winter and Arctic tern only in the breeding season.

12.235 Potential impacts associated with the construction, installation, operation, maintenance and decommissioning of the development on bird ecology have been assessed. This assessment identified a number of key issues associated with bird ecology, including disturbance and displacement caused by construction activity and vessel operation, disturbance and displacement caused by the turbines themselves, collision risk with the turbines and accidental spillage of pollutants from vessels (both construction and maintenance) and from the turbines.

12.236 Disturbance and displacement impacts due to vessel traffic during construction were assessed on the basis of each species' sensitivity to vessels and site usage (e.g. if species are present only in winter the risk of construction impacts are small). The combination of the small scale of the Project, the proposed choice of construction vessels and the sensitivity of each species to these sources of disturbance resulted in impacts of negligible / not significant or minor / not significant being assessed.

12.237 Disturbance due to maintenance vessels was considered to cause and even lower levels of impact than during construction, since this will involve smaller vessels present for shorter periods of time, hence impacts of no more than negligible / not significant or minor / not significant were assessed.

12.238 Disturbance and displacement impacts due to construction activities, in particular in relation to drilling for piles were assessed on the basis of direct noise impacts on diving birds and also indirect ones on potential fish prey species. The hearing sensitivity of diving seabirds is not well understood. However, given that the impacts on fish, which have much more sensitive underwater hearing, were considered at worst to result in strong avoidance of the noise source to a distance of 10m (Section 13), the impacts were assessed for diving seabirds as not significant.

12.239 Displacement of diving seabirds due to the presence of the turbines was assessed on the basis of potential sub-lethal impacts. As a worst case, displaced birds could fail to breed successfully. Using population models to explore reduced reproduction at the population level, all of the species assessed (those diving species present in greatest numbers during the breeding season) were found to be at risk of negligible / not significant impacts.

12.240 Collision risk for diving species was assessed for those species considered to be at potential risk on the basis of foraging ecology. These species were gannet, shag, cormorant, common guillemot, razorbill, black guillemot and puffin. Assessment of potential impacts used a combination of exposure time modelling and population modelling to determine the likelihood that sufficient mortality due to collisions with turbines could occur in order to cause a population level impact. Gannet and cormorant were determined to be at negligible / not significant risk of collision impacts, while shag, common guillemot, razorbill, puffin and black guillemot were assessed to be at risk of minor / not significant collision impacts. No specific mitigation measures were identified for this impact, however MeyGen is committed to working with the regulator to undertake monitoring to reduce uncertainty in the assessment of this potential impact.

12.241 The risk of impacts due to accidental spillage of pollutants from either vessels or turbines, and also during drilling operations, was assessed in relation to seabird sensitivity to surface pollutants and the likelihood of such events. No significant impacts were identified. Mitigation measures identified for this impact in relation to vessels include standard measures to prevent the risk and minimise the impact should a spill occur, and in relation to turbines the use of low toxicity and biodegradable fluids wherever possible.

12.14 References

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