European Offshore Wind Deployment Centre
Environmental Statement

Appendix 12.1: Marine Mammals Baseline Technical Report

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GENESIS

European Offshore Wind Deployment Centre

Marine Mammal Environmental Baseline

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Contents

FIGURES

TABLES

1. INFORMATION FOR THE NON-TECHNICAL SUMMARY

The marine mammal environmental baseline drew upon existing research surveys conducted on marine mammals in the wider area as well as several years of land based and boat surveys of the wider EOWDC development area. Several marine mammal species have been recorded (sighting and/or stranding) in Aberdeen Bay and the surrounding area; including 12 odontocete species, three mysticete species and three pinniped species. Of these, bottlenose dolphins, harbour porpoises, white-beaked dolphins, minke whales, Risso's dolphins, harbour seals and grey seals occur regularly in the area, with other species only being recorded occasionally or rarely.

Bottlenose dolphins in the Aberdeen area are part of the resident population from the Moray Firth Special Area of Conservation (SAC), which have a range extending from the Moray Firth to the Firth of Forth. There appears to be sub-groups within the population with one group spending most of their time within the inner Moray Firth (SAC) and the other group having a wider range and spending less time in the inner Moray Firth area.

The bottlenose dolphin population of the Moray Firth has recently been expanding its range in a southerly direction, beyond the boundaries of the Moray Firth SAC, with an increase in sightings and identified individuals along the east coast of Scotland as far as St Andrews and the Firth of Forth. Although Aberdeen is recognised as an important area for bottlenose dolphins, further studies are required to more accurately determine the proportion of the population that utilises this area throughout the year.

Bottlenose dolphins are generally found within coastal waters, although have been observed in offshore areas off north-east Scotland. Bottlenose dolphins have been observed off Aberdeen throughout the year, although there appears to be an increase in occurrence between November and May.

Bottlenose dolphin were the second most frequently sighted cetacean species during the surveys carried out as part of the EOWDC, with a total of 200 individuals being detected. The majority of the sightings occurred in the spring and summer months. A higher number of bottlenose dolphins were recorded in the wind farm area in comparison to the control site and in the vicinity of the entrance to Aberdeen harbour, which is a known hotspot for dolphin sightings. Their presence at this site has been linked to salmon migration up the river.

Young bottlenose dolphin calves have been observed in the Aberdeen area during spring and early summer, indicating a possible increased sensitivity to any potential disturbance during this time.

From the available information it is apparent that the Aberdeen area is important for bottlenose dolphins, however it is unclear how reliant they are on the area as they are regularly observed, both feeding and with calves, at various locations along the north-east coast of Scotland.

Harbour porpoises are the most common species of cetacean in the North Sea and have a wide range and distribution in both coastal and offshore areas. Harbour porpoises regularly occur in the Aberdeen area throughout the year, with peak occurrence during August and September.

The diet of harbour porpoises is varied and they have been recorded to take a wide range of prey items. In Scottish waters their diet is primarily whiting, sandeels, haddock/saithe/Pollock and *Trisopterus* spp. It is unclear if porpoises in the Aberdeen area are attracted to a specific prey species.

The calving period for harbour porpoises in Scottish waters is estimated to be between April and June, and calves have been observed off Aberdeenshire between May and September, indicating a possible increased sensitivity to any potential disturbance during this time.

Harbour porpoises were the most recorded cetacean species during the EOWDC boat surveys with over 420 individuals detected. The harbour porpoise was the only species that was detected in sufficient numbers to allow a detection function to be applied that would allow for abundance and density estimates to be generated. The density of harbour porpoises was higher in the control area in all seasons except summer. Lowest densities occurred during May and June. The density estimates produced for harbour porpoise all show considerable error margins which is a reflection of the sampling effort, further surveys would reduce this. In the four surveys carried out during 2010-2011 the northern transect had the highest proportion of harbour porpoises, except in January when highest densities were recorded in the southern transect.

The harbour porpoise, as expected, was the most frequently detected cetacean species during the acoustic surveys. In agreement with the results of the visual surveys the control area recorded more acoustic detections than the wind farm survey area. In the acoustic surveys carried out during 2010-2011 higher numbers of detections were made in the offshore survey area during the August and September surveys, although it is too early to conclude whether this represents a movement of animals further offshore during the summer months.

White-beaked dolphins are present in the central and northern North Sea throughout most of the year. Sightings data suggests their presence in the coastal waters off Aberdeenshire is seasonal, with sightings recorded between June and August; however strandings data indicate they may be present in the area between February and October.

The movement of white-beaked dolphins into coastal waters during summer months is thought to relate to the calving period, with calves being observed off Aberdeenshire in all three months that the species has been observed.

The seasonal movement may also be related to the seasonal abundance or movement of prey species, such as herring or mackerel. It is hoped that the marine ecology and fisheries studies will provide more information on potential prey in the area.

Along the Aberdeenshire coast, white-beaked dolphins appear to have a preference for sections of the coast adjacent to deeper waters, with a higher incidence of sightings between Aberdeen and Stonehaven compared to the area between Aberdeen and Collieston.

White beaked dolphins have been detected during the EOWDC surveys over the course of several years during the month of August, this data supports the occurrence of this dolphin as a seasonal summer visitor that possibly moves to coastal waters following prey such as mackerel and for calving purposes. Although white-beaked dolphins are found throughout the central North Sea and generally in more offshore areas, it is apparent that the coastal waters off Aberdeen could be important during the summer/calving period.

Minke whales occur throughout the central and northern North Sea, particularly during summer months. They are generally observed in offshore deeper waters, but appear to move into coastal waters along the north-east coast of Scotland from July.

Minke whales have been recorded off the Aberdeenshire coast primarily during summer months (July – August); although observations and strandings indicate they may be present in the area throughout the year.

The seasonal movement of minke whales into coastal waters during the summer is thought to be related to prey availability. Minke whales generally feed on a small pelagic fish, such as sandeels, herring and sprat.

Six minke whales have been observed as part of the EOWDC surveys. Minke whales are thought to have a preference for water depths of 38m or deeper, these depths are generally found further offshore and beyond the EOWDC crown estate lease, although one minke whale was detected within the lease area during the boat based surveys.

Although minke whales occur regularly in the area off Aberdeen, especially during summer, it is unclear how important the area is relative to other areas.

In the northern and central North Sea, Risso's dolphins are primarily observed around Shetland and Orkney. However, there has been an increase in reported sightings along the north-east coast in recent years. Risso's dolphins have been recorded off Aberdeenshire since 2005 at various times of the year.

The increase in recent sightings in the Aberdeen Bay area may indicate that Risso's dolphins are using the area more frequently, and although occasionally recorded in the area this may change and should be monitored. Possible reasons for the apparent recent increase in observations in the area are unclear, but could be related to prey availability, Risso's dolphins feed primarily on cephalopods, and/or climate change.

Risso's dolphins were observed during vantage point surveys, but not during any of the EOWDC boat surveys. The increase in sightings of Risso's dolphins may point towards an increase in the use of the Aberdeen area in comparison to historic levels.

Harbour seals are widely distributed along the east coast of Scotland. They are present in the Aberdeen area throughout the year. Their occurrence at the estuaries of the Rivers Dee and Don is seasonal with an increase in numbers during the winter and early spring.

Harbour seals use haul-out sites at the Donmouth, at the mouth of the Ythan River and at Catterline. Harbour seals have been observed feeding on salmonids and flatfish at the estuaries of the Rivers Dee and Don, as well as other marine prey species.

The pupping period for harbour seals occurs from June to July and moulting occurs from June to September, during these times they spend a higher proportion of their time ashore and in coastal waters.

Both species of seal grey and harbour seals are regularly present and frequently sighted in Aberdeen bay, especially at the entrances to the rivers Dee and the Don. Grey seals were the most frequently observed seal species recorded during the boat surveys carried out between 2007-2007. Almost equal proportions of grey and common seals were recorded during boat surveys carried out during 2010-2011.

Designated coastal SACs for harbour seals are present along the east coast of mainland Scotland, these are situated in the Dornoch Firth and Morrich Moore in the Moray Firth and Firth of Tay and Eden estuary.

Grey seals are also found along the east coast of Scotland. They are present in the Aberdeen area throughout the year. Grey seals use haul-out sites at the Donmouth, at the mouth of the Ythan River, outside Peterhead harbour, Cruden Bay, Boddom and at Catterline.

The most well established colony in the area is at Catterline, where up to five pups may be born each year. The pupping period for grey seals occurs from October to November and moulting occurs from February to April, during these times they spend a higher proportion of their time ashore and in coastal waters.

Grey seals have been observed feeding on salmonids and flatfish at the estuaries of the Rivers Dee and Don, as well as other marine prey species.

Designated SAC's for grey seals along the east coast of Scotland include the Isle of May at the entrance of the Firth of Forth, and it can be expected that individual seals from these colonies may be passing through and the EOWDC development area.

For species such as white-sided dolphins, killer whales, common dolphins, striped dolphins, long-finned pilot whales, sperm whales, humpback whales, fin whales, northern bottlenose whales, Sowerby's beaked whales and other pinniped species, although present in the area off north-east Scotland this is only a marginal part of their habitat, and is likely to be inhabited only during a restricted part of the year by relatively few individuals.

2. INTRODUCTION

Genesis Oil and Gas Consultants (GOGC) have been commissioned by AOWFL to undertake a marine mammal impact assessment of the EOWDC. The structure of the assessment can be summarised as follows:

- **Baseline Report** (this document) – this provides a summary of the existing information relating to the distribution and abundance of marine mammals in Scotland with a focus on Aberdeen Bay. This report draws on the findings of a desk based study and marine mammal research studies and also dedicated marine mammal surveys carried out for the purpose of supplementing the baseline for the EOWDC.
- **EIA Technical Report** – an assessment of the impact of the project on marine mammals in the study area.
- **Non-Technical Summary Chapter for the Environmental Statement** – a summary of findings from the Baseline Report and EIA Technical Report.

In order to assess the importance of the proposed EOWDC and surrounding area for marine mammals and the potential impacts associated with the project, it is necessary to understand the occurrence and distribution of marine mammals in the area and understand why they are there.

The main aim of the baseline study is to provide detailed information on marine mammals that may be present in the crown estate licence area and also the surrounding area to inform the EIA technical report. The baseline report provides information on the following:

- Marine mammals present in Aberdeen Bay and Scottish coastal waters
- Abundance and distribution of marine mammals, and seasonal patterns of distribution and migration
- Usage of the Aberdeen Bay by marine mammals (feeding, passage area, calving)
- Identification of any potential seasonal sensitivities (e.g. calving period)
- knowledge/data gaps relating to marine mammals in Aberdeen Bay

3. DATA SOURCES

The following key data sources have been used to inform the baseline assessment:

- Boat based surveys of the EOWDC and wider area carried out by Institute of Estuarine and Coastal Studies (IECS) (2007-2008) and the Sea Mammal Research Unit (SMRU) 2010-2011 (Section 3.1)
- Land based Vantage Point surveys carried out as part of the baseline surveys of EOWDC March 2005-2007 Section 3.2
- Joint Nature Conservation Committee (JNCC) aerial survey data of Aberdeen Bay 2005-2006 (Section 3.3)
- Marine mammals present along the Scottish coastline were assessed as part of Strategic Environmental Assessment (SEA) area 5 as part of the oil and gas licensing programme (Section 3.4)
- Northern North Sea Cetacean Ferry Surveys (NORCET) cetacean survey information (Section 3.5)
- Moray Firth cetacean study 2009-2011 into the effects of proposed oil and gas exploration (Section 3.6)
- Cetacean stranding data (Section 3.7)

A full list of documents referenced in the baseline assessment is provided in the reference section.

3.1 BOAT SURVEYS

The aim of all of the boat based surveys was to collect marine mammal data to generate density and abundance estimates by year, month/season and stratified for the wind farm and control site. The passive acoustic monitoring element allowed for the acoustic analysis of marine mammal data to generate detection rates for harbour porpoise and delphinids.

Marine mammal and seabird surveys were carried out on behalf of AOWL by the Institute of Estuarine and Coastal Studies (IECS), University of Hull from February 2007 – April 2008, inclusive.

SMRU Ltd were contracted to undertake 12 monthly surveys for marine mammals and seabirds. Included in the baseline report are provisional survey data collected from the initial four surveys completed in August, September and November 2010 and January 2011.

For all the marine mammals surveys conducted as part of the EOWDC baseline marine mammal observers followed standard survey transect procedures to collect data on marine mammals, and the surveys occurred in a Beaufort sea state 4, or less.

The vessel used for the IECS surveys and the initial 4 SMRU surveys was an ex-Clyde class lifeboat *Gemini Explorer*. It had an observation platform 5.1 m above sea level, cruising speed of 8-9 knots and a clean electronic footprint which was required for the acoustic survey component.

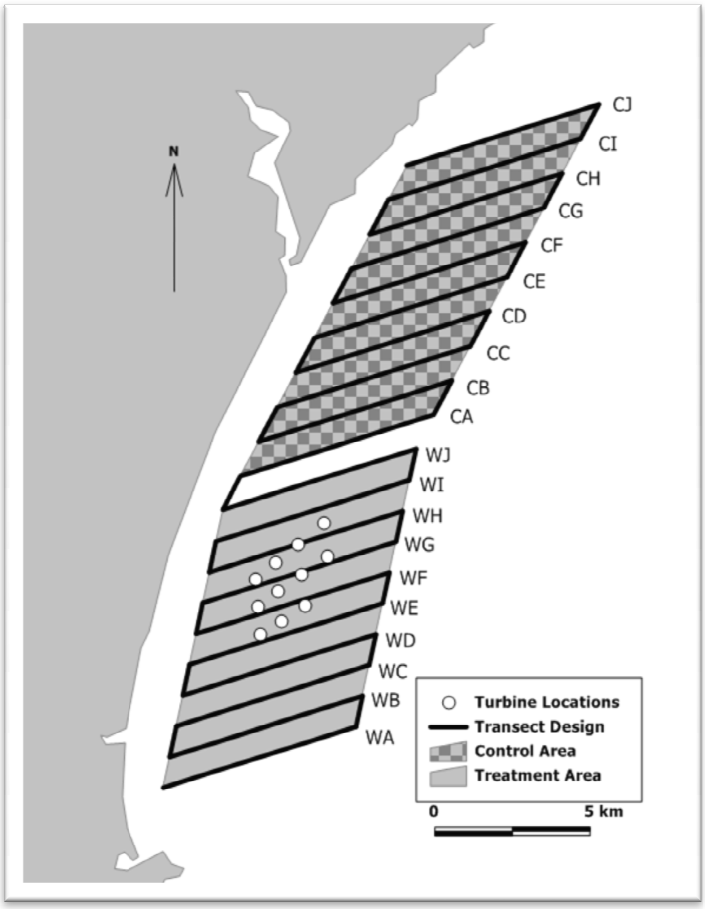
3.1.1 IECS boat based surveys 2007-2008

The survey approach used in the IECS boat based surveys was a Before-After-Control Impact design (BACI) and the scope was for a significantly larger wind farm. The survey approach was developed in consultation with the Joint Nature Conservation Committee (JNCC) and Scottish Natural Heritage (SNH) in 2006. Two survey areas were defined; the 'wind farm' area and a 'control area', immediately to the north (Figure 1). The terminology control area has been used to define one of the survey areas, however, it is accepted that establishing a true control area with equivalent environmental conditions to the wind farm area is difficult, if not impractical for a coastal environment.

In each area (50.8 km^2), parallel line transect surveys were completed across two survey strata (Wind farm and Control). During each survey month, ten transects of 6.5 km length were surveyed in each of the two areas

giving a total survey effort of 130 km per survey month. Surveys were undertaken during a total of 15 months between February 2007 and April 2008 (Table 1), giving 1,950 km of survey effort during this phase of data collection (Travers, *et al*., 2008).

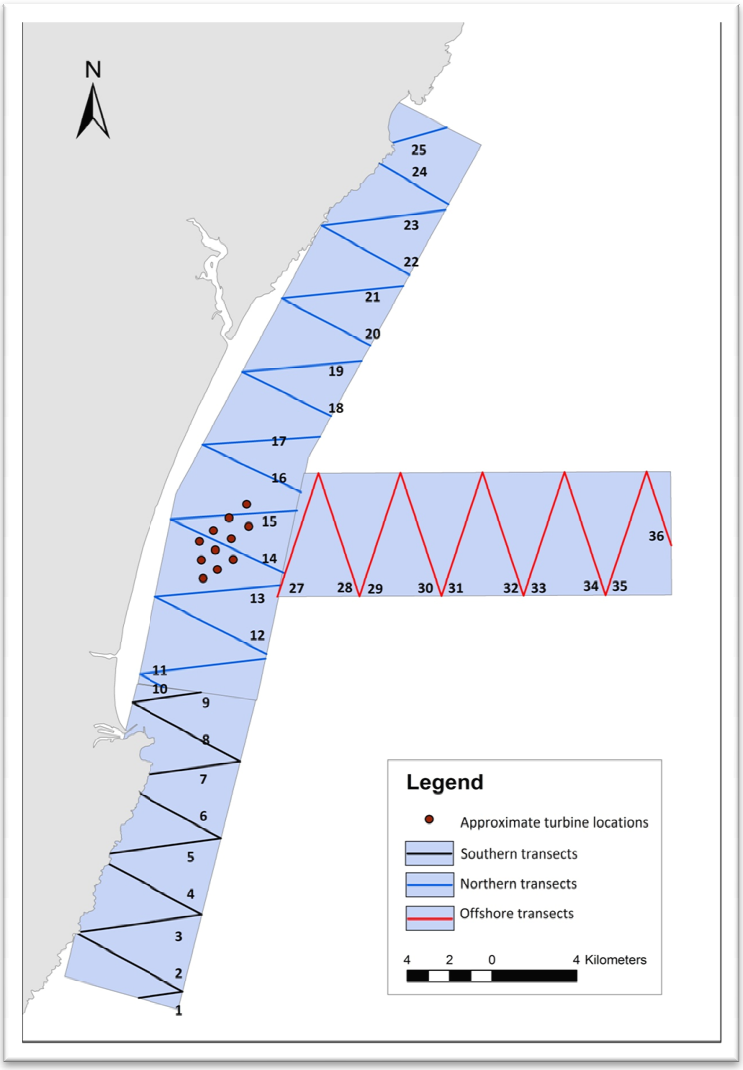
Figure 1 Boat based survey transects 2007-2008 (IECS), the grey area with the turbine locations is the wind farm area and the cross-hatched area is the control area (Travers, *et al*., 2008)



3.1.2 SMRU Ltd boat based surveys 2010-2011

SMRU Ltd were contracted to undertake an additional 12 months of surveys for marine mammals and seabirds. The survey design differed to that used by IECS and is based on zigzag line transects and the survey area is extended into the South, North and Offshore survey areas which were 82.8 km^2, 150.8 km^2 and 105.2 km^2 in area respectively (Figure 2) (SMRU Ltd, 2011a). The North survey area encompassed the Wind farm and 'Control' areas surveyed between February 2007 and April 2008. During each survey , 9, 16 and 10 transects were undertaken in the South, North and Offshore areas respectively, giving a total survey effort of approximately 40 km, 75 km and 60 km per survey block. For each survey a total of 36 transects were therefore surveyed, providing a total of 175 km of survey effort.

Figure 2 The boat based survey areas covered during 2010-2011; the southern area, (survey transects shown in black), the northern area, (survey transects shown in blue), and the offshore area, (survey transects shown in red). The survey transects are also labelled 1-36 (SMRU Ltd, 2011a).



The survey is based on a gradient design and the shortfalls of the 'Before and After Controlled Impact' (BACI) approach used in the first phase of data collection are avoided. The data collected using this gradient approach is compatible, and can be analysed in conjunction with the first phase of boat based surveys. Where sufficient observations of marine mammals have been collected this will allow pooled density estimates and abundances of marine mammals to be generated. The survey results will enable a repeatable baseline to monitor throughout the development of the proposed EOWDC.

All observers operated from the bridge roof (approx 5 m above sea level) and followed standard line transect procedures for marine mammals and modified European Seabird At Sea (ESAS) methods for seabirds. The main change to the ESAS method was the use of a third observer to count flushed birds ahead of the vessel. There were 3 seabird and 4 cetacean observers on each survey. Surveys were carried out in Beaufort sea state 4 or below with good visibility.

Included in this baseline report are the initial results from the data collected from the initial four surveys completed in August, September and November 2010 and January 2011 (SMRU Ltd, 2011a). There have been further surveys carried out in February and March, which have not yet been analysed.

3.1.2.1 Survey Effort during IECS (2007-2008) and SMRU (2010-2011) boat based surveys

The amount of survey effort completed on each transect varied slightly between surveys due to navigational issues (i.e. shipping traffic) or avoidance of heritable fishing grounds. The GPS logger data from each survey were therefore used to provide an accurate measure of survey effort for each transect, and these effort values were used for analysis.

IECS boat based surveys were carried out from February 2007 – April 2008. April was surveyed three times, to concentrate more survey effort during the breeding season, and February was surveyed twice, all other months were only surveyed once. The seasonal survey effort was highest in the winter and spring months with, with 520 km and 650 km, respectively (Table 1).

SMRU surveys were undertaken during August, September and November 2010, and January 2011 a total survey effort of approximately 600 km during this phase of monitoring (Table 2). A survey was not possible during October 2010 due to ongoing seismic surveys and then poor weather. Due to potential access restrictions, that Marine Scotland were made aware of, it was not possible to conduct a December survey.

When the seasonal survey effort collected during the IECS and SMRU surveys are combine there is fairly even coverage during each season, the season with the highest effort is winter (696 km) and the lowest is summer (595 km) (Table 3).

Upon the completion of the final 12 months of survey effort the environmental baseline chapter will be updated and the boat based survey results will be analysed together. Both phases of boat based survey results will be combined and used to develop a spatial model of marine mammal density and abundance throughout the survey area, where sufficient data allows. The results of this further analysis will be considered in any updates necessary to the marine mammal impact assessment and any revisions to the impact assessments will be incorporated.

Table 1 Total number of EOWDC boat based surveys and survey effort between February 2007 and April 2008 (IECS)

Season	Month	Number of surveys	Year	Total Effort (km)	Seasonal effort (km)
Winter	December	1	2007	130	520
	January	1	2008	130	
	February	2	2007, 2008	260	
Spring	March	1	2007	130	650
	April	3	2007, 2008, 2008	390	
	May	1	2007	130	
Summer	June	1	2007	130	390
	July	1	2007	130	
	August	1	2007	130	
Autumn	September	1	2007	130	390
	October	1	2007	130	
	November	1	2007	130	

Table 2 Total number of EOWDC boat based surveys carried out 2010-2011 (SMRU)

Month	Number of surveys	Year	Total Effort (km)
August	1	2010	175
September	1	2010	175
October	0	2010	0
November	1	2010	175
December	0	2010	0
January	1	2011	175
*February**	1	2011	175
*March**	1	2011	175

* February and March data was not available for inclusion in the baseline report

Table 3 Total number of EOWDC surveys and survey effort completed per season between February 2007 and April 2008 (IECS) and August 2010 and January 2011 (SMRU)

Season	Number of Surveys			Effort (km)		
	Total	IECS	SMRU	Total	IECS	SMRU
Winter	5	4	1	695	520	175
Spring	5	5	0	650	650	0
Summer	3	3	1	565	390	175
Autumn	5	3	2	640	390	250

3.1.2.2 Passive Acoustic Monitoring Methods

Passive Acoustic Monitoring was used during the surveys carried out by IECS in 2007-2008 and the SMRU surveys carried out during 2010-2011; the total number of surveys and associated effort is shown in Table 4 and Table 5.

In the IECS survey a hydrophone array was towed behind the survey vessel during the line transects across both the wind farm and control area. Acoustic effort was calculated by examining the times contained within the acoustic files, and comparing these with the GPS data. If acoustic data was being recorded and the vessel was shown to be on a long transect line, the effort status was classed as being “on effort”. If acoustic data was being recorded but the vessel was not sailing a transect line, or was sailing a short transect line, the effort status was classed as “opportunistic”.

During the SMRU acoustic survey a hydrophone array was towed behind the survey vessel during all surveys. Acoustic effort was recorded in the field, and is defined as periods when hydrophone and associated recording equipment are operational and the survey vessel is adhering to one of the pre-designed survey transects. If the hydrophone and associated recording equipment are operational but the vessel is not sailing a transect line, the effort status was classed as “opportunistic”. During the August survey, poor visibility resulted in the repetition of some of the southern transects for the visual observers and these extra transects have been included in the August acoustic analysis.

Table 4 Total number of IECS surveys with hydrophone deployed and survey effort completed per month between October 2007 and April 2008.

Month	Surveys	Effort (km)
Oct-07	1	111
Nov-07	1	102
Dec-07	1	127
Jan-08	1	88
Feb-08	1	127
March-08	0	0
April-08	2	227

Table 5 Total number of SMRU surveys with hydrophone deployed and survey effort completed per month between August 2010 and January 2011

Month	Surveys	Effort (km)
Aug-10	1	207.5
Sept-10	1	168.6
Nov-10	1	166.7
Jan-11	1	164.2

Hydrophone data were run through a harbour porpoise detection algorithm in real time in the field using the Rainbow Click software (freely available from www.ifaw.org). Rainbow click highlights porpoise-type clicks within the acoustic data, and these detections were validated manually to ascertain the number of harbour porpoise detections. Detection rates are expressed as events per kilometre.

In addition to the Rainbow Click files created during the line transect surveys; recordings were also made at a sample rate of 96 kHz. The combined data set was run through the PAMguard "whistle and moan" detector module (PAMguard software freely available from www.pamguard.org) by SMRU Ltd to identify any dolphin whistles that may have been recorded. Detections were validated manually to ascertain the number of dolphin events. Detection rates are expressed as events per kilometre.

3.1.2.3 Analysis methods for visual marine mammal data

Visual marine mammal data was analysed using conventional and multi-covariate distance sampling using Distance version 6 (Thomas et al. 2010). For the marine mammal species detected, there were only enough sightings of the harbour porpoise to enable detection function to be applied for this species only, for all other species too few observations were recorded. Only on transect effort was used in the analysis (i.e. short transit legs between transects were discarded).

The standard equations for estimating density and abundance are:

$$\hat{D} = \frac{n}{2\mathrm{L}.\,\mathrm{esw}}$$

Where *n* is the number of sightings, *s* is the mean group size, *L* is the total length of transect surveyed and *esw* is the effective strip half width. The *esw* is a function (inverse of the detection function *f(y)*) of the perpendicular distances associated with the sighting and is modelled by fitting a key function with series expansion. The best model was primarily judged by the lowest value of the Akaike's Information Criteria (AIC) compared to others. How well the model fitted the data was judged by the Goodness of fit tests and QQ-plots.

Abundance is then simply the density estimate multiplied by the survey area. Variance was estimated empirically using the delta method (Buckland et al. 2001).

Surveys within the same month were combined to generate the density and abundance estimates. The sightings data for harbour porpoises were pooled over the entire 15 month survey period. Data were then stratified at the estimation stage to generate density and abundance estimates by month and season for each of the areas. Months were divided into four seasons: Winter (December, January, and February), Spring (March, April and May), Summer (June, July and August) and Autumn (September, October and November).

3.2 VANTAGE POINT SURVEYS

Shore-based vantage point bird surveys were conducted for two hours weekly at Blackdog and Donmouth and fortnightly at Drums and Balmedie covering a distance of up to 2 km from shore (Figure 10.2). These surveys were designed primarily for bird observations, but collected information on marine mammals observed. Vantage point surveys were conducted from August 2005 until March 2008 (Alba Ecology and Envirocentre 2008).

Bottlenose dolphins have been recorded at all four sites (Donmouth, Blackdog, Balmedie and Drums), with the distance from shore ranging from less than 0.5 km to greater than 3 km and the direction of travel being up and down the coast. Bottlenose dolphins have been observed throughout the year (except in June) and at various times of the day.

Harbour porpoises have been recorded at all four sites (Donmouth, Blackdog, Balmedie and Drums), with the distance from shore ranging from 0.5 km to 2 km and the direction of travel has been both up and down the coast, although the majority appeared to be heading north. Harbour porpoises have been observed in January, February, May, June, July, August, September and December and at various times of the day.

The majority of seal sightings were of individual animals, probably grey seals, although harbour seals were recorded at Blackdog in June 2007 and at the Donmouth in July 2007. Seals have been recorded at all four sites Donmouth, Blackdog, Balmedie and Drums, although there is only one recorded sighting at Drums, with the distance from shore ranging from the surf zone to 1.5 km. Seals have been observed in January, February, March, August and December, at various times of the day.

Other species recorded were Risso's dolphins in April 2006 and April 2007. Single minke whales were recorded at both Donmouth and Blackdog on 13th July 2007, although this may have been the same individual moving along the coast and a large unidentified cetacean more than 5 km from the coast was observed in December 2006.

3.3 JNCC MARINE MAMMAL OBSERVATIONS DURING WINTER AERIAL SURVEYS OF ABERDEEN BAY

The Joint Nature Conservation Committee (JNCC) conducted aerial surveys of wintering aggregations of seaducks, divers and grebes within Aberdeen Bay in December 2004, February 2005, December 2005, January 2006, May 2006 and April 2007. Surveys were conducted from light aircraft, following a line-transect method (details of the survey methods are provided in Söhle *et al*. (2006) and Wilson *et al*. (2006). During these surveys observations of bottlenose dolphins and harbour porpoises were recorded incidentally (Table 6).

Table 6 Marine mammal observations during JNCC aerial surveys of Aberdeen Bay (2004-2007) (Söhle *et al*.,, 2006; Wilson *et al*., 2006)

Date	Bottlenose dolphin	Harbour porpoise
11th December 2004	4	0
17th February 2005	1	0
8th December 2005	4	6
24th January 2006	0	5
10th May 2006	0	0
26th April 2007	1	0

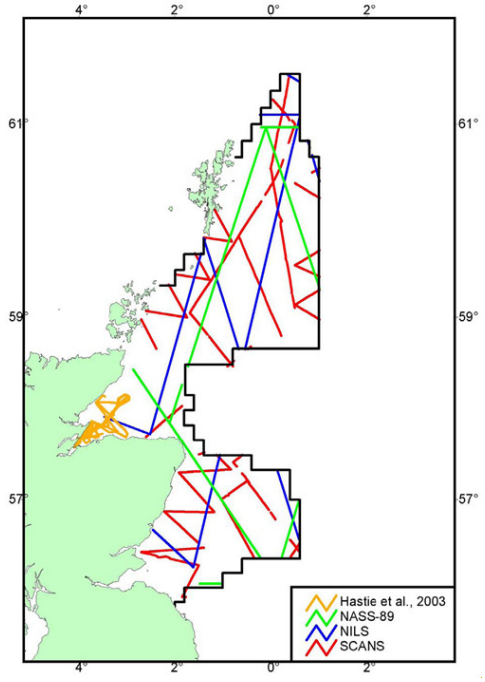
3.4 DISTRIBUTION AND ABUNDANCE OF CETACEANS TO THE NORTH AND EAST OF SCOTLAND (SEA5)

Hammond *et al*. (2004) examined the distribution and abundance of cetaceans occurring to the north and east of Scotland during the Strategic Environmental Assessment (SEA) 5 (Figure 3). Species that are known to occur regularly in this area are the harbour porpoise, white-beaked dolphin, Atlantic white-sided dolphin, killer whale, bottlenose dolphin and minke whale. In addition there are occasional at-sea records in the area of at least eight further cetacean species: humpback whale, fin whale, sperm whale, northern bottlenose whale, long-finned pilot whale, Risso's dolphin, short-beaked common dolphin and striped dolphin.

Hammond *et al*. (2004) reviewed quantitative information for this area from a variety of sightings surveys including the Small Cetacean Abundance in the North Sea (SCANS) survey in July 1994 (Hammond *et al.* 1995; 2002), the North Atlantic Sightings Surveys (NASS) in July 1989 (Bjørge and Øien, 1995), and the Norwegian Independent Line transect Surveys (NILS) in July 1995 and 1998 (Schweder *et al.,* 1997; Skaug *et al.,* 2003). There are also published cetacean observations made during seismic surveys in 1996 to 1999 (Stone, 1997; 1998; 2000; 2001; 2003a). Acoustic recordings have also been used to determine the general distribution and seasonal patterns of movement of some cetacean species by Cornell University, Aberdeen University and the Joint Nature Conservation Committee using the US Navy's SOSUS hydrophone array and low frequency sonor buoys (Swift *et al.,* 2002).

Information from Hammond *et al*. (2004) has been included in this review, with particular reference to the north-east coast of Scotland.

Figure 3 SEA 5 Area: north and east Scotland, including cruise tracks from various surveys conducted in the SEA5 area and SCANS (Hammond *et al.*, 1995; 2002: black line outlines SEA5 area)



3.5 Northern North Sea Cetacean Ferry Surveys (NORCET)

Cetacean surveys have been conducted from the bridge of the *MV Hascosay* ferry between Aberdeen, Orkney and Shetland during daylight hours in summer months (April to September) from 2002 to 2006 (MacLeod *et al.*, 2007). Data from these surveys provided important additional information on the occurrence and distribution of cetaceans in areas away from the coast that are not regularly covered by other surveys. Although the surveys have been continuing after 2006, no analysed sightings data was available.

In the first five years, surveys were been conducted on over 100 days and 383 sightings of 1,148 individual cetaceans were recorded. These sightings represent 10 different species. The most commonly sighted species was the harbour porpoise (164 sightings) which were recorded throughout the region. Minke whales were the second most commonly recorded species (55 sightings) and were most commonly sighted in deeper waters of the outer Moray Firth in early summer and in more coastal waters in later summer. The third most commonly seen species was the white-beaked dolphin (53 sightings). Again this species was recorded through out the study area, but was most commonly sighted in July and August in coastal waters. Thirty-nine groups of bottlenose dolphins were sighted, but this species was almost exclusively sighted close to shore as the ferry passed along the coast of mainland Scotland. Only harbour porpoises, minke whales and bottlenose dolphins were recorded in all summer months. The remaining species sighted were the Atlantic white-sided dolphin (10 sightings), the common dolphin (9 sightings), the Risso's dolphin (6 sightings), the killer whale (3 sightings), the fin whale (3 sightings) and the humpback whale (1 sighting).

The data collected from the NORCET ferry surveys 2002-2006 is summarised in Figure 4. The proportion of cetacean species detected during each month and year of survey effort is illustrated in Figure 5 and Figure 6.

Figure 4 Cetacean species detected along the north east coast of Scotland during NORCET Ferry crossings 2002-2006 (MacLeod *et al.*, 2007)

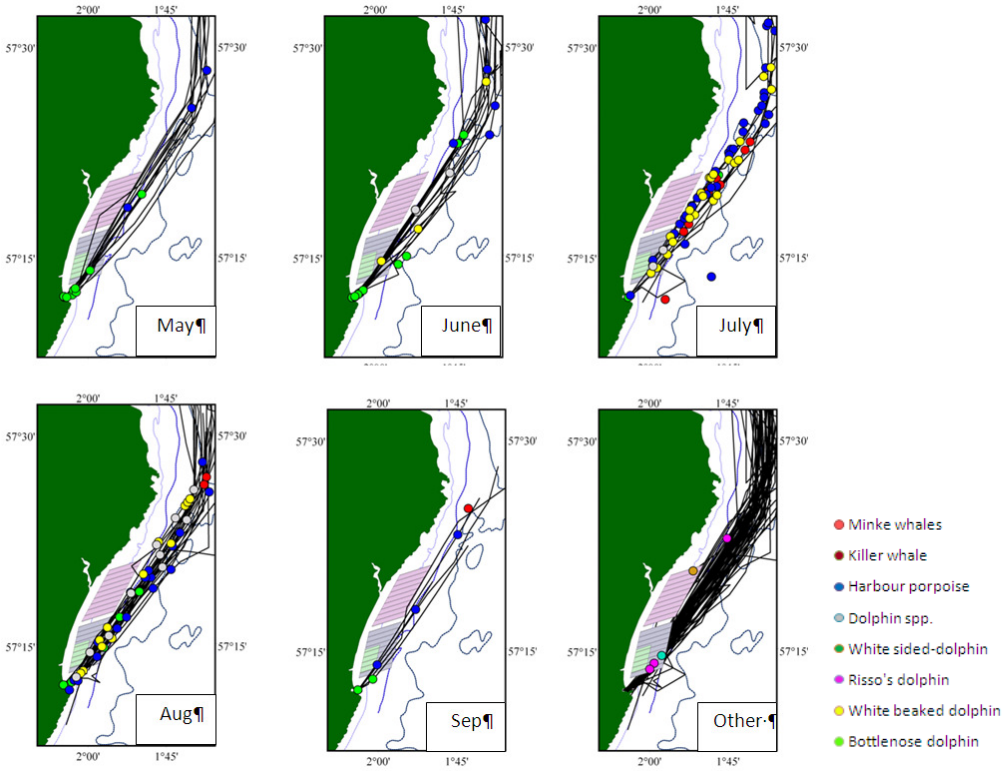


Figure 5 Proportion of cetacean sightings per month during the NORCET surveys 2002-2006(Data used from MacLeod *et al.*, 2007)

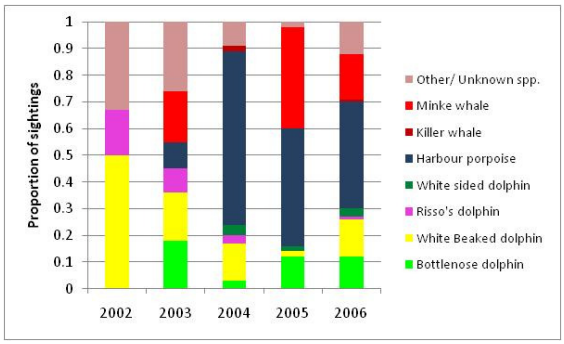
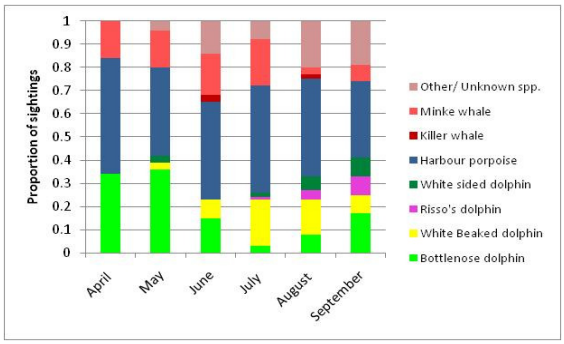


Figure 6 Proportion of cetacean sightings per year during the NORCET surveys 2002-2006(Data used from MacLeod *et al.*, 2007)



3.6 MORAY FIRTH STUDY ASSESSING IMPACTS OF POTENTIAL OIL AND GAS SEISMIC SURVEYS

The Department and Energy and Climate Change (DECC), with co-funding from the Scottish Government COWRIE and Oil and Gas UK funded a three year research programme that will finish in 2012 to assess the potential impacts of proposed oil and gas activities on cetaceans in the Moray Firth. The project involved the collection of boat based survey, aerial survey (2010) and deployment of acoustic hydrophones (C-Pods) to detect the vocalisations of cetaceans. The interim results of the first two years of surveys have been published and results applicable to the two main cetacean species observed in the Moray Firth the harbour porpoise and bottlenose dolphin will be presented (Thompsen, *et al*., 2010; Thompsen *et al*., 2011).

3.7 CETACEAN STRANDING DATA: FRASERBURGH TO INVERBERVIE (JANUARY 1992 – MARCH 2010)

The Scottish Agricultural College Veterinary Services at Inverness carry out necropsies on stranded and by-caught cetaceans in Scotland for the DEFRA funded Marine Mammal Strandings Program as part of the United Kingdom Government's commitment to a number of international conservation agreements. Post mortem procedures, sampling and data collection by the SAC follow the recommended procedure of the European Cetacean Society (Kuiken and Hartmann, 1991) and the UK Marine Mammal Project (Law, 1994).

Nine cetacean species have been recorded in the strandings database by the Scottish Agriculture College along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and March 2010 (SAC, 2006; CSIP 2010). Of the 167 cetaceans in the strandings records for the north-east coast the majority (approximately 78%) were harbour porpoises, other species were white-beaked dolphins, sperm whales, minke whales, common dolphins, Risso's dolphins, bottlenose dolphins, long-finned pilot whale and Sowerby's beaked whale (Table 7).

Table 7 Strandings data recorded from Fraserburgh to Inverbervie 1992-2006 (SAC, 2006; CSIP 2010)

Species	Number
Harbour porpoise	130
White-beaked dolphin	14
Sperm whale	9
Minke whale	5
Common dolphin	3
Risso's dolphin	2
Bottlenose dolphin	2
Long-finned pilot whale	1
Sowerby's beaked whale	1

4. MARINE MAMMALS IN ABERDEEN BAY AND SURROUNDING AREA

The northern and central North Sea is in an important area for several marine mammal species. Minke and killer whales, white-beaked and white-sided dolphins and harbour porpoises may occur regularly in the area, of which the harbour porpoises, minke whales and white-beaked dolphins are the most abundant. Bottlenose dolphins are regularly seen in coastal waters in the Moray Firth and along the north east coast of Scotland. Long-finned pilot and sperm whales, common, striped, Risso's and bottlenose dolphins are less frequently sighted in the central and northern North Sea, while other species including northern bottlenose, Sowerby's beaked, fin and humpback whales are encountered infrequently/ rarely (Hammond *et al*., 2001, 2002, 2004; Northridge *et al*., 1995; Reid *et al*., 2003; Stone, 1997, 1998, 2000, 2001, 2003a, b; Weir and Stockin, 2001; Weir *et al*., 2007; Wilson *et al*., 2000).

There abundance of marine mammal species that are known to occur, or have been previously recorded, in Aberdeen Bay area is shown in Table 8.

Table 8 Summary of abundance of marine mammals within Aberdeen Bay

Common name	Latin name	Abundance
Bottlenose dolphins	*Tursiops truncatus*	common/regular
Harbour porpoises	*Phocoena phocoena*	common/regular
White-beaked dolphins	*Lagenorhynchus albirostris*	common/seasonal
Minke whales	*Balaenoptera acutorostrata*	common/seasonal
White-sided dolphins	*Lagenorhynchus acutus*	occasional
Killer whales	*Orcinus orca*	rare
Common dolphins	*Delphinus delphis*	infrequent/rare
Risso's dolphins	*Grampus griseus*	occasional
Striped dolphins	*Stenella coeruleoalba*	rare
Long-finned pilot whales	*Globicephala melas*	infrequent/rare
Sperm whales	*Physeter macrocephalus*	infrequent/rare
Humpback whales	*Megaptera novaeangliae*	rare
Fin whales	Balaenoptera physalus	rare
Sowerby's beaked whales	*Mesoplodon bidens*	rare
Northern bottlenose whales	*Hyperoodon ampullatus*	rare
Harbour seals	*Phoca vitulina*	common/regular
Grey seals	*Halchoerus grypus*	common/regular

Between 1999 and 2001, a total of 9 different cetacean species were reported between Peterhead and Arbroath (Weir and Stockin, 2001). The most frequently sighted cetaceans were the bottlenose dolphin and harbour porpoise. Both species were reported from all along the coastline, although the majority of bottlenose dolphin sightings were in the vicinity of Aberdeen harbour. Other species recorded include the white-beaked dolphin, minke whale, killer whale and long-finned pilot whale (Weir and Stockin, 2001). Since 2001 a further three cetacean species have been recorded for the first time in the area; these were humpback whale, northern bottlenose whale and Risso's dolphins (SGSW unpublished data).

Marine mammal surveys have been conducted along the Aberdeenshire coast from 2001 to 2005 (prior to the EOWDC marine mammal surveys), during these surveys a total of seven different species of cetacean were recorded: bottlenose dolphins, harbour porpoises, white-beaked dolphins, minke whales, long-finned pilot whales, Risso's dolphins and humpback whales (Canning, 2007). Bottlenose dolphins, harbour porpoises, minke whales, white-beaked dolphins, harbour seals and grey seals are known to occur regularly in the Aberdeen Bay area.

For cetacean species such as common dolphins, fin whales, humpback whales, northern bottlenose whales, long-finned pilot whales, sperm whales and striped dolphins the area off north-east Scotland is only a marginal part of their habitat, and is likely to be inhabited only during a restricted part of the year (Hammond *et al.*, 2004).

Table 9 Summary of the presence, seasonal occurrence and seasonal sensitivities of marine mammals in the Aberdeen Bay area

Species	Presence	Seasonal Occurrence											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottlenose dolphin	regular				*	*	*	*	*	*			
Harbour porpoise	regular				*	*	*	*	*	*			
White-beaked dolphin	regular/seasonal						*	*	*				
Minke whale	regular												
White-sided dolphin	occasional												
Killer whale	rare												
Common dolphin	occasional												
Risso's dolphin	occasional/regular												
Striped dolphin	rare												
Long-finned pilot whale	occasional												
Sperm whale	rare												
Humpback whale	rare												
Fin whale	rare												
Northern bottlenose whale	rare												
Sowerby's beaked whale	rare												
Harbour seal	regular						*	*	*	*			
Grey seal	regular		*	*	*						*	*	
Hooded seal	rare												

Key

	Present in area (sighting and/or stranding)
	Peak abundance
	Potential to be present in area
*	Seasonal sensitivities (e.g. calving period, moulting period)

5. CETACEANS

5.1 BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*)

5.1.1 Distribution

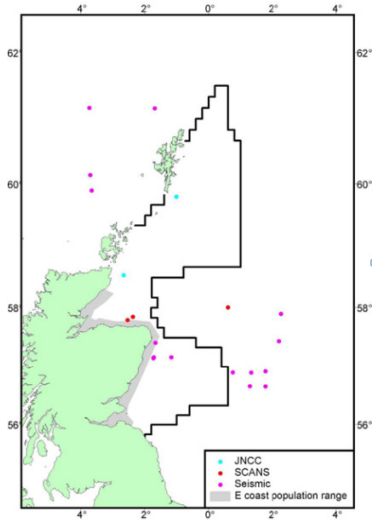
Bottlenose dolphins occur world-wide; they are found in virtually all tropical and temperate seas and occupy most marine habitats from the open ocean to coastal lagoon. Bottlenose dolphins occur in European waters along the Atlantic shores from Portugal to the Faroe Islands. Their distribution appears to be linked to sea temperature; in the north-east Atlantic resident coastal populations extend only as far north as Scotland. However, the species is caught in the Faroes drive fishery, suggesting that it may be more abundant and widespread than is generally thought (Hammond *et al.*, 2001). Bottlenose dolphins are not particularly common in the north-eastern area of the North Atlantic but there are a number of well-documented and, in some cases, well-studied coastal populations along the Atlantic margin of Europe (Hammond *et al*., 2004).

There are two main areas of UK territorial waters where there are semi-resident groups of bottlenose dolphins: Cardigan Bay in Wales and the Moray Firth on the north-east coast of Scotland. Both of these areas have been designated Special Areas of Conservation (SAC) for bottlenose dolphins. There are also smaller populations of bottlenose dolphins off south Dorset, around Cornwall and in the Sound of Barra in the Outer Hebrides. Other bottlenose dolphin groups, presumed to be of transients, have been recorded further offshore in deeper water to the west of Scotland.

Figure 9 shows the locations of bottlenose dolphin sightings made during systematic surveys and some platforms of opportunity off north-east Scotland (Hammond *et al*., 2004). The few observations offshore in the North Sea may indicate that animals from the Moray Firth population could be distributed offshore at least for part of the year (Hammond *et al*., 2004).

During the SCANS II surveys in July 2005, bottlenose dolphins were encountered around the coasts of Britain, Ireland, France, Spain and Portugal. They were also sighted in outer shelf waters off Scotland and Ireland and in the Celtic Sea. The total abundance of bottlenose dolphins for the entire SCANS II survey area is estimated to be 12,645 (CV=0.27) (SCANS II, 2008).

Figure 7 Scottish east coast range and sightings of bottlenose dolphins from various sources (Hammond *et al.*, 2004)



5.1.2 Occurrence in Aberdeen Bay and surrounding area

Bottlenose dolphins are known to occur regularly in the Aberdeen Bay area. Observations indicate they are present in the area throughout the year, with a peak occurrence during the winter and spring months (November-May), when they can be observed almost daily feeding at Aberdeen Harbour (Canning, 2007; Stockin *et al*., 2006).

The habitation of Aberdeenshire's coastal waters by bottlenose dolphins appears to have increased since the early 1990s and they are now the most frequently reported cetacean species in the area (Stockin *et al*., 2006; Weir and Stockin, 2001). There has been a recent increase in sightings along the east coast of Scotland as far south as St Andrews (Wilson *et al*., 2004).

Analysis of cetacean distribution and habitat use along the Aberdeenshire coast, indicate that the entrance to the River Dee (Aberdeen harbour) is an important feeding area for bottlenose dolphins, especially during the winter and spring when dolphins are most abundant (Canning, 2007). The majority of sightings away from Aberdeen were of groups travelling while those sighted at Aberdeen generally exhibited foraging behaviours (Canning, 2007).

Bottlenose dolphin presence at Aberdeen harbour showed a strong correlation with tidal height and river flow. These factors are also known to influence salmon migration up river, suggesting that salmon presence is the factor attracting these dolphins to this site. The seasonal pattern in the age of salmon that move upstream (with the older, multi-winter fish coming inshore during the winter and spring), matches the seasonal pattern in the bottlenose dolphin sightings suggesting they could be targeting these older fish (Canning, 2007).

The importance of the Aberdeen harbour area during the winter is the opposite of what has been observed within the Moray Firth, where the majority of sightings are during the summer (Wilson *et al.*, 1997a). Bottlenose dolphins are now also regularly recorded off St Andrews (70 miles south of Aberdeen) and again the sightings here

are mainly during the summer, with peak sightings occurring between June and August (N. Quick, Pers. Comm.; Hammond *et al.*, 2004).

Bottlenose dolphin sightings recorded during targeted project Vantage Point surveys (August 2005 – March 2008) are summarised in Table 10 .

Table 10 Bottlenose dolphin sightings recorded during Vantage Point surveys (August 2005 – March 2008)

VP site	Observations
Donmouth	April 2006, May 2006, March 2007, April 2007, July 2007, August 2007, September 2007 and March 2008
Blackdog	April 2006, May 2006, July 2006, August 2006, January 2007, and July 2007
Balmedie	December 2005, August 2007 and April 2007
Drums	August 2005, November 2005, August 2006, December 2006, February 2007 and July 2007.

During the JNCC aerial survey of Aberdeen Bay, bottlenose dolphins were recorded in December 2004, February 2005, December 2005 and April 2007 (Table 2).

A number of unidentified dolphin species were detected during the four months of SMRU Ltd acoustic surveys carried out for the EOWDC, these results are presented in Appendix 8.2

5.1.2.1 Boat based survey results 2007-2008: Bottlenose dolphins

There were 200 bottlenose dolphins that were recorded during 62 observations both on and off effort during the boat based surveys carried out 2007-2008 (Figure 8). There were 10 observations of 58 bottlenose dolphins collected on effort that would have been available for distance analysis (if statistically feasible). The mean group size of all sightings both on and off effort was 5.2 individuals. The majority of sightings occurred during the spring months with sightings occurring throughout the year. A higher number of individuals were observed in the wind farm survey area in comparison to the control site (Table 11).

Figure 8 Bottlenose dolphins observed on and off effort during the 2007-2008 EOWDC boat surveys

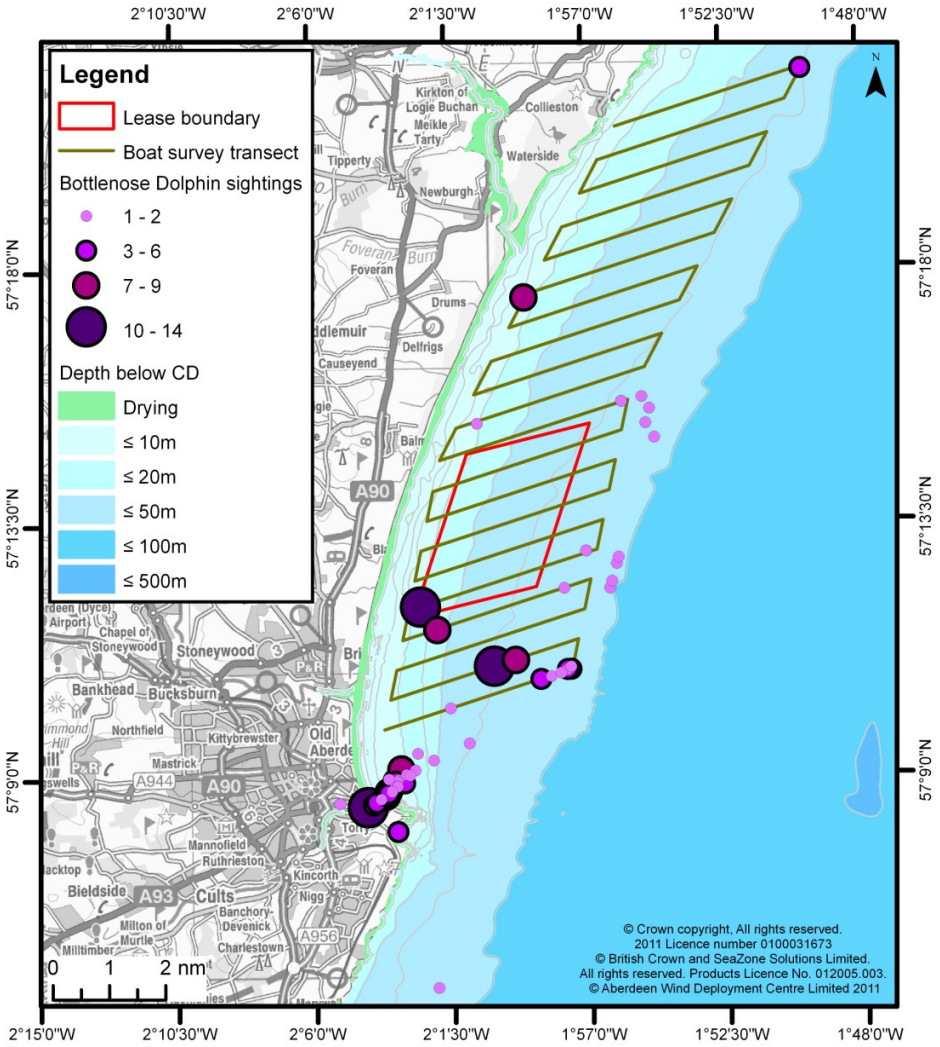


Table 11 Sightings information for bottlenose dolphins recorded during the boat based surveys 2007-2008

Common name	Winter	Spring	Summer	Autumn	Total On effort	Total Off effort	Total On /Off effort	Windfarm	Control
Bottlenose dolphin	0 (9)	20 (76)	34 (45)	3 (13)	58	142	200	46 (69)	13 (71)

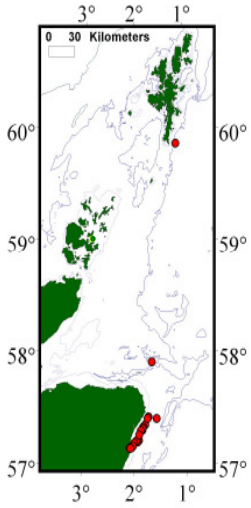
During the boat based surveys in August, September and November 2010 and January 2011 no bottlenose dolphins were recorded, although a total of 13 unidentified dolphins and dolphin vocalisations were detected during these surveys.

5.1.3 Observations from ferry surveys

Cetacean surveys were conducted from the bridge of the *MV Hascosay* ferry between Aberdeen, Orkney and Shetland during summer months (April to September) from 2002 to 2006. During these surveys, bottlenose dolphins were not sighted evenly throughout the study area, and the sightings were concentrated in the region along the coast of mainland Scotland, and particularly in the waters around Aberdeen Harbour (Figure 9). Thirty-nine sightings of bottlenose dolphins were recorded during more than 100 survey days, making it the fourth most commonly sighted species in the region. Bottlenose dolphins were recorded in all months surveyed. The average group size was five individuals, but groups ranged from one to 25 individuals (MacLeod *et al.*, 2007).

Observations during the ferry surveys are consistent with studies conducted in the outer Moray Firth and along the Aberdeenshire coast, which indicate that bottlenose dolphins primarily use coastal waters in this region, and suggest that this population of bottlenose dolphins rarely use the deeper, more open waters of the outer-most Moray Firth and the northern North Sea. In addition, observations during the ferry surveys suggest that bottlenose dolphins rarely, if ever, occur in the coastal waters around Orkney and Shetland (MacLeod *et al.*, 2007).

Figure 9 Distribution of bottlenose dolphin sightings during ferry surveys (April to September, 2002-2006)



5.1.4 Moray Firth population Bottlenose dolphin

5.1.4.1 Distribution and occurrence

In March 2005, an area of the inner Moray Firth (with an outer boundary from Helmsdale on the north coast to Lossiemouth on the south coast) was designated as a marine SAC for the conservation of the bottlenose dolphin population. In the 1980s, the core of this population's range was in the inner Moray Firth. Dolphins are distributed throughout the inner Moray Firth and there are three areas 'hotspots' where sightings are concentrated: the Kessock Channel, Channory narrows, and around the mouth of the Cromarty Firth, all of which are narrow, deep channels associated with strong tidal currents (Wilson *et al.*, 1997a; Hastie *et al.*, 2003b).

Spatial patterns of cetacean distribution within the Moray Firth have been investigated using a combination of visual and passive acoustic boat-based line-transect surveys in the inner and outer Moray Firth during the summers of 2004 and 2005. Bottlenose dolphins had a predominately near-shore distribution with a confirmed preference for hotspots within the inner Moray Firth. However, some regular, but sporadic, dolphin activity was present at the Beatrice wind farm site (offshore) during the late summer/autumn of the sampling period (Lusseau *et al.*, 2005; Talisman, 2005).

Bottlenose dolphins are observed all year round within the Moray Firth SAC, although there is a seasonal pattern to their sightings with peak sightings occurring during the summer months between May and September and lower number in winter and spring (Wilson *et al.,* 1997a).

Systematic boat surveys conducted along the southern outer Moray Firth coastline between the ports of Lossiemouth and Fraserburgh from May to October 2001 to 2005 inclusive by the Cetacean Research and Rescue Unit, found that bottlenose dolphins were only recorded in shallow waters rarely exceeding 25m depth and encounters were highly variable across all months (Robinson *et al*., 2008).

From the analysis of the acoustic data collected as part of the Moray Firth study on the potential impacts oil that and gas exploration has upon cetacean, dolphins tended to be detected most often in the inner Moray Firth and along the southern Moray Firth and less frequently in the central Moray Firth, but with detections increasing again at more offshore locations (Figure 10). Aerial survey data collected during August to November 2010 confirmed that cetacean sightings in the central and offshore waters of the Moray Firth were either the Risso's dolphin, white beaked dolphin or common dolphin and therefore indicated that most if not all of the dolphins detected in the Cpods in more offshore water represent detections of these other species (Figure 10). The 2010 results were compared with acoustic detections in 2009 and the data indicate that the spatial variation in dolphins was consistent between years (Thompsen *et al*., 2011).

Figure 10 Proportion of days that dolphin detections were recorded at the C-pod location sites (reproduced from Thompsen *et al*. 2011)

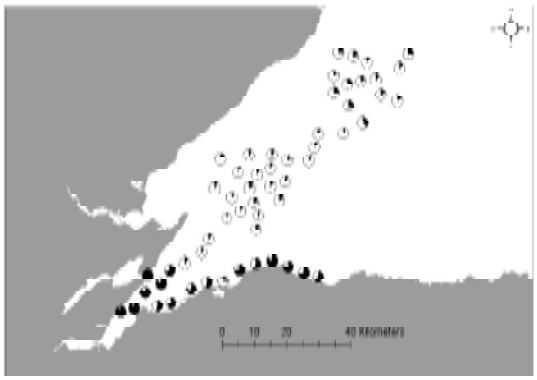
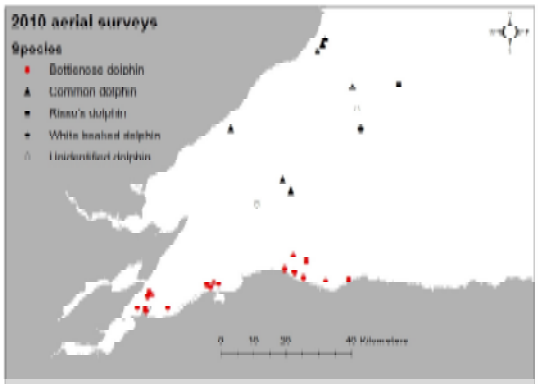


Figure 11 Dolphin observations during the aerial surveys carried out August-November 2010 (reproduced from Thompsen *et al*. 2011)



5.1.4.2 Abundance

Data collected during 1990 and 1993 estimated that 129 individuals (95% Confidence Interval (CI): 110-174) used the Moray Firth area at this time (Wilson *et al*., 1999a). Analysis of survey data between 1990 and 2002 indicated considerable variability among years, with estimates ranging between 75-200 (Thompson *et al*., 2004a) and similarly, analysis of data collected in 2001 estimated an average population size of around 85 (95% probability interval = 76-263) (Durban *et al*., 2005), although there is uncertainty about current trends in abundance (Thompson *et al*., 2004a).

Data collected up to 1997 were analysed to estimate rates of survival and reproduction, which were incorporated in a Population Viability Analysis (PVA) to predict likely future population trends (Sanders-Reed *et al*. 1999). These models predicted that, if conditions remained the same, the Scottish east coast population was likely to decline at a rate of around 5% per annum. The results of the modelling study were used to assign the bottlenose dolphin population to 'unfavourable – declining' (according to the framework categories within the Common Standards Monitoring). However, the calculated annual estimates of abundance from 1990 to 2002 showed no clear trend

(Hammond *et al*., 2004). Subsequent results from the monitoring programme that Scottish Natural Heritage established to follow changes in the number of dolphins using the SAC indicated that, whilst the numbers had declined during the 1990's, these appeared to be stabilising by 2004. As a result, the condition was assessed as "unfavourable recovering" in 2005 (Thompsen, *et al*., 2009).

5.1.4.3 Genetic and social structure

The Moray Firth bottlenose dolphin population is thought to be genetically isolated, with studies indicating a low mitochondrial genetic diversity (Parsons *et al*., 2002). From genetic studies it appears that Scottish east coast bottlenose dolphins are more closely related to the Welsh population in Cardigan Bay and to individuals stranded around the southern coast of England than to individuals encountered in the Scottish Western Isles (Parsons *et al*., 2002).

Analysis of the social structure of bottlenose dolphins along the Scottish east coast suggest that the population is composed of two social units with restricted interactions via a few common individuals (Lusseau *et al*., 2005). These two units appear to be related to known differences in the ranging pattern of individuals (Wilson *et al*., 2004). Individuals commonly seen in the inner Moray Firth were not observed in other locations and these individuals tend not to interact with individuals coming into the inner Moray Firth area during summer and mostly remained within their communities. The home ranges of the two social units largely overlap and this may be related to the presence of abundant prey in the area that allows the two communities to co-inhabit in the same area at this time (Lusseau *et al*., 2005).

5.1.4.4 Range expansion

Recent evidence suggests that the Moray Firth bottlenose dolphin population has been extending its range beyond the boundaries of the Moray Firth and associated SAC, with an increase in sightings along the east coast of Scotland as far south as St Andrews and the Firth of Forth (Wilson *et al*., 2004).

Between 1990 and 2000, photo-identification surveys were conducted within the inner Moray Firth, along the coastal waters of the outer Moray Firth and along the coasts south of Fraserburgh (Wilson *et al*., 2004). Examination of the data for 54 distinctly marked individuals (approximately 42% of the estimated population, which were identified in the inner Moray Firth between 1990 and 1992 and were known to have survived through the 1990s), found that the majority (74%) had subsequently been identified in the outer Moray Firth and 61% had been seen along the coasts south of Fraserburgh, confirming that they had come from the 'Moray Firth population' (Wilson *et al*., 2004). The animals seen in other areas continued to be seen within the inner Moray Firth, indicating an expansion, rather than shifting of their range (Wilson *et al*., 2004).

There appears to be a spatio-temporal stratification pattern within the population, with animals using areas outside the inner Moray Firth also spending less time within the inner Moray Firth. Animals that were identified in areas outside the Moray Firth also occupied the areas furthest from the head of the inner Moray Firth when identified within the inner Moray Firth, compared to animals that were predominantly sighted within the inner Moray which tended to be found most often closest to the headwaters (Wilson *et al*., 2004).

In addition, animals that used areas outside the inner Moray Firth appeared to move greater distances between sightings and moved faster during sightings. For example, one individual was identified south of Aberdeen in June 1996 and was re-identified off Burghead 52 hours later, representing a distance of 218 km and a minimum swimming speed of 4.2 km/h (Wilson *et al*., 2004). For consecutive sightings 5 or less days apart, the median rate of travel for dolphins identified primarily within the inner Moray was 0.071 km/h, whereas for dolphins observed using areas outwith the inner Moray Firth it was significantly grater at 0.22 km/h. Similarly, during sightings in the outer Moray Firth and along the coasts south of Fraserburgh the median rate of progress was 7.6 km/h, which was twice as fast as in the inner Moray Firth (3.9 km/h) (Wilson *et al*., 2004).

The reasons for the apparent range expansion appear to be related to changes in prey resources (Wilson *et al*., 2004). For example, the rapid and long-range movements observed outside the inner Moray Firth suggests that prey resources may be more widely dispersed and/or different in these areas. The stratification among individuals may indicate competition for resources (Wilson *et al*., 2004).

5.1.4.5 Diet

Bottlenose dolphins are opportunistic feeders and take a wide variety of fish and invertebrate species. Despite the large amount of information on bottlenose dolphins in the area, relatively little is known about their diet. Stomach content analysis of bottlenose dolphins (n= 10) from Scottish waters indicate that the main prey eaten were cod (*Gadus morhua*), saithe (*Pollachius virens*) and whiting (*Merlangius merlangus*) although several other fish species were also eaten, including salmon (*Salmo salar*) and haddock (*Melanogrammus aeglefinus*) and cephalopods (Santos *et al*., 2001a).

5.1.4.6 Habitat use and foraging

Bottlenose dolphin presence at the mouth of the River Dee (Aberdeen harbour) has been associated with salmon migration, suggesting that salmon presence is a factor in attracting these dolphins to this site (Canning, 2007). Although the River Dee is situated in a large bay, it flows out through a man-made harbour, the entrance to which is narrow and deeper than the surrounding waters, therefore creating a potential “bottleneck” for migrating fish (Canning, 2007).

Within the inner Moray Firth, feeding behaviour by bottlenose dolphins was significantly higher in areas used intensively by dolphins, these discrete areas occur in deep narrow entrances to coastal inlets that have steep seabed gradients and strong tidal currents (Hastie *et al*., 2004; Wilson *et al*., 1997a). Behaviours that were associated with feeding on large prey peaked in deep waters over steep seabed gradients, particularly during June and July (Hastie *et al*., 2004). It has been suggested that these areas create bottlenecks for migratory fish, most likely migrating salmonids (*Salmo salar* and *Salmo trutta*) potentially increasing foraging opportunities (Wilson *et al*., 1997a).

Passive acoustic monitoring within the deep (55m), narrow channel at the entrance to the Cromarty Firth, indicated that bottlenose dolphins used the full water column and consistently dived to depths of around 50 m, close to the seabed. However, the majority of their time appeared to be spent within the surface layers and feeding behaviour occurred primarily at depths between 20 m and 30 m (Hastie *et al*., 2006).

At the Kessock channel within the inner Moray Firth, bottlenose dolphins were most abundant during the flood tide, particularly during the stationary stage of the tidal front. They showed a spatial association with the area near the surface features of the front, which could be related to increasing foraging efficiency resulting from the accumulation of prey in the frontal region (Mendes *et al*., 2002).

During land-based observations at Aberdeen harbour between early May and late July 2002, bottlenose dolphins were found to present during all times of the day and tide, although occurred more frequently around midday and early afternoon, while their abundance was greater around high tide and late afternoon. Foraging was the most commonly observed activity (Sini *et al*., 2005).

5.1.4.7 Life history

Bottlenose dolphins are long-lived animals with life spans of up to 40-50 years. Females are sexually mature at between 5-12 years of age and can produce a calf every 2-3 years, although 3 to 6 year intervals are more common (Connor and Smolker, 1990; Scott *et al*., 1996; Connor *et al*., 2000). Calves stay with their mothers for at least 4 years (Smolker *et al*., 1992). However, studies in the Moray Firth indicate that the association between calves and mothers remains high until the calf is 8 years old (Grellier *et al*., 2003).

Immature bottlenose dolphins (juveniles/calves) have been observed off Aberdeenshire throughout the year, with an increase in the proportion of calves during the spring, between April and June (Canning, 2007; Stockin *et al*., 2006; Weir and Stockin, 2001). Very young calves have been recorded during spring and early summer (Weir and Stockin, 2001).

In surveys along the outer Moray Firth (May to October, 2001-2005), calves were recorded in 84% of all bottlenose dolphin encounters, with newborn animals being observed from July to October inclusive (Robinson *et al*., 2008).

5.1.4.8 Strandings

Two bottlenose dolphins have been recorded stranded by the Scottish Agricultural College along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and March 2010 (CSIP 2010). One was a male with a body length of 267 cm recovered in December 1999 near Balmedie, the other had a body length of approximately 200 cm, the sex was not determined and it was recovered from Peterhead in December 2005 (SAC, 2006). Although there are only two stranding records of bottlenose dolphins along the north-east coast (1992-2010), this reflects the small population size in the area, rather than their low occurrence in the area.

5.1.4.9 Threats

Post-mortem analyses of stranded animals have identified that some fishery by-catch occurs and that at least some calf mortality results from infanticide (Patterson *et al*., 1998).

Bottlenose dolphins from eastern Scotland have a high prevalence of several different types of skin lesion (Thompson and Hammond, 1992; Wilson *et al*., 1997b). In comparison with similar data from other parts of the world the prevalence and severity of lesions are high but mainly related to exposure to water of low salinity and/or temperature (Wilson *et al*., 1999b). The causal links underlying these patterns remain unknown, but it is possible that they are related to an increase in physiological stress, potentially making the animals more prone to other

factors, including anthropogenic agents such as contaminants (McKenzie *et al*., 1997) or infections from viruses, bacteria or fungi. Subsequent studies have shown that severity and prevalence of lesions vary among individuals in the Moray Firth and that variation patterns can be related to the behaviour of infectious diseases (Wilson *et al*., 2000).

5.2 HARBOUR PORPOISE (*PHOCOENA PHOCOENA*)

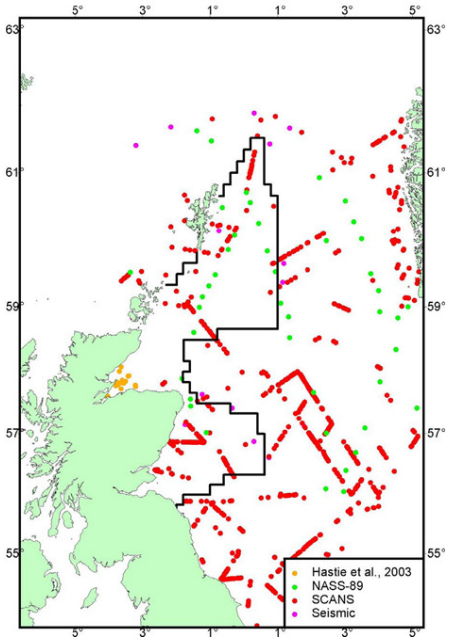
5.2.1 Distribution

Harbour porpoises are found in temperate and sub-arctic waters of the Northern Hemisphere, mainly on the continental shelves. They are distributed around the fringes of the North Atlantic Ocean basin, extending from North Carolina, off the United States, to Greenland and northern Norway and south through European waters as far as North Africa (Hammond *et al*., 2004).

The harbour porpoise is widespread throughout the cold and temperate seas of north-west Europe, including the North Sea, the Skagerrak, Kattegat, Irish Sea, west of Ireland and Scotland, northwards to Orkney and Shetland and off the coast of Norway (Jackson and McLeod, 2002). In the North Sea, sightings from shipboard and aerial surveys indicate that harbour porpoises are widely and almost continuously distributed, with important concentrations in the central North Sea, along the Danish and northern German coasts (Donovan and Bjørge, 1995; Hammond *et al.*, 2002; IWC, 1996). Harbour porpoises are highly mobile and distributed around the UK coast (Reid *et al*., 2003).

Figure 12 (taken from Hammond *et al*., 2004) shows the numerous locations of harbour porpoise sightings made during systematic surveys and some platforms of opportunity in the north and east of Scotland.

Figure 12 Harbour porpoise sightings made during various surveys. Sightings are represented by a coloured circle (Hammond *et al.*, 2004).



Harbour porpoises are generally described as a shelf species that frequents relatively shallow bays, estuaries and tidal channels, generally in depths less than 200 m in continental shelf waters (Klinowska, 1991). However, they have been observed in the deep waters of the Norwegian Rinne, in deep water areas between Iceland and the Faroe Islands, and on the Rockall and Faroe Banks (Northridge *et al.*, 1995). Summer surveys in the North Sea and adjacent waters found porpoises in large numbers offshore as well as in coastal waters (Hammond *et al.*, 2002). Porpoises have also been sighted in offshore waters with depths between 953 and 1502 m off north-west Scotland (Atlantic Frontier) (MacLeod *et al.*, 2003). By-catch data from Ireland also suggest that porpoises occur regularly offshore, with records from up to 220 km from land (Rogan and Berrow, 1996). Aggregations of harbour porpoises are often associated at local sites with strong tidal features, such as headlands, and areas with upwellings, tidal races and rips, often close to reefs and small islands, where prey are probably concentrated into patches (Gaskin, 1992; Pierpoint, 2001; Read and Westgate, 1997).

Spatial patterns of cetacean distribution within the Moray Firth were investigated using a combination of visual and passive acoustic boat-based line-transect surveys in the inner and outer Moray Firth during summers 2004 and 2005. These surveys indicate that harbour porpoises tended to have a diffuse and offshore distribution (Hastie *et al.*, 2003a; Lusseau *et al.*, 2005)

During systematic boat surveys conducted along the southern outer Moray Firth coastline between the ports of Lossiemouth and Fraserburgh from May to October 2001 to 2005, harbour porpoises were encountered throughout the study area, although they were usually more abundant in deeper waters, further from shore, with

sightings typically occurring along the 20-50 m isobaths. Porpoises were observed throughout the study period, with an increase in encounters from May through to October (Robinson *et al.*, 2008).

During the Moray Firth surveys carried out during 2009 and 2010 as part of the research study to investigate potential impacts from oil and gas exploration on cetaceans the harbour porpoise was the most frequently observed cetacean. The results of the acoustic monitoring, using C-pods in 2009 and 2010, found that harbour porpoises were typically detected at each of the monitoring locations on most days, especially at the offshore sites (Figure 13) (Thompsen *et al.*, 2011). The spatial occurrences of harbour porpoise during both 2009 and 2010 were consistent. The harbour porpoise was the most frequent cetacean detected during the aerial survey programme, a total of 230 encounters of harbour porpoise were encountered with the mean group size being 1.52 (Figure 14).

Figure 13 Proportion of days that harbour porpoise were detected by C-pods during 2010 (Thompsen *et al.*, 2011)

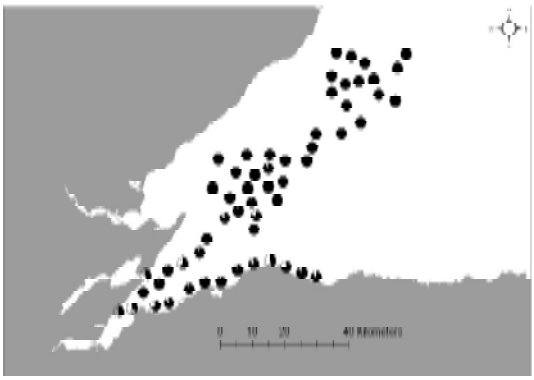
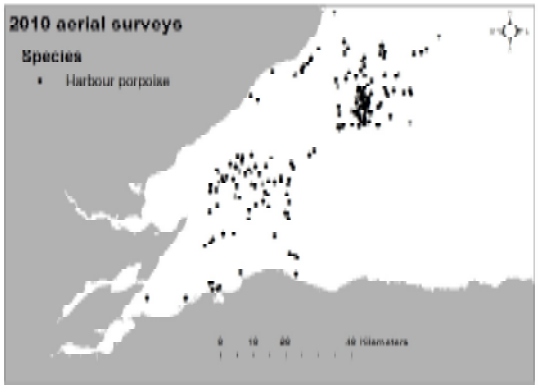


Figure 14 Observations of harbour porpoise during aerial surveys carried out in 2010 (Thompsen *et al.*, 2011)



5.2.2 Seasonal movements

The seasonal movements and migratory patterns of harbour porpoises in the North East Atlantic and North Sea are not well understood. Porpoises may reside within an area for an extended period of time, however, onshore/offshore migrations and movements parallel to the shore are also thought to occur (Bjørge and Tolley, 2002). In the North Sea, there may be a general westward movement from the eastern North Sea and possibly from the very northern areas of the North Sea into the western edge of the northern North Sea (along the east coast of Scotland) during April to June and a further influx to the northern North Sea during July to September (Northridge *et al.*, 1995). These seasonal movements are thought to coincide with the calving and mating seasons, respectively.

Animals in the eastern North Atlantic are not known to perform long migrations, but satellite-tagged animals in Canada and Denmark have been shown to move some hundreds of kilometres within a year. Recent satellite-tracking data from Denmark have shown animals moving from northern Denmark to the northern North Sea and Shetland (Hammond *et al.*, 2004). Satellite telemetry studies suggest that porpoises are highly mobile and capable of covering large distances in short time periods, with daily distances travelled in the Bay of Fundy varying from 14 to 58 km (Read and Westgate, 1997).

5.2.3 Abundance

The harbour porpoise is the most abundant cetacean recorded in the North Sea (Evans, 1992; Hammond *et al.*, 2002) and was the mostly commonly sighted cetacean during surveys along the southern outer Moray Firth coastline and the second most frequently sighted cetacean along the south Grampian coastline (Weir and Stockin, 2001).

The estimated summer abundance of harbour porpoises in North Sea areas during the first SCANS survey in July 1994 was 268,452 (approximate 95% confidence interval of 210,000 – 340,000). This estimate includes shelf waters to the west of Shetland and Orkney (Hammond *et al.,* 2002). Bjørge and Øien (1995) estimated that there were 82,600 porpoises in the North Sea north of 56^{o}N. This estimate is known to be biased downwards because the probability of detection on the transect line was assumed to be one (certain detection). Seabirds At Sea data from 1979 to 1991 show the highest rate of porpoise sightings in the northern North Sea is in April to June (the calving season), and July to September (Hammond *et al*., 2004).

Initial harbour porpoise abundance estimates in the entire North Sea are 231,000 from the SCANS II surveys conducted July 2005. The total abundance of harbour porpoises for the entire SCANS II survey area is estimated to be 385,616 (CV=0.20) (SCANS II, 2008). During the SCANS II surveys harbour porpoise density was highest in the south central North Sea and coastal waters of northwest Denmark (~0.6 animals/km^2), elsewhere there was relatively little variation in porpoise density (0.3-0.4 animals/km^2) (SCANS II, 2008).

Numbers of porpoises present in UK waters vary seasonally and more animals are likely to pass through UK waters than are present at any one time (Jackson and McLeod, 2002).

5.2.4 Occurrence in Aberdeen Bay and surrounding area

Harbour porpoises are known to occur regular in the Aberdeen Bay area throughout the year. Land- and vessel based sightings between March 1999 and October 2001, along the Aberdeenshire coast (between St Cyrus and Collieston, primarily between Stonehaven and Aberdeen) indicated that harbour porpoises were present throughout the year with peak occurrence during August and September (Weir *et al*., 2007).

Land based surveys carried out by the Seawatch Foundation indicated that porpoises were sighted more frequently between Stonehaven and Aberdeen, than between Aberdeen and Collieston, with the majority of sightings occurring off Cove and Girdleness to the south of Aberdeen (Weir *et al*., 2007). Tidal height and sea depth appears to have a strong influence on where and when porpoises are sighted and it is thought this is a reflection of prey behaviour (Canning, 2007).

Harbour porpoise sightings were frequently recorded during vantage point surveys of the wind farm area between August 2005 – March 2008 and the sightings are summarised in Table 12.

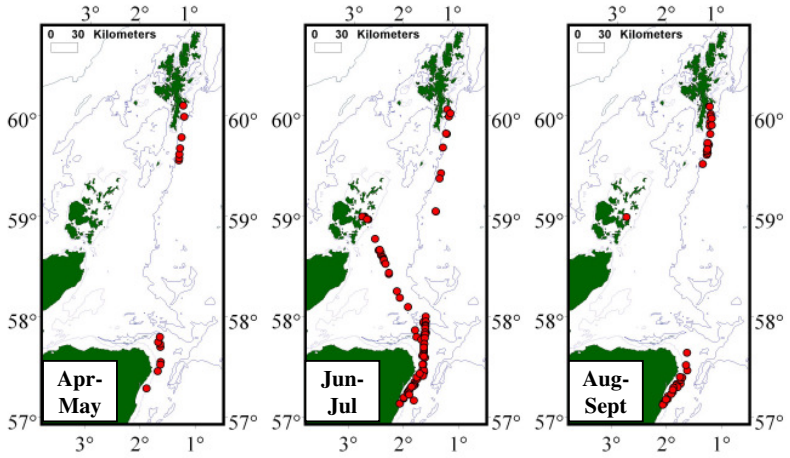
Table 12 Harbour porpoise sightings recorded during Vantage Point surveys (August 2005 – March 2008)

VP site	Observations
Donmouth	August 2006, September 2006, February 2007, September 2007, December 2007 and January 2008
Blackdog	May 2006, August 2006, September 2006, January 2007, February 2007, July 2007, August 2007 and September 2007,
Balmedie	September 2006, December 2006, January 2007, August 2007 and March 2008
Drums	December 2006, January 2007, February 2007, June 2007, August 2007, December 2007 and February 2008

During the JNCC aerial survey of Aberdeen Bay, harbour porpoises were recorded in December 2005 and January 2006 (Söhle *et al*., 2006)

Harbour porpoises were the most recorded cetacean species during over 100 days of surveys conducted from the bridge of the *MV Hascosay* ferry as it travelled between Aberdeen, Orkney and Shetland in summer months between 2002 and 2006 (MacLeod *et al*., 2007). Porpoises were recorded through out the region and in all months surveyed with no obvious changes in distribution over time (Figure 15). Recorded group sizes ranged from one to six, with an average of two. There was no variation in average group size across the summer months, but the maximum group size peaked in August and was lowest in April and September (MacLeod *et al*., 2007).

Figure 15 Distribution of harbour porpoise sightings during ferry surveys (April-September, 2002-2006)



5.2.4.1 Boat based survey results: Harbour porpoise

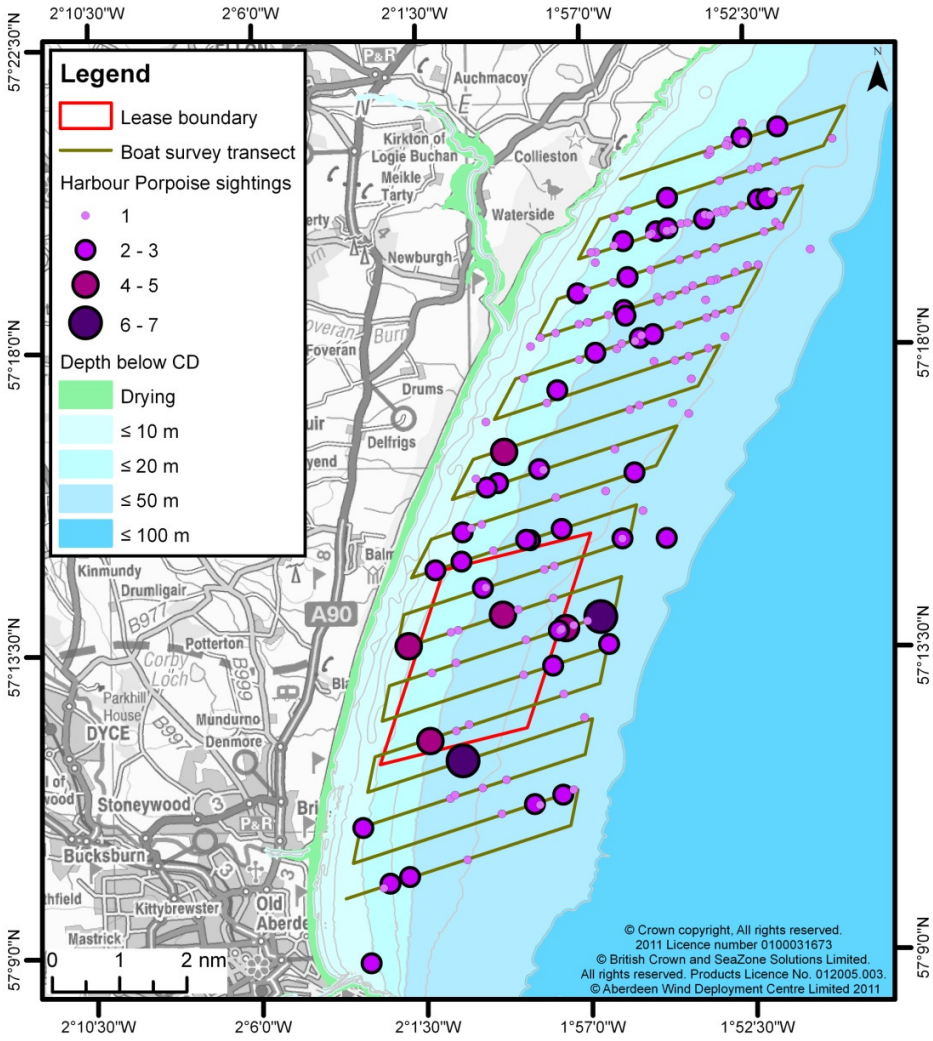
The harbour porpoise was the only species which was detected in sufficient numbers to allow a detection function to be applied. The detection function was applied to both phases of boat based surveying, the initial survey period

2007-2008 and the four months of survey carried out 2010-2011. The results of each phase of boat based surveys are discussed in the following sections.

5.2.4.2 *Harbour porpoise survey results 2007-2008*

There were 197 observations of 291 individuals observed during the boat based surveys carried out during 2007-2008. The distribution of all observations recorded, including those off effort are displayed in Figure 16.

Figure 16 Observations of harbour porpoise on and off effort during EOWDC boat surveys 2007-2008



5.2.4.2.1 Estimation of density using distance analysis 2007-2008

There were 175 observations of 251 individuals recorded on 1950 km of survey effort. Only on transect effort was used in the analysis (i.e. short transit legs between transects were discarded).

The radial distance and angles recorded to each sighting were converted to perpendicular distances and examined as a histogram (Figure 17). The histogram shows that there a peak in sightings within 100 m of the transect. The data are also spiked at the transect line which means that there are more sightings than would be expected on the transect line. To fit the detection function, the perpendicular distance were grouped with a wide first perpendicular distance bin, extending from the transect line to 200 m. This was done to 'force' Distance to fit a shoulder near the transect line distances rather than the reality, which is a spike. The data were also right truncated at 800 m (*n* = 167).

The best model of the detection function was a simple Hazard-rate without adjustment terms (p = 0.68) (Figure 18). The *esw* was 355m (%CV = 9.7).

Figure 17 Histogram of the perpendicular distances associated with the harbour porpoise sightings 2007-2008 data

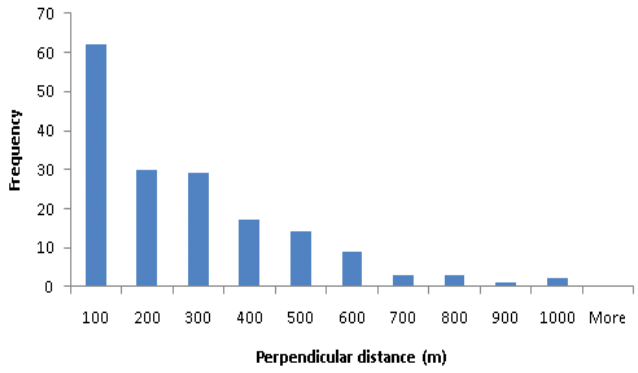
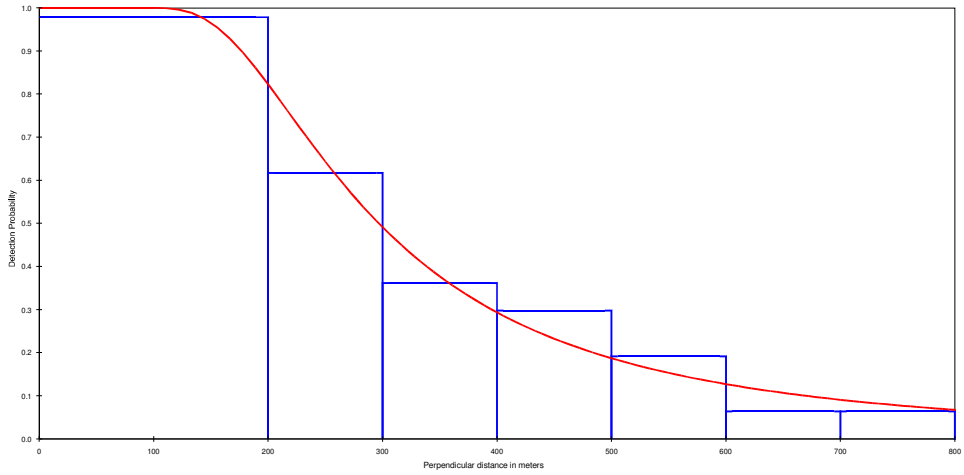


Figure 18 Detection probability fitted to perpendicular distances of harbour porpoise sightings February 2007-April 2008



The pooled detection function was then applied to the estimation of density and abundance by month and season. Multiple surveys within the same month were pooled to generate the density and abundance estimates. The mean group size was 1.42 (SE=0.07)). Density and abundance estimates by area/season and area/month are given in Table 13 and Table 14.

Density of harbour porpoise was higher in the control area in all seasons except summer (Table 14). The highest densities at both sites occurred during autumn (September-November). Lowest densities of harbour porpoises occurred during May and June at both the wind farm and control site. Peak densities were recorded during November at the wind farm site but during October and January at the control site (Figure 19).

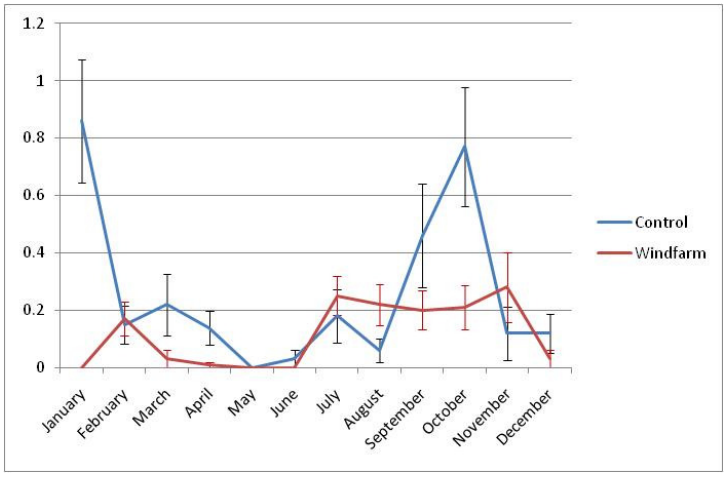
Table 13 Density and abundance of harbour porpoises by month and area estimated from year 1 survey data (February 2007 – April 2008, where n= number of sightings, DS = density of schools, D = density of animals and N = abundance. CV is the coefficient of variation and CI is the confidence interval

	CONTROL AREA				WIND FARM AREA				Area with highest animal density
Month	***n***	***DS (CV)***	***D (CV)***	***N (CV) [95% CI]***	***n***	***DS (CV)***	***D (CV)***	***N (CV) [95% CI]***	
January	29	0.6 (26.4)	0.92 (26.9)	47 (26.9) [27-83]	0	0	0	0	CONTROL
February	10	0.10 (39.1)	0.14 (39.4)	7 (39.4) [3-16]	11	0.12 (35.1)	0.18 (35.4)	9 (35.4) [4-18]	WIND FARM
March	7	0.16 (44.1)	0.22 (44.3)	11 (44.3) [4-29]	1	0.02 (100.5)	0.03 (100.6)	2 (100.6) [0-10]	CONTROL
April	14	0.10 (86.4)	0.14 (86.6)	7 (86.6) [2-33]	1	0.007 (100.5)	0.01 (100.6)	1 (100.6) [0-3]	CONTROL
May	0	0	0	0	0	0	0	0	-
June	1	0.02 (100.5)	0.03 (100.6)	2 (100.6) [0-11]	0	0	0	0	CONTROL
July	6	0.16 (57.5)	0.22 (57.7)	11 (57.7) [3-38]	8	0.18 (27.0)	0.26 (27.4)	13 (27.4) [7-23]	WIND FARM
August	5	0.10 (36.11)	0.15 (36.4)	7 (36.4) [3-16]	7	0.16 (32.1)	0.22 (32.5)	11 (32.5) [6-23]	WIND FARM
September	16	0.33 (38.9)	0.46 (39.1)	24 (39.1) [10-54]	7	0.14 (33.5)	0.20 (33.9)	10 (33.9) [5-21]	CONTROL
October	25	0.56 (26.8)	0.80 (27.2)	40 (27.2) [23-72]	6	0.12 (39.4)	0.17 (39.7)	9 (39.7) [4-20]	CONTROL
November	4	0.09 (77.1)	0.13 (77.2)	6 (77.2) [1-30]	9	0.20 (43.8)	0.29 (43.6)	15 (43.6) [6-37]	WIND FARM
December	4	0.09 (77.1)	0.13 (77.2)	6 (77.2) [1-30]	1	0.02 (100.5)	0.03 (100.6)	2 (100.6) [0-10]	CONTROL

Table 14 Density and abundance of harbour porpoises by season and area estimated from year 1 survey data (February 2007 – April 2008), where n= number of sightings, DS = density of schools, D = density of animals and N = abundance, CV is the coefficient of variation and CI is the confidence interval

	CONTROL AREA				WIND FARM AREA				Area with highest animal density
Season	***n***	***DS (%CV)***	***D (%CV)***	***N (%CV) [95% CI]***	***n***	***DS (%CV)***	***D (%CV)***	***N (%CV) [95% CI]***	
Winter	42	0.24 (27)	0.34(27.7)	17 (27.7) [10-29]	12	0.07 (35.7)	0.10 (36.0)	5 (36.0) [2-10]	CONTROL
Spring	21	0.09 (59.9)	0.13 (60.1)	6 (60.1) [2-20]	2	0.009 (70.7)	0.01 (70.9)	1 (70.9) [0-2]	CONTROL
Summer	13	0.09 (36.0)	0.13 (36.4)	7 (36.4) [3-14]	15	0.11 (25.36)	0.15 (25.8)	8 (25.8) [5-13]	WIND FARM
Autumn	45	0.35 (24.5)	0.46 (25.0)	24 (25.0) [14-39]	22	0.16 (24.1)	0.23 (24.6)	11 (24.6) [7-19]	CONTROL

Figure 19 Monthly patterns in harbour porpoise density at the wind farm and control site (vertical bars represent +- standard error)



5.2.4.3 Harbour porpoise boat based surveys results 2010-2011

A total of 134 observations of harbour porpoise were recorded, consisting of 296 individuals during the 4 months of SMRU Ltd surveys. The radial distance and angle from the transect line were converted to perpendicular distance within Distance, after truncation of sightings beyond 800 m there were a total of 132 observations of harbour porpoise available for analysis. The model chosen was a half normal key function with second order cosine adjustment terms (Figure 20). Cluster size was regressed against distance from transect and as this regression was non-significant at 0.15, mean cluster size was used throughout. The mean cluster size over all data

was 2.13 (SE= 0.15) and the effective strip half width was 241.6 m (%CV=7.3). Density and abundance were estimated by month and assumed certain detection of animals on the transect line (g(0) = 1). The estimates have also been corrected using a g(0)=0.34 (which is the probability of detecting an animal on the transect line) (Hammond et al., 2002). The effects of varying g(0) and the influence that this has on the estimated abundance value is discussed in Appendix 8.1.

Figure 20 Detection probability curve for harbour porpoise observations, based on all data from the four months and three study areas, and using 100m data 'bins'

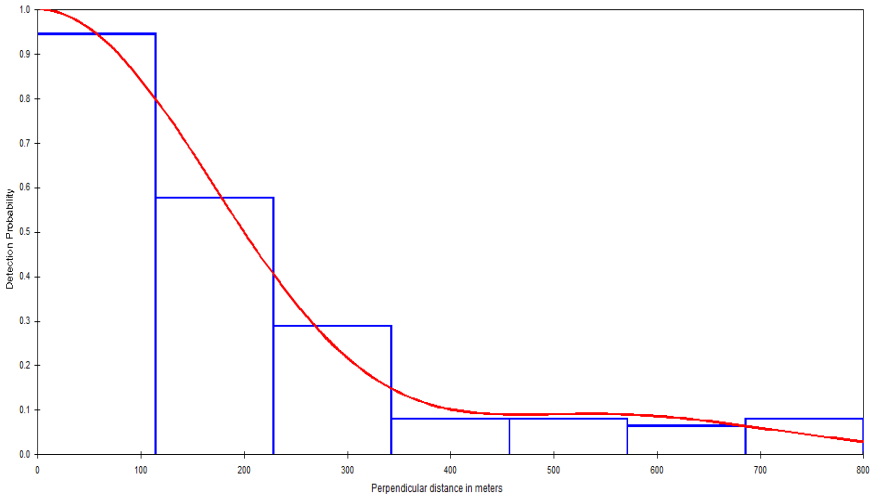


Figure 21 On-effort locations of harbour porpoise sightings during along transects during August, September and November 2010, and January 2011

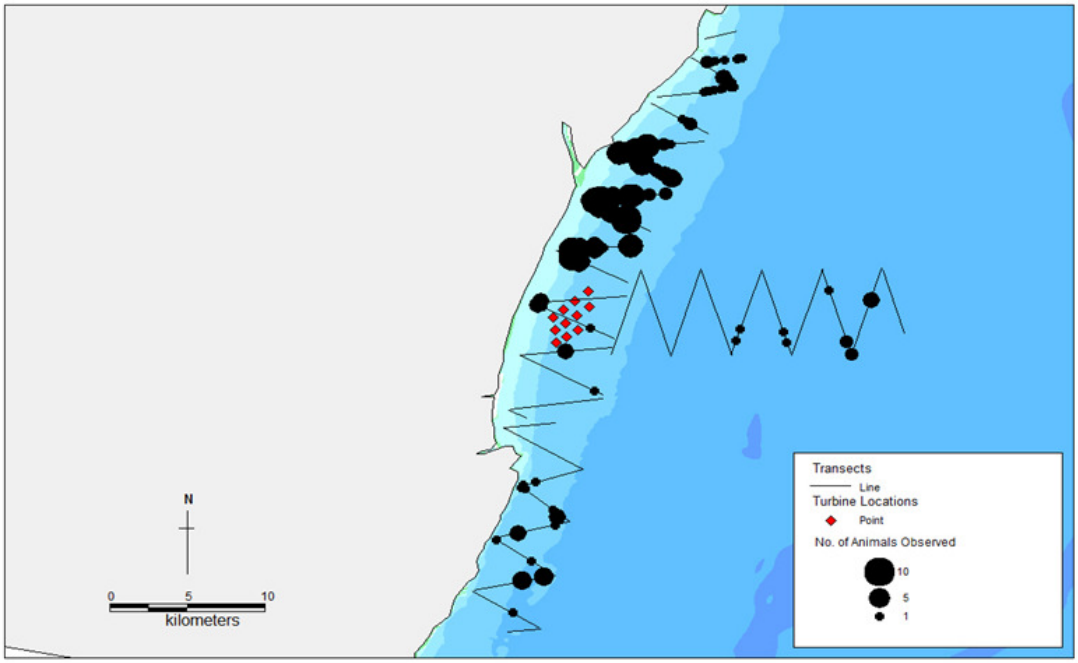
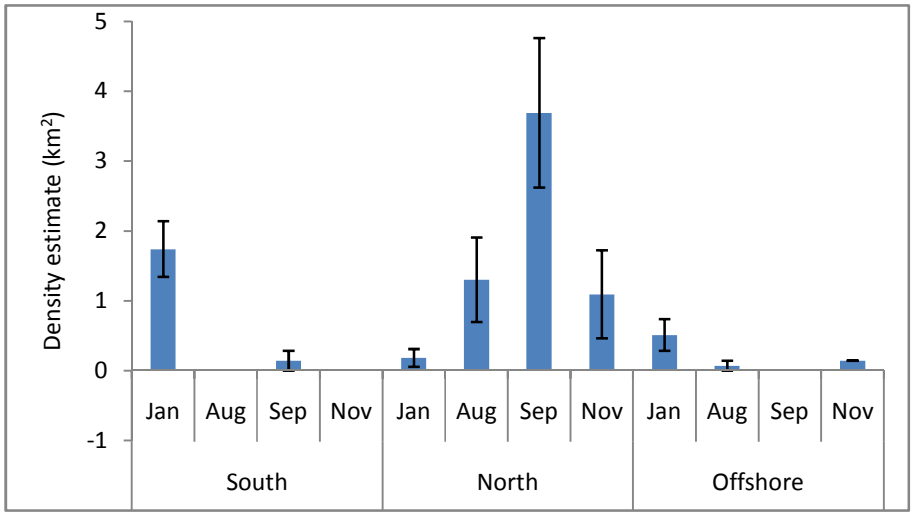


Table 15 Estimates of density (no. per km^2) and abundance (no. per survey stratum) of harbour porpoise in the South, North and Offshore Strata (corrected abundance estimates assuming g(0) = 0.34)

Site	Month	Animal Density (%CV)	Abundance (%CV)	95% Confidence intervals	Corrected abundance (%CV)
South	Aug	1.74 (23)	147 (23)	89-242	432 (22.9)
	Sept	0	0	0	0
	Nov	0.14 (100.5)	12 (100.5)	2-83	34 (100.4)
	Jan	0	0	0	0
North	Aug	0.18 (70.9)	28 (70.9)	7-109	83 (70.9)
	Sept	1.3 (46.6)	200 (46.6)	78-510	588 (46.5)
	Nov	3.69 (29)	568 (29)	314-1029	1671 (28.9)
	Jan	1.09 (57.8)	169 (57.8)	54-526	496 (57.7)
Offshore	Aug	0.51 (44.4)	55 (44.4)	21-141	161 (44.3)
	Sept	0.07 (100.5)	8 (100.5)	1-50	22 (100.5)
	Nov	0	0	0	0
	Jan	0.14 (0.67)	15 (0.67)	4-60	45 (67.4)

Figure 22 monthly estimates (+/- SE) of density of Harbour porpoise in the South, North and Offshore Strata (Assuming g(0)=1)

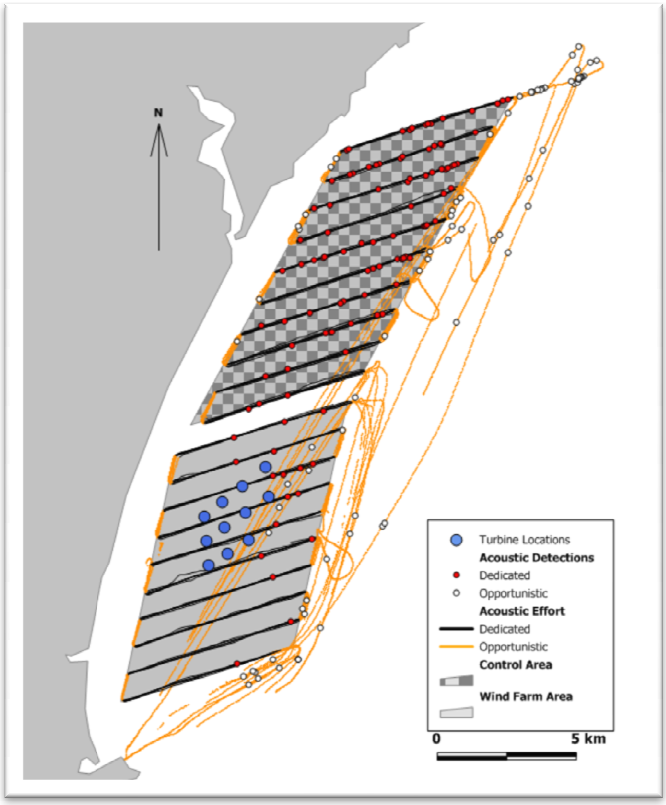


Most of the estimates produced show considerable error margins at present. These errors stem from the small number of surveys currently available for analyses, and are expected to reduce as more surveys are carried out.

5.2.4.4 Towed Passive Acoustic Monitoring (PAM) results for surveys 2007-2008

The harbour porpoise was the most frequently detected marine mammal species during the acoustic surveys. Only the dedicated acoustic effort was used to assess the acoustic detection rates of marine mammals across both the wind farm area and the control area. The harbour porpoise detections 'off effort' that were opportunistic detections are shown in Figure 23.

Figure 23 Combined acoustic effort from Oct-07 to April-08 across both the control and wind farm areas. Yellow lines show the opportunistic acoustic effort. Dedicated acoustic effort is shown by the black lines. Red circles show "on effort" acoustic detections, white circles show "opportunistic" acoustic detections (SMRU Ltd 2011b)



Harbour porpoises were detected on all seven surveys in which the hydrophone was deployed (Table 16). Combined detection rates ranged from 0.03 detections per km of dedicated effort, (early April survey, 2008) to 0.22 detections per km of dedicated effort (November survey, 2007). Detection rates were much lower in both of the April surveys than in any of the preceding five surveys.

Table 16 Number of porpoise detections and detection rate (detection/km) for each of the 7 surveys for which acoustic data were collected

Month of survey	Number of detections	Effort (km)	Detection rate (detections per km)
Oct-07	16	111	0.14
Nov-07	23	102	0.22
Dec-07	23	127	0.18
Jan-08	17	88	0.19
Feb-08	25	127	0.20
Early April-08	3	101	0.03
Late April-08	6	126	0.05

There appears to be marked differences in spatial distribution of porpoises over the areas surveyed, with more detections made in the control area than in the wind farm area. A total of 113 harbour porpoise detections were made overall, of which 96 were made within the control area (0.23) detections per km dedicated acoustic effort), and 17 were made within the wind farm area (0.05 detections per km dedicated acoustic effort) (Figure 23). Figure 24 shows the detection rate per survey in both the control and the wind farm areas. In each monthly survey the detection rate is higher in the control area.

The detection rate per transect is shown in Table 17. All transects recorded acoustic detections with the exception of transect 'WC' located in the wind farm area (Figure 1 provides details of the transect names).

Figure 24 Histogram comparing the detection rate for harbour porpoises in the control area and the wind farm area across all survey months.

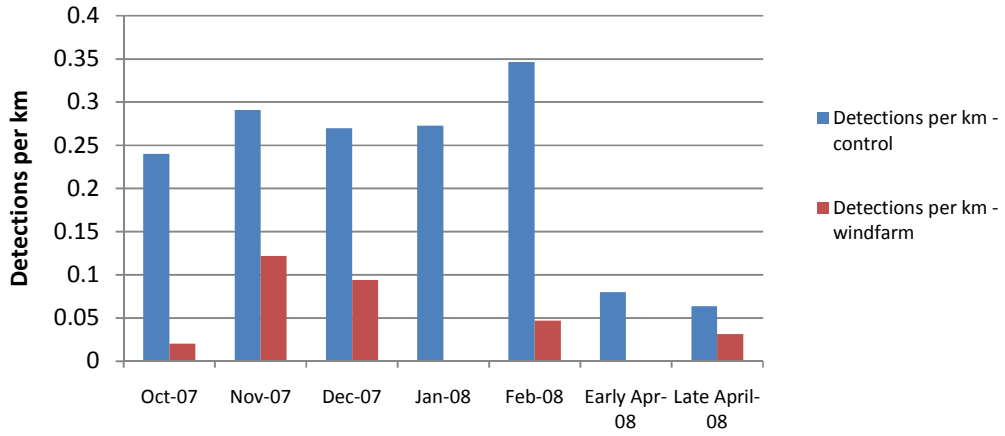


Table 17 Harbour porpoise detection rate for each individual survey transects, combined across all surveys 2007-2008

Transect ID	Number of detections	Effort (km)	Detection rate
WA	1	29.72	0.03
WB	1	33.35	0.03
WC	0	40.99	0.00
WD	1	38.57	0.02
WE	2	39.20	0.05
WF	1	38.37	0.03
WG	2	38.71	0.05
WH	4	38.48	0.10
WI	2	33.57	0.05
WJ	3	38.92	0.09
CA	3	42.03	0.07
CB	4	43.25	0.09
CC	8	44.30	0.18
CD	8	44.96	0.18
CE	9	42.51	0.21
CF	17	45.04	0.38
CG	6	36.19	0.17
CH	14	38.20	0.37
CI	13	37.78	0.34
CJ	14	39.11	0.39

5.2.4.5 Towed Passive Acoustic Monitoring (PAM) results for surveys 2010-2011

Harbour porpoises were detected acoustically on all four of the surveys (Table 18). Combined detection rates ranged from 0.08 detections per km of dedicated effort, (January 2011) to 0.15 detections per km of dedicated effort (September 2010).

A total of 85 “on effort” harbour porpoise detections were made across all three strata. Of these, 56.5% were made in the north stratum, 20% in the south stratum and 23.5% in the offshore stratum (Table 18 and Figure 29). The number of detections and detection rate per transect is shown in Table 19. Whilst all strata contained porpoise detections, 10 of the individual transects did not. The locations of harbour porpoise detections in each of the four surveys can be seen in Figure 25-Figure 28 “On effort” sightings are shown by red circles; “off effort” detections by orange circles. In some cases, due to navigational constraints, the actual sailed transects differed slightly from the pre-designed survey tracks. Designed tracks are shown in grey, actual sailed transects are shown in black. Some of the southern transects were sailed twice.

Figure 25 Locations of harbour porpoise detections during the August 2010 survey

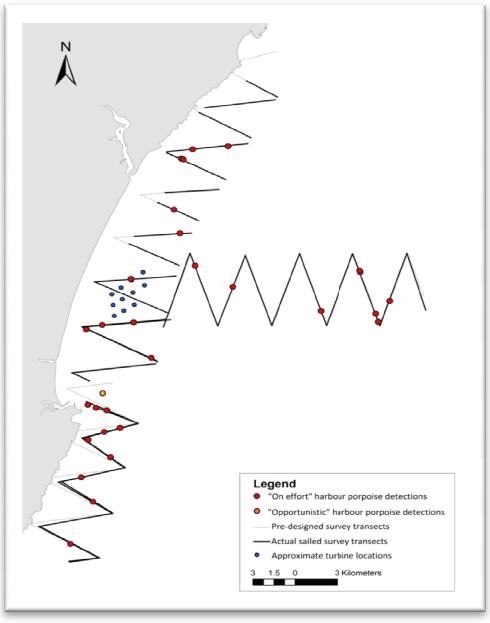


Figure 26 Locations of harbour porpoise detections during the September 2010 survey

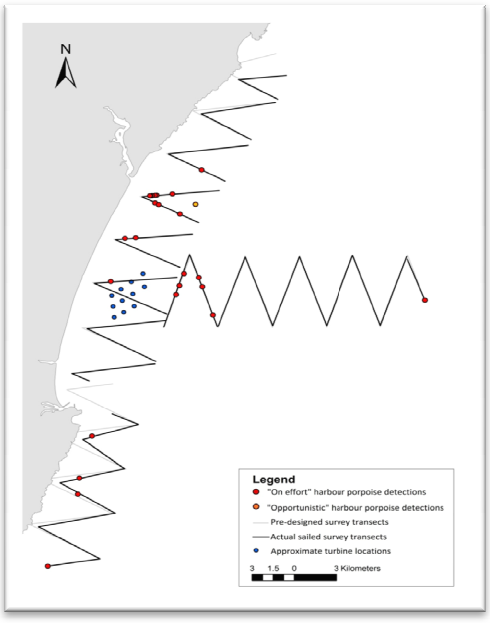


Figure 27 Locations of harbour porpoise detections during the November 2010 survey

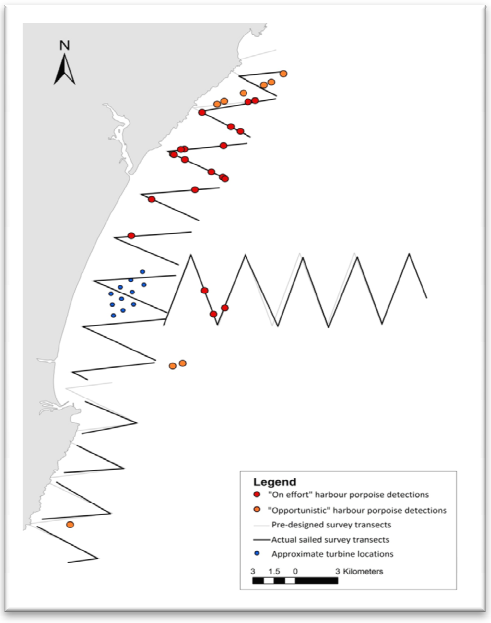


Figure 28 Locations of harbour porpoise detections during the January 2011 survey

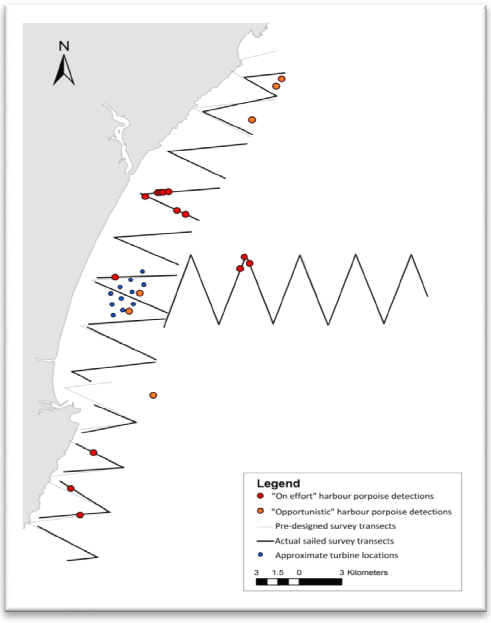


Table 18 Number of porpoise detections and detection rate (detection/km) for each of the surveys

Month of survey	Number of "on effort" detections	Kilometres of effort	Detection rate (detections per km)
Aug 2010	27	207.5	0.13
Sept 2010	26	168.6	0.15
Nov 2010	18	166.7	0.11
Jan 2011	14	164.2	0.09

Table 19 The spread of harbour porpoise detections across survey strata

Strata	Number of "on effort" porpoise detections	% total porpoise detections	Detections per km dedicated effort
South	17	23.5%	0.10
North	48	56.5%	0.15
Offshore	20	20%	0.08

Figure 29 Monthly detection rates of harbour porpoises in the South, North and Offshore Strata

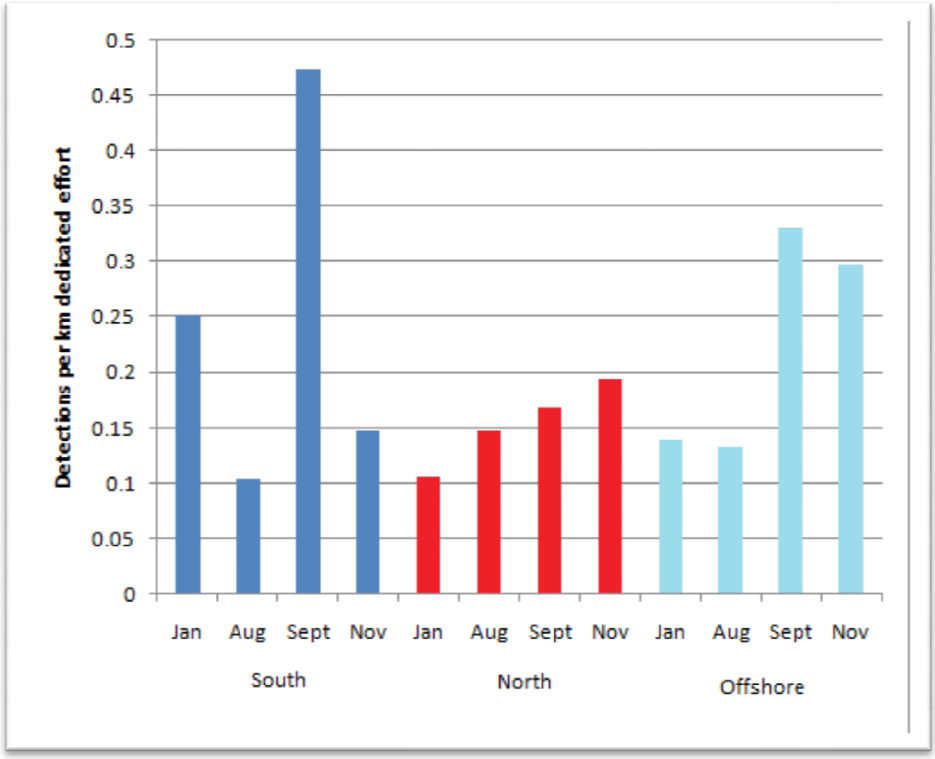


Table 20 Harbour porpoise detection rates for each individual survey transects, combined across all 4 surveys

Strata	Transect ID*	Number of detections	km of survey effort	Detection rate
South	1	1	12.3	0.08
	2	0	24.9	0.00
	3	2	26.1	0.08
	4	2	22.6	0.09
	5	1	22.7	0.04
	6	5	19.2	0.26
	7	4	20.3	0.20
	8	2	16.5	0.12
	9	Not surveyed		
North	10	0	5.6	0.00
	11	0	23.7	0.00
	12	3	28.9	0.10
	13	2	29.2	0.07
	14	0	22.9	0.00
	15	3	23.1	0.13
	16	0	19.1	0.00
	17	4	20.5	0.20
	18	8	17.1	0.47
	19	11	20.4	0.54
	20	8	18.5	0.43
	21	5	22.8	0.22
	22	2	16.4	0.12
	23	2	21.2	0.09
	24	0	11.7	0.00
	25	0	9.6	0.00
	26	Not surveyed		
Offshore	27	3	24.5	0.12
	28	6	24.2	0.25
	29	4	23.9	0.17
	30	1	23.9	0.04
	31	0	23.7	0.00
	32	1	24.0	0.04
	33	0	24.1	0.00
	34	4	23.7	0.17
	35	1	23.9	0.04
	36	0	15.8	0.00

**Locations of transits within the survey design can be seen in Figure 2*

Harbour porpoise acoustic detections appear to follow a similar pattern of distribution to the sightings of animals. The pattern of detections from the November survey most closely resembles the pattern formed from the visual data. Higher numbers of detections were made in the offshore survey area during the August and September 2010 surveys, although it is too early to conclude whether this represents a movement of animals offshore during the summer months. Acoustic detection rates were lowest during the January survey, but again, more data are required to determine if this is part of a trend.

The acoustic dolphin detections (both clicks and whistles) made during the August 2010 survey coincide both temporally and spatially with sightings of white-beaked dolphins made in the offshore strata. Additional detections in the northern stratum which do not coincide with visual observations reinforce the value of carrying out simultaneous passive acoustic data collection alongside the use of visual observers.

5.2.5 Diet

The diet of harbour porpoises in Scottish waters has been determined through stomach content analysis and, although fish from 15 taxa, cephalopods from five taxa and crustaceans from four taxa were recovered from the stomachs of harbour porpoises between 1992 and 2003, the diet is dominated by four main prey categories: (i) whiting; (ii) sandeels (Ammodytidae spp.); (iii) haddock/saithe/pollack and (iv) *Trisopterus* spp. (Norway pout and poor cod) (Santos *et al.*, 2004a). Whiting and sandeels are the most important prey types, in terms of contribution by number and mass, in the diet of harbour porpoises from Scottish waters (Santos *et al.*, 2004a).

The main fish species consumed by porpoises (identified in samples recovered mainly from fishing nets) from the Scottish east coast between 1959 and 1971 were herring, sprats, whiting, sandeels, cod, Norway pout and other gadoids, decapod shrimps were also present (Rae 1965, 1973).

5.2.6 Life history

Harbour porpoises in Scottish waters have a distinct reproductive season. Examination of the reproductive status of stranded harbour porpoises (1992-2005) indicates that conception takes place between April and September, gestation appears to last 10-11 months and the calving period is between April and June. Lactation appears to last 9 to 10 months with weaning taking place in March/April (Learmonth, 2006.).

The period of conception for harbour porpoises in Scottish waters coincides with observations of larger group sizes of porpoises in July and August off the North Sea coast (N. Quick, Pers. Comm.).

In the coastal waters off Aberdeenshire juvenile porpoises and calves have been observed between May and September, with a peak during June (Weir *et al.*, 2007). Sightings suggest that calving may take place in June with the observation of very small calves during this time (Weir and Stockin, 2001).

In surveys along the southern coast of the outer Moray Firth (May to October, 2001-2005), neonatal porpoise calves were typically observed between May and July and the progressive increase in harbour porpoise encounters from May through to October was believed to result from the inshore movements of lactating females with their calves, followed thereafter by the males (Robinson *et al.*, 2008).

5.2.7 Strandings

One hundred and thirty stranded harbour porpoises have been recorded by the Scottish Agricultural College along the north east coast of Scotland from Fraserburgh to Inverbervie between January 1992 and March 2010(CSIP 2010). Thirty-three were females, 51 were male and the sex was not determined for 48 individuals. Body lengths were between 76 cm and 165 cm. Harbour porpoises were recovered all along the north-east coast of Scotland throughout the year, with the majority recovered in the 1st and 2nd quarters (January-June: approximately 84%), in all years (SAC, 2006; CSIP 2009).

Stranding records indicate that harbour porpoises are regularly present in the area through out the year, with an increase in the number of stranded porpoises between January and June. Similarly, an examination of stranded harbour porpoises around Scotland between 1992 and 2004 found an increase in the number of strandings in March, April and June, with lower numbers in October, November and December, even when porpoises with body lengths less than 110 cm were removed to reduce the bias of the higher number of immature porpoises stranded during the birth and weaning periods (March to June) (Learmonth, 2006).

5.2.8 Harbour porpoises killed by bottlenose dolphins

One hundred and forty-three of the 389 harbour porpoises (37%), for which cause of death was established in Scottish waters between 1992 and 2004, died as a result of attacks by bottlenose dolphins (Learmonth, 2006). All fatal bottlenose dolphin attacks were recorded on the North Sea coast, ranging from Brora in the north to the Firth of Forth in the south, with the majority (66%) in the Moray Firth. The distribution of bottlenose dolphin attacks on harbour porpoises is consistent with an overlap in the distribution of the two species on the Scottish east coast (Wilson *et al.*, 2004). The fatal attacks by bottlenose dolphins along the north east coast also indicates that bottlenose dolphins are present in the area throughout the year, despite the low number of strandings recovered.

Fatal bottlenose dolphin attacks on harbour porpoises in Scottish waters were recorded in all months of the year, with higher numbers between April and June (Learmonth, 2006). There was some evidence of a seasonal shift in bottlenose dolphin attacks on porpoises along the east coast, with 75% of bottlenose dolphin attacks within the Moray Firth occurring between April and September and 77% of bottlenose dolphin attacks outside the Moray Firth occurring between January and June (Learmonth, 2006). The increase in bottlenose dolphin attacks outside the Moray Firth between January and June is consistent with an increase in the number of sightings of bottlenose dolphins off Aberdeen between the months of February and May (Weir and Stockin 2001; Canning, 2007).

There were significant annual variations in the number of harbour porpoises that had died from fatal bottlenose dolphin attacks in Scottish waters between 1992 and 2004, although no overall trend increase or decrease in numbers was detected. However, there was evidence of an increase in the number of bottlenose dolphin attacks outside the Moray Firth in recent years. The increase in bottlenose dolphin attacks on harbour porpoises out with the Moray Firth is consistent with a recent range expansion of bottlenose dolphins (Wilson *et al.*, 2004).

Sightings reports suggest fine-scale segregation, both temporal and geographical, in the occurrence of harbour porpoises and bottlenose dolphins (Canning 2007; Thompson *et al.,* 2004b). Segregation within a small area may result from different uses of the area between the two species or could be due to avoidance behaviour by porpoises as a result of the violent attacks by bottlenose dolphins (Thompson *et al.,* 2004b).

5.3 WHITE-BEAKED DOLPHIN (*LAGENORHYNCHUS ALBIROSTRIS*)

5.3.1 Distribution

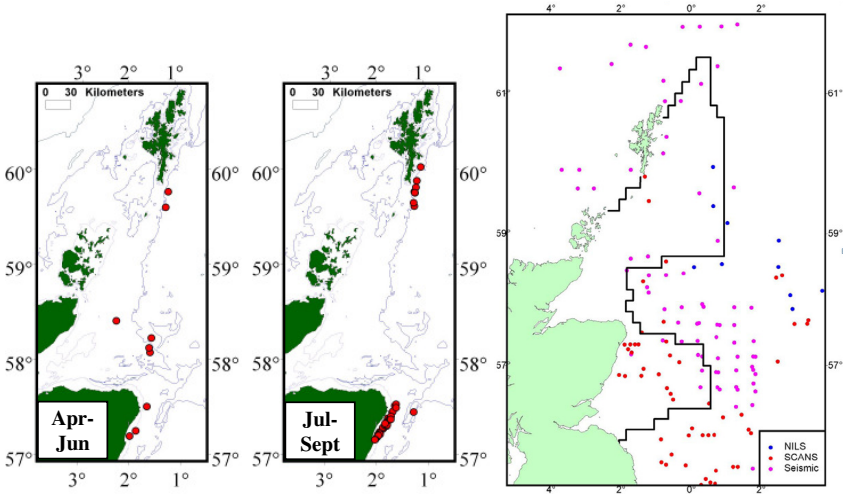
White-beaked dolphins are most commonly sighted in the central part of the North Sea between 54°N and 59°N (Hammond *et al.*, 2001). White-beaked dolphins are restricted to temperate and sub-Arctic waters of the North Atlantic (Reid *et al.*, 2003). They are mainly distributed over the continental shelf, usually in waters of 50-100 m depth (Reid *et al.*, 2003). In the North Sea they are thought to be more numerous within about 200 nm of the Scottish and north-eastern English coasts (Northridge *et al.,* 1995). White-beaked dolphins are present year round in the North Sea, including waters of Shetland and Orkney (Northridge *et al.* 1997).

The locations of white-beaked dolphin sightings made during systematic surveys and some platforms of opportunity off north-east Scotland are presented in Figure 31 (Hammond *et al,*. 2004). During the SCANS II survey in July 2005, white-beaked dolphins were seen in the northern and central North Sea and west of Britain and Ireland (SCANS II, 2006). Analysis of the UK stranding database suggested that sea temperature influences the distribution of this species around the UK (Canning *et al.*, 2008).

There has been a decline in the relative frequencies of strandings and sightings of white-beaked dolphins, a colder-water species and a relative increase in strandings and sightings of common dolphins, a warmer-water species off northwest Scotland. Theses changes in the cetacean community off northwest Scotland have been linked to climate change (MacLeod *et al.*, 2005).

Figure 30 Distribution of white-beaked dolphin sightings during ferry surveys (April-September, 2002-2006

Figure 31 White-beaked dolphin sightings made during various surveys (Hammond *et al.* 2004)



5.3.2 Seasonal Movements

White-beaked dolphins are present year-round in the North Sea, with most sightings recorded between June and October (Evans, 1992; Northridge *et al*., 1995; Reid *et al*., 2003). Seasonal aggregations of white-beaked dolphins have been recorded along the north-east English coast during April and June (Northridge *et al*., 1997).

5.3.3 Abundance

The summer abundance of white-beaked dolphins in the North Sea areas during the first SCANS survey in July 1994 was 7,856 (95% confidence interval 4,000–13,300). This estimate includes shelf waters around Shetland and Orkney in which there were an estimated 1,157 animals (Hammond *et al*., 1995, 2002, 2004).

Current estimated abundance in UK and adjacent waters (shelf only) is 22,400 individuals (SCANS II, 2008). White-beaked dolphins are usually found in schools numbering less than 10 individuals, but schools of up to 50 are not uncommon, and aggregations can comprise 100-500 animals in northern parts of their range and also in the North Sea (Reid, et al. 2003).

5.3.4 Occurrence in Aberdeen Bay and surrounding area

The presence of white-beaked dolphins in the Aberdeen Bay area is seasonal. During land- and vessel based surveys between March 1999 and October 2001, along the Aberdeenshire coast (between St Cyrus and Collieston, primarily between Stonehaven and Aberdeen), white-beaked dolphins were recorded only between June and August, despite good coverage for both land- and vessel-based surveys in most other months. White-beaked dolphin calves were observed in all three months that the species was recorded (Weir *et al*., 2007).

The fine-scale distribution varied within the study area, with an apparent preference for sections of coast adjacent to deeper water. Most white-beaked dolphins were sighted along the Cove to Girdle Ness coast. During the land-based surveys, the incidence of white-beaked dolphins was significantly higher in the area between Aberdeen and Stonehaven than in area between Aberdeen and Collieston (Weir *et al*., 2007).

Similarly, white-beaked dolphins were only recorded during summer months during land and boat surveys along the Aberdeenshire coast (Stonehaven to Aberdeen) between 2002 and 2005. During land based surveys at Aberdeen harbour (November 2002 – April 2005), white-beaked dolphins were recorded during the summer of 2004 and during land-based surveys at Stonehaven (March 2003 – March 2005), they were observed between May and August during 2003 and in July during 2004 (Canning, 2007). Analysis of the sightings indicate that seabed depth and slope influence the distribution of white-beaked dolphins in this area and this is thought to be related to prey distribution. Sea temperature was found to influence white-beaked dolphin group size, with smaller groups being recorded at higher temperatures (Canning, 2007).

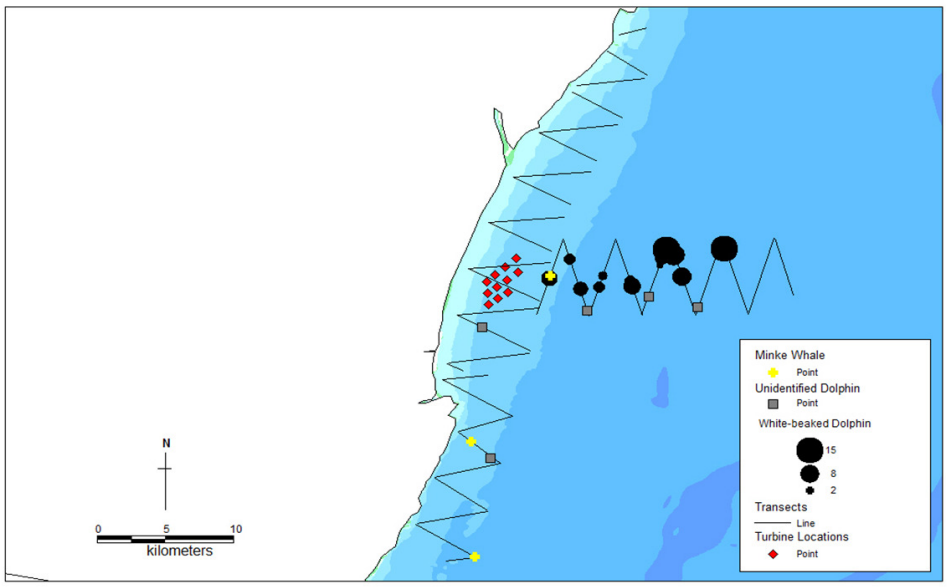
The high number of calves observed during the boat surveys off Aberdeenshire and in the stranding data during the summer, suggests the inshore movement of this species at this time of year may be related to calving. The stranding data also suggested there may be a difference in when males and females move inshore (Canning, 2007).

White-beaked dolphins were the most commonly-sighted species of dolphin during northern North Sea ferry surveys between Aberdeen, Orkney and Shetland in summer months between 2002 and 2006 (MacLeod *et al*., 2007). White-beaked dolphins were recorded throughout the study area, but were recorded more frequently in

more coastal waters, such as along the coast of mainland Scotland, in the late summer and early autumn. Group sizes ranged from one to 20, with an average of five individuals per group. White-beaked dolphins were the only species of cetacean recorded in all years when surveys were conducted. White-beaked dolphins made up the highest proportion of sightings in July, accounting for almost 20% of all sightings. White-beaked dolphins were not recorded in April (MacLeod *et al*., 2007).

During the boat based survey carried out as part of the wind farm during 2007-2008 one sighting of three individual white beaked dolphins occurred in August 2007, and this was an incidental sighting when the observers were off effort. Again during the August survey there were 14 observations of white beaked dolphins that in the offshore transect comprising a total of 88 individuals (Figure 32). The sightings data collected as part of the EOWDC marine mammal data supports other observational data records which suggests the species is a seasonal summer visitor to the Aberdeenshire coast.

Figure 32 White beaked dolphins, minke whale and unidentified dolphins detected during August, September and November 2010, and January 2011



5.3.5 Diet

White-beaked dolphins take a range of prey, including fish, cephalopods and some crustacean species (Reid *et al*., 2003). Herring and whiting have been recorded as prey items of this species in the North Sea (Fraser, 1974; Harmer, 1927). The diet of those found around Britain includes whiting, hake, herring, cod, mackerel, scad, sandeel, long rough dab, *Trisopterus sp*, and the octopus *Eledone cirrhosa* (Evans, 1992; Santos *et al.,* 1994). Stomach contents analysis of white-beaked dolphin (n=22) stranded around Scotland (1992-2003) identified a wide variety of prey species: haddock and whiting were the predominant fish species and other prey species included cod, herring and mackerel (Canning *et al*., 2008). Elsewhere in the North Atlantic herring and gadoid fishes also appear to be the main diet items (Reeves *et al.*, 1999a).

5.3.6 Life history

Little is known about the reproductive behaviour of this species but mating is thought to occur during the summer with parturition occurring the following summer (Kinze *et al.,* 1997). White-beaked dolphin calves have been observed off Aberdeenshire in all three months (June, July and August) that the species has been observed (Weir *et al*., 2007).

Information on the life history of white-beaked dolphins in Scottish waters is limited. However, the examination of the reproductive status of stranded individuals (1996-2002) suggests that mating occurs between July and August; however the majority of stranded white-beaked dolphins for which age and reproductive data are available, were sexually immature and aged four years and less.

5.3.7 Strandings

The majority of white-beaked dolphins stranded in the UK are found around Scotland and along the east coast of England (Canning *et al*., 2008). Fourteen white-beaked dolphins have been recorded by the Scottish Agricultural College along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and December 2009. Seven were female and 7 were male, with body length between 119cm and 263cm (Table 21). White-beaked dolphins were recovered along the north-east coast of Scotland between February and October, with the majority in June and July, in 1992-1995 and 2001-2004 (Table 21).

Table 21 White-beaked dolphins stranded along the northeast coast of Scotland January 1992 – August 2009 (CSIP 2010)

Date Found	Location	Sex	Body length
June 1992	Aberdeen	M	132 cm
March 1993	Aberdeen	F	225 cm
September 1994	Aberdeen	M	222 cm
July 1994	Balmedie	M	119 cm
July 1994	Aberdeen	F	134 cm
April 1995	Fraserburgh	F	188 cm
July 1995	Balmedie	F	122 cm
July 2001	Forvie	F	245 cm
June 2002	Forvie	M	263 cm
June 2002	Blackdog	M	155 cm
June 2002	Collieston	F	171 cm
October 2003	Aberdeen	M	158 cm
February 2004	Fraserburgh	M	200 cm
January 2008	Collieston	F	176 cm

Stranding records suggest that white-beaked dolphins may be present in the area throughout the year, with the exception of winter (November-January). The peak occurrence appears to be in summer, especially during the months of June and July.

5.4 MINKE WHALE (*BALAENOPTERA ACUTOROSTRATA*)

5.4.1 Distribution

Minke whales are widely distributed in the northern hemisphere, tropical, temperate and polar seas (Reid *et al*., 2003). There are three distinct populations: Southern Hemisphere, Northern Pacific and North Atlantic. In the North Atlantic the International Whaling Commission recognises three stocks for management purposes: NE Atlantic, west Greenland and Canadian east coast. Minke whales off north-east Scotland are part of the NE Atlantic stock (Hammond *et al*., 2004).

Minke whales occur throughout the central and northern North Sea, as illustrated by the distribution of sightings during the SCANS survey and on other surveys on platforms of opportunity Figure 34 (Hammond *et al*., 2001). Minke whales are more frequently sighted inshore during summer months. The locations of minke whale sightings made during systematic surveys and some platforms of opportunity off NE Scotland are shown in Figure 35 (Hammond *et al*., 2004). Minke whales are widely distributed in the area off north-east Scotland, both in offshore and coastal areas. During the SCANS II survey in July 2005, minke whales were found in the northern and central North Sea and west of Britain and Ireland (SCANS II, 2008).

Between May and October from 2001 to 2006 inclusive, systematic boat surveys were conducted along an 83 km length of the southern coastline of the outer Moray Firth between Lossiemouth and Fraserburgh, using four dedicated survey routes positioned parallel to the shore: three outer routes, approximately 1.5 km apart in latitude, and an inner coastal route. Minke whales were encountered throughout the survey area, but were more generally distributed towards the central and eastern area of the study site, with a notable absence to the far west. A larger number of whales were also sighted on the innermost survey route, but once corrections for survey effort had been made, a considerably higher abundance of animals was shown for each of the outer survey routes, typically occurring along the 20-50 m isobaths. Whilst minke whales were recorded during all survey months (May to October inclusive), the animals were typically encountered in this region from mid June onwards, showing a peak in occurrence during July and August. In addition, the temporal distribution of whales suggested an inshore movement of animals across the summer months, with the whales being recorded in deeper, offshore waters in May and June followed by increasing numbers of encounters of animals in more shallow, inshore waters from July onwards (Robinson *et al*., 2007).

5.4.2 Migration

There is no direct evidence that minke whales in the Northern Hemisphere migrate, but in some areas there appear to be shifts in latitudinal abundance with season (Hammond *et al*., 2004). This is true for the North Sea, where minke whales appear to move into the North Sea at the beginning of May and are present throughout the summer until October (Hammond *et al*., 2004; Northridge *et al.*, 1995).

5.4.3 Abundance

A total abundance of 16,400 individuals has been estimated for UK and adjacent waters, and results from the CODA survey in 2007 estimated a total abundance in the survey area to be 6,765 [95% CI=1,239-36,925] (Macleod, *et al*., 2008). Minke whales are usually seen singly or in pairs although, when feeding, they sometimes form larger aggregations that can number 10-15 individuals (Reid, *et al*. 2003).

During the SCANS I survey, the highest densities were recorded in the northwest North Sea, particularly off the mainland coast of Scotland (Hammond *et al*., 2001). Estimates of the number of minke whales in the North Sea, north of 56°N, were 5,430 (SE=1,870) for 1989 and 20,300 (SE=5,240) for 1995. These estimates are approximately 8-18% of the estimated size of the north-east Atlantic stock of 67,000 whales in 1989 and 112,000 whales in 1995 (Hammond *et al*., 2004; Schweder *et al.*, 1997). Abundance estimates for the North Sea from the Norwegian surveys in July 1998 were 11,700 (SE=3,460) (Hammond *et al*., 2004; Skaug *et al.*, 2003). The SCANS II survey calculated an increased abundance of minke whales for the whole of the North Sea (approximate 95% confidence interval = 10,445-33,171).

5.4.4 Occurrence in Aberdeen Bay and surrounding area

The status of minke whales in the Aberdeen Bay area is unclear. During land- and vessel based surveys along the Aberdeenshire coast (between St Cyrus and Collieston, primarily between Stonehaven and Aberdeen, from March 1999 to October 2001), minke whales were recorded only in the month of August (Weir *et al*., 2007). The five sightings all involved solitary individuals, of which three were adults and two were juveniles, which were observed only in a relatively small spatial region between Aberdeen and Stonehaven (Weir *et al*., 2007). During land-based surveys at Aberdeen harbour (November 2002 – April 2005) and Stonehaven (March 2003 – March 2005), minke whales were recorded during the summer of 2004 and August 2003, respectively (Canning, 2007). However, in recent years minke whales have been observed off the Aberdeenshire coast during most months of the year, with sightings occurring even during the winter months of December and March.

Northern North Sea ferry surveys between Aberdeen, Orkney and Shetland in summer months between 2002 and 2006 recorded minke whales throughout the region, and in all months surveyed (April to September) Figure 35 (MacLeod *et al*., 2007). Most observations of minke whales during the NORCET surveys occurred in more offshore waters in April to June and in more coastal waters in July and September (Figure 5). Minke whales were the second most commonly sighted species during the ferry surveys (MacLeod *et al*., 2007).

During bird vantage point (VP) surveys for the this project, single minke whales were recorded at both Donmouth and Blackdog on 13th July 2007, although this may have been the same individual moving along the coast.

Four minke whales have been recorded during all the boat based wind farm surveys carried out to date. One minke whale was recorded during the surveys carried out in 2007-2008 (Figure 33). Three minke whales were recorded in the four months of boat based surveys carried out during 2010-2011 (Figure 32).

Figure 33 Common dolphin, Minke whale, White beaked dolphin, unidentified dolphin and unidentified cetacean observations during the EOWDC boat based surveys 2007-2008

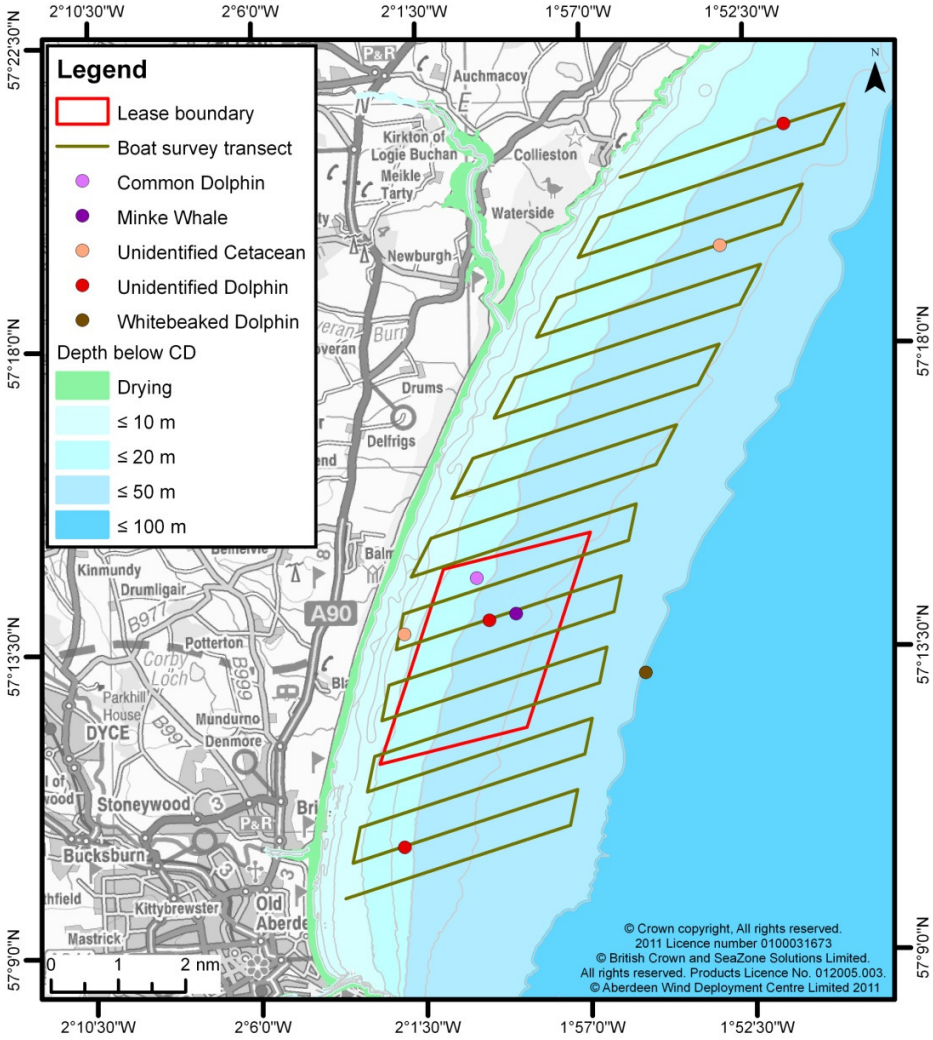


Figure 34 Minke whale sightings made during SCANS, NASS-89, NILS-95, JNCC and seismic surveys (Hammond *et al*., 2004)

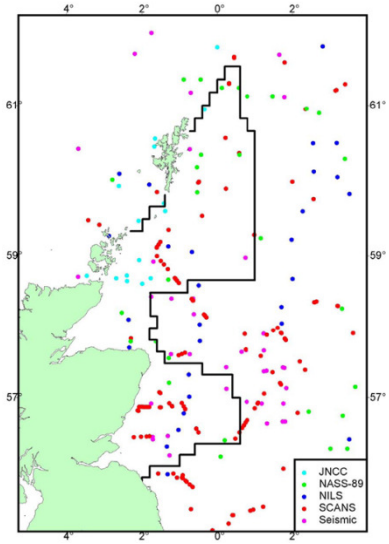
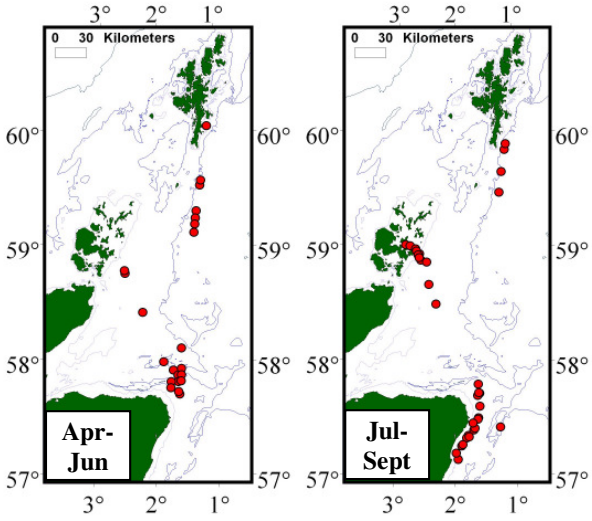


Figure 35 Distribution of minke whales sightings during ferry surveys (April-September, 2002-2006)



5.4.5 Diet

Minke whales are known to feed on a variety of fish species, including herring, cod, haddock, saithe and sandeel (Reid *et al*., 2003). In the north-east Atlantic, minke whales feed on small pelagic fish and its distribution has been related to concentrations of sandeels and herring in Scottish waters (Evans, 1980; Macleod *et al*., 2004; Northridge, 1988). Stomach content analysis of minke whales stranded around the Scottish coast between 1992 and 2002 indicates that the diet comprised mainly sandeels, herring and sprat (Pierce *et al*., 2004).

Sightings of minke whales in the outer Moray Firth were found to be significantly higher during warm water plume events than when the colder water Dooley current was prevailing. In addition, GIS plots of the physiography of the coastal study site revealed a strong preference by the species for areas with steep, northerly-facing slopes, mean water depths of 38 m and sandy gravel sediment type. Sandy gravel sediments showed the strongest positive correlation with minke distribution, and this type of substrate is seen to be the optimal habitat utilised by burrowing sandeels (Robinson *et al*., 2007).

5.4.6 Strandings

During 1992-2002 approximately 110 strandings of minke whales were recorded in Scotland. Most strandings were recorded between April and November, with a peak strandings of males in July and August (Pierce *et al*., 2004).

Five stranded minke whales have been recorded by the Scottish Agricultural College along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and March 2010 (SAC, 2006; CSIP 2010). The body lengths of the whales were between 585 cm and 800 cm and three of the five minke whales were identified as male. Minke whales were recovered in the months of July, September, October and November within the years 1993, 1995 and 2000 between Peterhead and Inverbervie (Table 7). Strandings records indicate that minke whales are present along the north east coast of Scotland between July and November.

Table 22 Minke whales stranded along the northeast coast of Scotland (January 1992 – August 2006)

Date Found	Location	Sex	Body length
September 1993	Near Slains Castle	M	760 cm
July 1995	Peterhead	M	585 cm
October 1995	Inverbervie	Unknown	c700 cm
November 1995	Near Catterline	M	700 cm
September 2000	Balmedie	Unknown	800 cm

5.5 ATLANTIC WHITE-SIDED DOLPHIN (*LAGENORHYNCHUS ACUTUS*)

5.5.1 Distribution

Atlantic white-sided dolphins are confined to the North Atlantic (Reeves *et al*., 1999b). White-sided dolphins live mainly in cool waters (7-12^{o}C), particularly along the edges of continental shelves at depths of 100-500 m, but they can be numerous in deeper waters (Reid *et al*., 2003). The Atlantic white-sided dolphin is primarily an offshore species, but has been recorded during a number of surveys in the North Sea, especially during summer (Northridge *et al*., 1997; Reid *et al*., 2003). They share most of their range with the white-beaked dolphin, but in the eastern North Atlantic they adopt a mainly offshore distribution and are consequently rarer than white-beaked dolphins over shelf waters (Hammond *et al*., 2001). Around Britain, Atlantic white-sided dolphins have been recorded mainly in the north and appear to be most common in the north-western parts of the North Sea (Hammond *et al*., 2001, 2004). Compared to white-beaked dolphins, Atlantic white-sided dolphins are generally distributed further northwest in deeper waters. In the North Sea, their presence is seasonal, with the majority of sightings occurring between May and September (Northridge *et al*., 1997).

5.5.2 Occurrence in Aberdeen Bay and surrounding area

Atlantic white-sided dolphins were recorded on nine occasions in groups of between one and 50 individuals during northern North Sea ferry surveys between Aberdeen, Orkney and Shetland in summer months between

2002 and 2006 (MacLeod *et al*., 2007). The majority of the sightings occurred in the more northern part of the study area around Shetland, with only one recorded sighting near the Scottish mainland coast (Figure 36). The sightings primarily occurred between July and September, with a single sighting being recorded in May. This species appears to be a seasonal but regular member of the cetacean assemblage of the northern North Sea, and primarily occurs in the more northern waters of the area (MacLeod *et al*., 2007). During surveys along the southern outer Moray Firth coast (May to October, 2001-2005), a single sighting of twelve white-sided dolphins was recorded in August 2005 (Robinson *et al*., 2008).

The locations of Atlantic white-sided dolphin sightings made during systematic surveys and some platforms of opportunity off north-east Scotland are illustrated in Figure 37. White-sided dolphins have been observed off the Aberdeen coast at Girdle Ness in June 2002 (Seawatch Foundation, 2011).

No white sided dolphins have been recorded in any of the surveys carried out as part of the EOWDC.

5.5.3 Abundance

There is no reliable total population estimate for this species at present. Abundance estimates have been difficult to obtain due to difficulties in separating white-sided dolphin and white-beaked dolphin identification at long-range (Hammond, *et al*., 2002). The white sided dolphin is known to occasionally be involved in mass stranding events, although none of these have been reported along the east coast of Scotland (Hammond *et al*., 2001).

The SCANS I survey estimated 11,760 *Lagenorhynchus* dolphins (white-beaked plus white-sided) in the North Sea (approx. 95% confidence interval 5,900 - 18,800). This estimate includes shelf waters around Shetland and Orkney (Hammond *et al*., 1995, 2002, 2004). The SCANS II survey estimated a total abundance of 27,227 (CV=0.38) for *Lagenorhynchus* species in UK and adjacent waters (shelf only) in the summer of 2005 (Scans II, 2006). This species is very gregarious, with observed school sizes frequently numbering in the tens to hundreds, and sometimes up to 1,000, particularly offshore. Within large aggregations, clusters of 2-15 animals can often be distinguished (Reeves, *et al*., 1999a).

5.5.4 Diet

The diet of Atlantic white-sided dolphins consists of a wide variety of fish, particularly gadoids such as blue whiting, whiting, *Trisopterus* spp., cod, clupeids, particularly herring; other species recorded in the diet include hake, mackerel, salmonids and squid (Reid *et al*., 2003). Different prey species may predominate at different times of year, representing seasonal movements of prey, or in different areas, indicating prey and habitat variability in the environment (Cipriano, 2002).

The stomach contents of three white-sided dolphins stranded around Scotland between 1993 and 1995 consisted of Gadidae and cephalopods, predominately the neritic and oceanic squid *Todarodes sagittatus* (Santos *et al*., 1995).

Figure 36 Distribution of Atlantic white-sided dolphin (blue) and common dolphin (red) sightings during ferry surveys (April-September, 2002-2006)

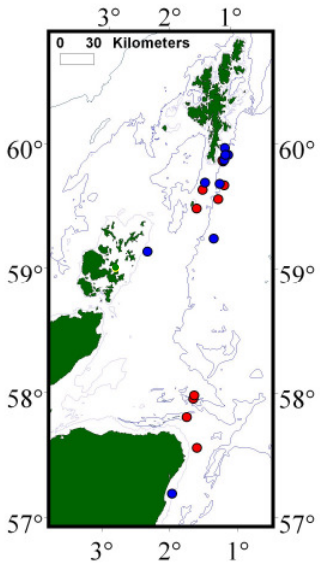
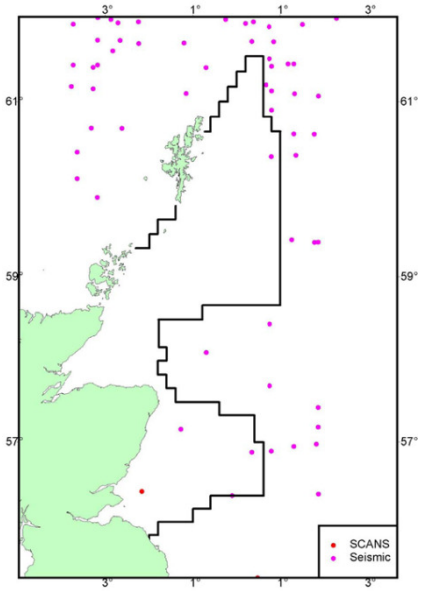


Figure 37 Atlantic white-sided dolphin sightings made during SCANS I survey and seismic surveys (Hammond *et al.*, 2004)



5.6 KILLER WHALE (*ORCINUS ORCA*)

5.6.1 Distribution

Killer whales have a worldwide distribution and are found in tropical, temperate and polar waters in both the northern and southern hemisphere (Reid *et al.*, 2003). In the eastern North Atlantic they occur in most areas

from coastal fjords to oceanic waters. Any seasonal movements appear to be associated with prey, including seals and herring, and are region-specific (Hammond *et al*., 2001, 2004; Reid *et al.*, 2003).

Killer whales have been observed throughout the north-western North Sea in most months (Hammond *et al*., 2001, 2004; Reid *et al.*, 2003). In UK near-shore waters the species is mainly recorded between April and October (Evans, 1988, 1992; Reid *et al*., 2003). Killer whales are not numerous in the North Sea in general, although they are recorded fairly frequently around Shetland in all months (Hammond *et al*., 2004). The locations of killer whale sightings made during systematic surveys and some platforms of opportunity off north-east Scotland are illustrated in Figure 38.

During opportunistic sightings of killer whales from Scottish pelagic trawlers fishing for mackerel (October to March) and herring (June to September) off north Scotland between 2000 and 2006, encounters with recorded killer whales were recorded between January and February 2006 from pelagic trawlers fishing for mackerel to the north and east of Shetland, no killer whale encounters were recorded from vessels fishing for herring (Luque *et al*., 2006).

Individual killer whales have been documented to move over very large areas, with ranges up to tens of thousands of km^2 for animals from both resident and transient populations (Baird, 2000).

5.6.2 Abundance

The most recent sighting surveys in the eastern North Atlantic (mainly from Iceland to the Faroes) indicate a population of between 3,500 and 1,2500 individuals (Gunnlaugsson and Sigurjonsson, 1990). Most sightings in UK waters are of singles or pods of less than eight individuals (mean = 4.6), although aggregations of up to one hundred have been observed (Macleod, 2004).

5.6.3 Occurrence in Aberdeen Bay and surrounding area

Along the southern outer Moray Firth coast (May to October, 2001-2005), killer whales were only intermittently sighted between the months of June and August (n = 6) (Robinson *et al*., 2008). During ferry surveys between Aberdeen, Orkney and Shetland in summer months between 2002 and 2006, killer whales were encountered on three occasions in groups ranging from one to five individuals (Figure 38). Two of these encounters were in August (2004 and 2006) and one was in June 2006. This suggests that killer whales are rare, but regular members of the cetacean community in the northern North Sea (MacLeod *et al*., 2007).

No killer whales were sighted during any of the EOWDC boat based surveys.

5.6.4 Diet

Killer whales have one of the most varied diets of all cetaceans, ranging from fish and squid to birds, turtles, seals and other cetaceans (Reid *et al*., 2003). Fish species taken in the eastern North Atlantic include herring, mackerel, cod and salmon (Evans, 1980; Reid *et al*., 2003). Little is known about the diet of killer whales in British waters (Hammond *et al*., 2001). Killer whales are thought to prey upon seals around haul outs in Shetland at least, and possibly offshore, as well as at least one porpoise, and have also been reported to feed on mackerel around Shetland (Fisher and Brown, 2001; Hammond *et al*., 2001).

The stomach contents of one killer whale stranded in Scotland between 1993 and 1995 consisted of oceanic cephalopods, including Gonatidae (*Gonatus steenstrupi*) and Histioteuthidae (Santos *et al*., 1995).

Figure 38 Distribution of killer whale (blue), Risso's dolphin (yellow) and fin whale (red) sightings during ferry surveys (April-September, 2002-2006)

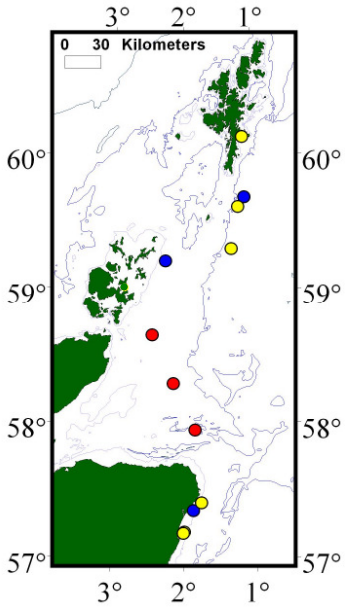
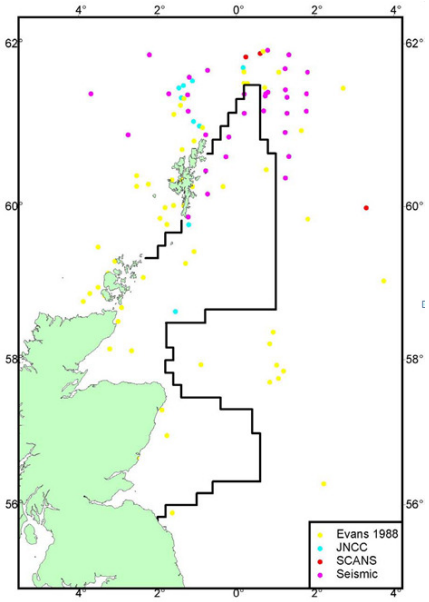


Figure 39 Killer whale sightings made during SCANS I survey, JNCC and seismic surveys and from Evans 1988 (Hammond *et al*., 2004)



5.7 COMMON DOLPHIN (*DELPHINUS DELPHIS*)

5.7.1 Distribution

Short-beaked common dolphins have a world-wide distribution in tropical and temperate waters (Reid *et al*., 2003). They are generally found in oceanic and shelf-edge waters but do occasionally use coastal areas. Around the British Isles, the species is most often reported from the west coast, especially the Celtic Sea (Hammond *et al*., 2004; Reid *et al*., 2003).

5.7.2 Abundance

There are no known local populations in UK waters, and those animals occurring in UK waters are part of a wider north-east Atlantic population. SCANS II covered all European Atlantic continental shelf waters in June/July 2005 and estimated total abundance in the area as 63,366 (CV=0.46) (SCANS-II 2008).

5.7.3 Occurrence in Aberdeen Bay and surrounding area

There have also been infrequent sightings during surveys in the North Sea, generally during summer months (Hammond *et al*., 2001). The species is also occasionally stranded along the UK North Sea coast (Reid and Patterson, 1998). Figure 40 shows sightings records of common dolphins made during systematic surveys and some platforms of opportunity off north-east Scotland (Hammond *et al*., 2004). During the SCANS II survey in July 2005, common dolphins were sighted in the waters west of Britain and Ireland, in the channel, and in shelf waters off France, Spain and Portugal (SCANS II, 2006).

Nine groups of common dolphins, ranging in size from one to 25 animals, were recorded during NORCET surveys between Aberdeen, Orkney and Shetland in summer months between 2002 and 2006 (MacLeod *et al*., 2007). Sightings occurred from June to August and in every year except 2005. This species primarily occurred in relatively coastal waters near Shetland and north-east Scotland (Figure 40). Therefore, common dolphins appear to be a regular, if rare and seasonal, member of the cetacean assemblage of the northern North Sea (MacLeod *et al*., 2007). In the outer southern Moray Firth, along the Southern Trench, approximately 300+ common dolphins were encountered on 8th July 2007 (Earthwatch, 2011)

One solitary common dolphin was recorded during the project boat based surveys carried out during 2007-2008 (Figure 33).

5.7.4 Seasonal occurrence

Short-beaked common dolphins are occasional summer visitors to the North Sea (Hammond *et al*., 2001; 2004). Most sightings of common dolphins in the North Sea have been recorded between June and September (Reid *et al*., 2003).

5.7.5 Diet

The diet of common dolphins comprises a wide range of small fish and squid (Reid *et al*., 2003). In the North Sea, small pelagic schooling fishes and squids are the likely main food items (Hammond *et al*., 2004). An influx of the squid *Todarodes sagittatus* to the North Sea during 1937 was accompanied by an influx of common dolphins that same year, and it was assumed that the common dolphins were feeding on these squid (Fraser, 1946; Hammond *et al*., 2004).

Two common dolphins stranded in Scotland between 1993 and 1995 had eaten mainly sandeels and Gadidae (such as whiting and haddock/saithe/pollack), but also herring (Clupeidae) (Santos *et al*., 1995). Fourteen fish

taxa and two cephalopod taxa were identified from the stomachs of nine common dolphins from Scottish waters between 2000 and 2003. Mackerel, followed by whiting were the main prey, other prey species included herring, sprat, *Argentine* sp., cod, haddock, blue whiting, *Trisopterus* spp., grey gurnard, scad, sandeels and plaice (Santos *et al*., 2004b).

5.7.6 Strandings

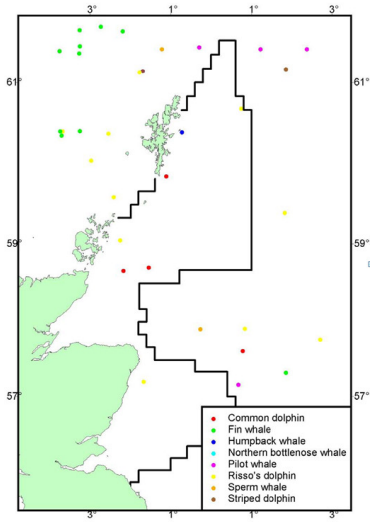
Three stranded common dolphins have been recorded by the Scottish Agricultural College along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and August 2006 (SAC, 2006). The body lengths of the dolphins were between 150 cm and 220 cm, two were female and one was male. Stranded common dolphins were recorded in March, April and May in 1992 and 2005 between Fraserburgh and Aberdeen (Table 8).

Table 23 Common dolphins stranded along the northeast coast of Scotland (January 1992 – August 2006)

Date Found	Location	Sex	Body length
March 1992	Aberdeen	F	193 cm
April 2005	Aberdeen	F	151 cm
May 2005	Rattray Bay	M	219 cm

Strandings records indicate that common dolphins are present along the northeast coast of Scotland between March and May, although there occurrence in the strandings record is infrequent (SAC, 2006).

Figure 40 Sightings records of common dolphins, fin whales, humpback whales, northern bottlenose whales, pilot whales, Risso's dolphins, sperm whales and striped dolphins made during NASS-87, NILS-95 JNCC seismic and other surveys.



5.8 RISSO'S DOLPHIN (*GRAMPUS GRISEUS*)

5.8.1 Distribution

Risso's dolphins have a wide distribution and are generally found in oceanic waters. Risso's dolphins are primarily a warm water (4.5-28^{o}C) pelagic species that is generally found in continental slope waters (Reid *et*

al., 2003). In UK continental shelf seas, Risso's dolphins have been recorded mainly over slopes of 50-100 m depth (Reid *et al*., 2003).

Most of the sightings recorded from the northern North Sea are around Shetland, Orkney, Fraserburgh, Aberdeen and Berwick, with only a few sightings in the central North Sea (Reid *et al*., 2003; Hammond *et al*., 2001). The sightings records of Risso's dolphins made during systematic surveys and some platforms of opportunity off north-east Scotland are illustrated in Figure 40.

5.8.2 Abundance

There have been no attempts to estimate the abundance of Risso's dolphins over wide areas of the North Sea, although the animals occurring in UK waters are likely to be part of a population ranging in size from 500 animals to the low 1,000s, similar to population sizes in the north-west Atlantic (JNCC, 2010).

5.8.3 Occurrence in Aberdeen Bay and surrounding area

Sightings of Risso's dolphins in northern North Sea are mainly between July and August, although some animals were present off north-east Scotland and Shetland in winter (Reid *et al*., 2003). Along the southern outer Moray Firth coast (May to October, 2001-2005), Risso's dolphins were exclusively recorded in September and were seen in increasing abundance during the latter years of the study (Robinson *et al*., 2008).

During ferry surveys between Aberdeen, Orkney and Shetland in summer months between 2002 and 2006, Risso's dolphins were sighted on six occasions, with group size ranging from one to four individuals (MacLeod *et al*., 2007). These sightings all occurred in 2006 and were either in relatively coastal waters close to Shetland or north-east Scotland.

Risso's dolphins have been recorded off the Aberdeenshire coast since 2005, with sightings off Girdleness in September 2005 and off Cruden Bay/Bullars of Buchan in October 2005. There were several reported sightings around Aberdeen during July/August 2006 and April 2007 and another from Torry in February 2007, more recently a group of 4 Risso dolphins were observed at Longhaven Cliffs near Aberdeen in 2010 (ACC, 2008; Seawatch Foundation, 2011).

Altghough no Risso's dolphins were observed in any of the EOWDC boat based surveys, during bird vantage point (VP) surveys for this project, 20 Risso's dolphins were recorded at Blackdog on the 28th April 2006 and 10 Risso's dolphins were observed at the Donmouth on the 24th April 2007.

The increase in recent sightings in the Aberdeen Bay area may indicate that Risso's dolphins are using the area more frequently, and although occasional in the area the frequency of the utilisation of Aberdeen Bay area may change and should be monitored.

5.8.4 Diet

Risso's dolphins are capable of deep dives and are thought to specialise in catching squid (Hammond *et al*., 2001). Risso's dolphins have been reported to feed mostly on cephalopods, although small fish are also taken (Reid *et al*., 2003). Analysis of stomach contents from individuals from British waters indicated a diet of mainly octopus *Eledone cirrhosa*, also cuttlefish *Sepia officinalis*, sepioloids and squid such as *Loligo forbesi* and *Todarodes sagittatus* (Reid *et al*., 2003). Three Risso's dolphins stranded in Scotland between 1993 and 1995 had been feeding on cephalopods, primarily the octopus *Eledone cirrhosa* (Santos *et al*., 1995).

5.8.5 Strandings

Two Risso's dolphins have been recorded by the Scottish Agricultural College along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and August 2006. One was a female with a body length of 325 cm recovered in November 2004 from Blackdog, the other had a body length of approximately 250 cm, the sex was not determined, and it was recovered from Fraserburgh in January 2005 (SAC, 2006; CSIP 2009).

Strandings records suggest that although Risso's dolphins may be present in the area, their occurrence is occasional and the number of animals in the area is likely to be low.

5.9 STRIPED DOLPHIN (*STENELLA COERULEOALBA*)

5.9.1 Distribution

The striped dolphin has a worldwide distribution, occurring in both southern and northern hemispheres mainly in tropical, sub-tropical and warm-temperate oceanic waters. It tends to occur beyond the continental shelf in depths of 1,000 m or deeper, but has been occasional recorded in shelf waters and even in waters of 60 m or less (Forcada *et al*., 1990; Reid *et al*., 2003).

5.9.2 Abundance

The abundance estimate obtained from the CODA surveys is 82,585 (95% CI = 29,548 – 230,819) animals (Macleod, *et al*., 2008).

Striped dolphins were not reported in Scottish waters until 1988 (Reid *et al*., 1993). It has been suggested that *Stenella coeruleoalba*, a warm-water species, could have recently expanded its distribution northwards. Macleod *et al.* (2005) proposed that increased sea temperatures caused by climate change could explain this shift in distribution.

5.9.3 Occurrence in Aberdeen Bay and surrounding area

Striped dolphins are generally rare in UK waters, with its normal distribution reaching its nothern limit at 50^{o}N, although they have been observed in the North Sea (Reid *et al*., 2003; Stone, 2001). Most near-shore records from the UK have been recorded between July and December (Evans, 1992; Reid *et al*., 2003). Sightings records of striped dolphins made during systematic surveys and some platforms of opportunity off north-east Scotland are illustrated in Figure 38.

No stripped dolphin's were recorded in any of the project surveys.

5.9.4 Diet

The striped dolphin diet consists of a variety of mesopelagic and benthic fish, including sprat, blue whiting, *Trisopterus* spp. and whiting, as well as squid and crustaceans (Reid *et al*., 2003).

The stomach contents of four striped dolphins stranded around Scotland (1993-1995) contained mainly Gadidae (whiting and *Trisopterus* spp.), but also cephalopods, including the sepiolid *Sepietta oweniana* and the oceanic squid *Gonatus steenstrupi* (Santos *et al*., 1995). Ten fish taxa and four cephalopod taxa were identified in the stomach contents of seven striped dolphins stranded around Scotland between 2000 and 2003. Crustacean and polychaete remains were found in three and one of the stomachs, respectively. The main prey

species were haddock/saithe/pollock (these species are grouped together as their otoliths are very similar and not always possible to distinguish), followed by *Trisopterus* spp. and whiting (Santos *et al*., 2004b).

5.9.5 Life History

Very little is known about the life history of striped dolphins in Scottish waters. The reproductive status was determined for 6 female and 6 male stranded striped dolphins between 2001 and 2003, with the majority being immature but the (small) sample included one pregnant female and one sexually active mature male. The pregnant female was recovered from Skye on the west coast of Scotland in September 2001 and the mature and sexually active male was recovered from the North Sea coast in May (Santos *et al*., 2008).

5.9.6 Strandings

During 1992-2003, 52 striped dolphin strandings were recorded in Scotland. Although strandings were recorded in every month of the year, highest numbers were found in January-March and August. Striped dolphins stranded all around the Scottish coast, but the majority were recovered from the west coast (Santos *et al*., 2008)

5.10 LONG-FINNED PILOT WHALE (*GLOBICEPHALA MELAS*)

5.10.1 Distribution

Long-finned pilot whales occur in temperate and sub-Arctic regions of the North Atlantic and in the southern oceans (Reid *et al*., 2003). Long-finned pilot whales in UK waters occur mainly off the continental shelf, but their numbers and distribution seems to be highly variable both between seasons and inter-annually. Most records were from waters greater than 200 m, with relatively few occurrences in the shallower waters of the North Sea (Hammond *et al*., 2001). The sightings of pilot whales made during systematic surveys and some platforms of opportunity off north-east Scotland are illustrated in Figure 40.

5.10.2 Abundance

There is no recent population estimate for this species. The NASS-89 survey estimated 778,000 long-finned pilot whales in the eastern North Atlantic (Hammond *et al*., 2001). There has been a sustained catch of pilot whales off the Faroes for many hundreds of years, during which period more than 230,000 whales have been taken. Historically, there were enough whales around Shetland to support a drive fishery. The largest catch on record in this fishery was 1,540 animals caught in 1845 (Nature in Shetland, 2011).

5.10.3 Occurrence in Aberdeen Bay and surrounding area

Incidental sightings of pilot whales in the North Sea appear to be more numerous between November and January (Reid *et al*., 2003). There are a few sightings in the northern North Sea and there are also records from the south-western North Sea during June, July, August, and December (Reid *et al.,* 2003). Pilot whales are seen in Shetland waters in most months of the year.

During land-based surveys at Stonehaven between March 2003 and March 2005, pilot whales were observed in November 2003 (Canning, 2007). Along the southern outer Moray Firth coast (May to October, 2001-2005), pilot whales were intermittently encountered in the study area between the months of July and August (Robinson *et al*., 2008).

No long finned pilot whales were recorded in any of the EOWDC boat surveys.

5.10.4 Diet

Cephalopods generally form the majority of their diet, although they take a range of species. Twelve genera of cephalopods, as well as 15 genera of fish and crustaceans have been recorded in studies near the Faroes, with squid, especially *Todarodes sagittatus* as a key component (Desportes and Mouritsen, 1993; Reid *et al*., 2003).

5.10.5 Strandings

Strandings along the UK North Sea coast have increased since 1947; there were a number of mass strandings involving more than 150 animals in total between November 1982 and January 1985 (Hammond *et al*., 2001; Martin *et al.*, 1987; Sheldrick, 1976). Pilot whales are one of the most commonly mass-stranded whales.

One long-finned pilot whale has been recorded by the Scottish Agricultural College along the north east coast of Scotland from Fraserburgh to Inverbervie between January 1992 and March 2010. The female had a body length of 308 cm and was recovered from Fraserburgh in April 2001 (SAC, 2006; CSIP 2010).

Strandings records suggest that although long-finned pilot whales may be present in the area, their occurrence is occasional/rare and the number of animals in the area is likely to be low.

5.11 SPERM WHALE (*PHYSETER MACROCEPHALUS*)

5.11.1 Distribution

Sperm whales have a wide distribution that includes tropical, temperate and sub-polar seas of the both the northern and southern hemispheres (Reid *et al*., 2003). Sperm whales are normally distributed to the west and north of the UK on, and beyond, the continental shelf break. They have also been recorded fairly regularly in Orkney and Shetland waters, with sightings and strandings reported in most months (Hammond *et al*., 2001). A number of sightings and strandings have been recorded from the North Sea in the last decade. Males migrate to high latitudes to feed and, as a result, all sperm whales sighted or stranded in the North Sea to date have been males (Hammond *et al*., 2001) (

Table 24).

The sightings records of sperm whales made during systematic surveys and some platforms of opportunity off north-east Scotland are illustrated in Figure 40. Sightings of sperm whales in British and Irish waters have been mainly recorded between July and December (Reid *et al*., 2003).

5.11.2 Abundance

The world population of sperm whales has been estimated at 2 million individuals, making them the most abundant species of large whale in the world (Hammond *et al*., 2001).

No sperm whales were detected in any of the project surveys.

5.11.3 Diet

Sperm whale diet is varied but primarily consists of medium to large-sized mesopelagic squid and in the North Atlantic most prey comprise mainly of Onychoteuthidae and Ommastrephidae, although other species are also taken (Reid *et al*., 2003).

Stomach contents of sperm whales stranded in Scotland and Denmark during 1990-96 were analysed (Santos *et al*., 1999). All were sub-adult or adult males and stranded between November and March. The diet of these whales was found to consist almost entirely of cephalopods, principally squid of the genus *Gonatus* (probably *G. fabricii*, an oceanic species characteristic of Arctic waters). The other prey species identified were also mostly oceanic cephalopods: the squids *Histioteuthis bonnellii*, *Teuthowenia megalops* and *Todarodes sagjttatus* and the octopus *Hahphron atlanticus*. There was little evidence of predation on fish. Remains of single individuals of the veined squid *Loligo forbesi*, the northern octopus *Eledone cirrhosa* and the saithe *Pouachius virens* provided the only possible evidence of feeding in the North Sea. The study suggested that sperm whales do not enter the North Sea to feed (Santos *et al*., 1999).

5.11.4 Strandings

Nine sperm whales have been recorded by the SAC along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and December 2009, six of which stranded together in Cruden Bay in January 1996. Nine stranded sperm whales along the north-east coast of Scotland were male during 1996, 2005, 2006 and 2009 and their body lengths ranged between 1,200cm and 1,375 cm (CSIP 2010) (

Table 24).

Table 24 Sperm whales stranded along the northeast coast of Scotland (January 1992 – March 2010)

Date Found	Location	Sex	Body length
January 1996	Cruden Bay	M	1,210 cm
January 1996	Cruden Bay	M	1,260 cm
January 1996	Cruden Bay	M	1,285 cm
January 1996	Cruden Bay	M	1,365 cm
January 1996	Cruden Bay	M	1,365 cm
January 1996	Cruden Bay	M	1,375 cm
May 2005	Cruden Bay	M	c1,350 cm
March 2006	Forvie	M	c1,200 cm
October 2009	Balmedie	M	1,400 cm

Stranding records suggest that although male sperm whales may be present in the area between January and May, their occurrence is occasional and the number of animals in the area is likely to be low (SAC, 2006).

5.12 HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*)

5.12.1 Distribution

The humpback whale occurs globally in tropical, temperate and polar seas of the northern and southern hemispheres (Reid *et al*., 2003). It is generally found along and over the edges of continental shelves. In summer they tend to have a more coastal distribution in some areas that is largely depended on local prey availability (Reid *et al*., 2003).

5.12.2 Abundance

In the summer, a very small number of humpbacks are found in British shelf waters, particularly around the Northern Isles and also in western areas from the Hebrides to the English Channel (Evans, 2003).

5.12.3 Occurrence in Aberdeen Bay and surrounding area

Most sightings over the UK continental shelf have been made between May and September (Reid et al., 2003). The sightings records of humpback whales made during systematic surveys and some platforms of opportunity off north-east Scotland are illustrated in Figure 40.

During ferry surveys between Aberdeen, Orkney and Shetland in summer months between 2002 and 2006, one group of humpback whales, consisting of two adults and one juvenile, was seen in July 2005 (MacLeod *et al*., 2007). While this species was once almost completely absent from the North Sea due to the depletion of the North Atlantic humpback whale population by whalers, this species is now becoming regularly recorded in the North Sea in small numbers possibly as a result of a recovery in the North Atlantic population (MacLeod *et al*., 2007). Along the southern outer Moray Firth coast, humpback whales were intermittently encountered in the study area between the months of July and August (Robinson *et al*., 2008).

Humpback whales have been recorded off the Aberdeen coast in the area between Girdleness and Cove, just south of Aberdeen in February 2003 and June 2002 and off Portlethen in 2010 (Seawatch Foundation 2011).

No humpback whales were recorded during the EOWDC surveys.

5.12.4 Diet

The diet of humpback whales in the North Sea area is unknown, but elsewhere they consume planktonic crustaceans and small schooling fish. The fish species most likely to be consumed are those that form dense pelagic schools such as sandeels, herring, sprats and mackerel (Hammond *et al*., 2001, 2004; Reid *et al*., 2003).

5.13 FIN WHALE (*BALAENOPTERA PHYSALUS*)

5.13.1 Distribution

Fin whales occur in the North Atlantic and are mainly found in deep waters (400-2,000 m depth) beyond the edge of the continental shelf, but in some areas they are known to occur in shallower waters less than 200 m deep (Reid *et al*., 2003). In north-west Europe fin whales are mainly distributed along or beyond the 500 m depth contour (Reid *et al*., 2003). The sightings records of fin whales made during systematic surveys and some platforms of opportunity off north-east Scotland are shown in Figure 40.

5.13.2 Abundance

The fin whale is the most abundant large baleen whale species in the North Atlantic. The best available estimates of recent abundance accepted by the IWC Scientific Committee are 25,800 (CV= 0.13) in 2001 for the central North Atlantic (East Greenland-Iceland, Jan Mayen, Faeroes and some waters within the UK 200 nm limit) (IWC, 2007); 4,100 (CV 0.21) in 1996-2001 for the north eastern North Atlantic (North and West Norway); and 17,355 (CV 0.27) in 1989 for the Spain-Portugal-British Isles area (Buckland *et al*., 1992).

5.13.3 Occurrence in Aberdeen Bay and surrounding area

Around the British Isles, fin whales occur mainly between June and December, with most sightings in northern Britain occurring between June and August (Reid *et al*., 2003).

Three groups of fin whales were recorded during NORCET surveys, all in the outer Moray Firth region. However, these were all during a single survey in June 2006 and may represent a small number of stray

animals rather than indicating the regular occurrence of this species in the northern North Sea (MacLeod *et al*., 2007).

No fin whales were recorded during any project surveys.

5.13.4 Diet

Fin whales feed primarily on planktonic crustaceans, mainly euphausiids, but they also take a variety of fish such as herring, sandeel, mackerel and blue whiting as well as cephalopods (Reid *et al*., 2003).

5.14 Beaked Whales

5.14.1 Distribution

Three species of beaked whale have been sighted in UK waters: northern bottlenose whale (*Hyperoodon ampullatus*), Sowerby's beaked whale (*Mesoplodon bidens*) and Cuvier's beaked whale (*Ziphius cavirostris*). Northern bottlenose whales only occur in temperate, sub-polar and polar seas in the North Atlantic (Reid *et al*., 2003). Bottlenose whales are mostly recorded in deep water and most sightings have been made north and west of Scotland along the continental shelf edge over the 1,000 m isobath. The species is rarely seen in shelf waters of the North Sea (Reid *et al*., 2003). Sowerby's beaked whale has the most northerly distribution of all species of *Mesoplodon* in the Atlantic and is the most frequently seen and stranded *Mesoplodon* species in the north Atlantic (Reid *et al*., 2003). It is generally found in deep water, although has been recorded in the North Sea (Reid *et al*., 2003). Cuvier's beaked whale, is frequently recorded in the Bay of Biscay and further south, and there have been a few confirmed sightings in UK waters (off west Scotland and in the northern North Sea), all in the summer (Reid *et al*., 2003).

5.14.2 Abundance

In the western Atlantic several estimates have been made for Mesoplodon spp. Grouped, and Cuvier's beaked whale and these have all been in the low hundreds. However, due to the cryptic nature of these species (deep diving and occurring in small groups) these estimates carry a substantial negative bias

5.14.3 Occurrence in Aberdeen Bay and surrounding area

The sightings records suggest that beaked whales are very rare visitors to the northern and central North Sea. In summer the northern bottlenose dolphin appears to move towards north-west European shelf waters, where most records occur between April and September, peak sightings off northern Scotland have been recorded in August (Evans, 1992; Reid *et al*., 2003).

A northern bottlenose whale was recently sighted near the entrance to Aberdeen Harbour in 2009 (C. Bloomer Pers comm.)

No beaked whale species were recorded during the project surveys.

5.14.4 Diet

Northern bottlenose whales are predominantly squid feeders. They do not appear to enter the North Sea very frequently and it is likely that when they do, they would be following squid (Hammond *et al*., 2001). Their diet is dominated by a variety of squid species, particularly *Gonatus fabricii* and species of the genera *Histioteuthis* and *Octopoteuthis*, but also includes some fish species and crustaceans (Reid *et al*., 2003).

Stomach content analysis of northern bottlenose whales stranded in the North Sea (Netherlands, 1993 and 1956; Denmark, 1997; Dunbar, Scotland, 1885) indicated that the food remains consisted almost entirely of cephalopod beaks, with only a few fish and crustacean remains. The cephalopod prey consisted mainly of oceanic species, in particular *Gonatus fabricii* (Santos *et al*., 2001b).

Sowerby's beaked whale diet is generally dominated by fish and squid. The stomach contents of three animals stranded in Scotland consisted of Merluccidae spp. and Gadidae spp. (MacLeod *et al*., 2003). The stomach contents of one Sowerby's beaked whale stranded in Scotland (1993-1995) had only large Gadidae otoliths (haddock/saithe/pollack) in the stomach (Santos *et al*., 1995).

5.14.5 Strandings

One Sowerby's beaked whale has been recorded by the SAC along the northeast coast of Scotland from Fraserburgh to Inverbervie between January 1992 and March 2010 (CSIP 2010). The male had a body length of 470cm and was recovered from Peterhead in January 2005 (SAC, 2006).

Strandings records suggest that although Sowerby's beaked whales may be present in the area, their occurrence is occasional/rare and the number of animals in the area is likely to be low.

6. SEALS

6.1 HARBOUR (OR COMMON) SEAL (*PHOCA VITULINA*)

6.1.1 Distribution

Harbour seals are one of the most widespread pinniped species and have a practically circumpolar distribution in the Northern Hemisphere. Harbour or common seals are found around the coasts of the North Atlantic and North Pacific from the subtropics to the Arctic. There are four sub-species. Only the eastern Atlantic harbour seal, *Phoca vitulina vitulina,* occurs around Britain (Hammond *et al*., 2004; SCOS, 2006).

Britain is home to approximately 40% of the world population of the European sub-species. Harbour seals are widespread around the west coast of Scotland and throughout the Hebrides and Northern Isles. On the east coast, their distribution is more restricted with concentrations in The Wash, Firth of Tay and the Moray Firth (Hammond *et al*., 2004; SCOS, 2006). The Moray Firth supports a population of approximately 1,600 harbour seals, the largest on the east coast of Scotland (Thompson *et al*., 2007).

Figure 41 depicts the distribution of harbour seals in the north-western North Sea as it was believed to be before satellite telemetry studies (after Reijnders *et al*., 1997), at-sea sightings from Pollock *et al*. (2000) are also shown (taken from Hammond *et al*., 2004).

Satellite telemetry of harbour seals found in Orkney and Shetland and seals hauling out in St Andrews Bay and the Moray Firth indicate the true distribution of seals around north-east Scotland as illustrated in Figure 42) (taken from Hammond *et al*., 2004).

Figure 41 Harbour seal distribution in the north-western North Sea after Reijnders *et al*. (1997). Also shown are haul-out sites during the moult (SMRU unpublished data) and at-sea sightings from JNCC surveys

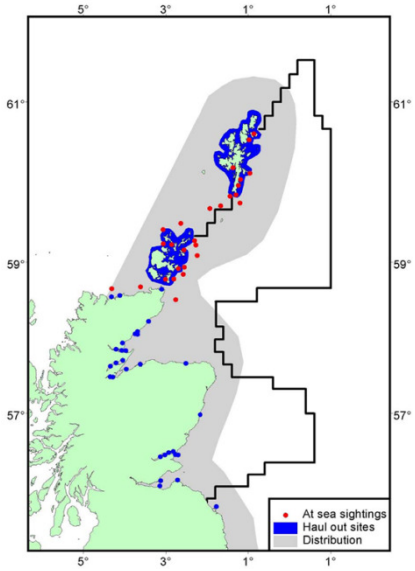
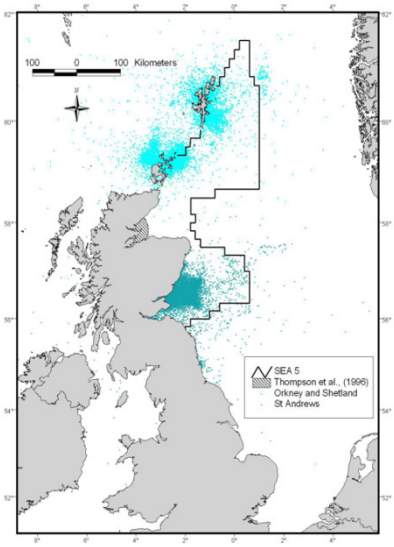


Figure 42 Locations of 55 harbour seals fitted with satellite-relay data loggers covering the period 2002-2004 (SMRU unpublished data) and the area used by VHF-tagged harbour seals in the Moray Firth



6.1.2 Occurrence in Aberdeen Bay area

Harbour seals are frequently observed in the River Don, and at least nine animals including juveniles and are often seen in the mouth of the Dee or hauled out on sand banks near the Bridge of Don. They are also recorded in Aberdeen Harbour, and may be expected to occur year-round in Aberdeen Bay. During project vantage point surveys, harbour seals were recorded at Blackdog in June 2007, Donmouth in July 2007 and at Blackdog and Donmouth in January 2008.

The SMRU data on haul out locations of harbour seals indicates the nearest harbour seal haul-out site is located 7.9 km from the proposed wind farm site during August 2005 survey (presented in Figure 48 and Figure 49).

Detailed observations of the behaviour of harbour seals at sites within the estuaries of the Rivers Dee and Don, in north-eastern Scotland, were made over two full years between 1993 and 1996 (Carter *et al.*, 2001). Small numbers of grey seals were also present. The presence of seals within the estuaries was strongly related to season, with maximum numbers observed in winter and early spring; seals were virtually absent in June and July. The River Don was used largely as a haul-out site, while the River Dee was used predominantly as a foraging site, although it was not possible to determine whether the same seals were using the two estuaries. More seals were hauled-out on the River Don during twilight and dark than in daylight (Carter *et al.*, 2001).

Common seals were only detected during the four months of EOWDC boat based survey 2010-2011, the results are discussed further in Section 6.3.

6.1.3 Abundance

The most recent estimate of the number of common seal in Scotland is 19,988, from surveys carried out in 2006-2008 (SCOS 2009). The abundance estimates have a degree of error as only a proportion of the individuals in the population will be hauled out and counted during. The total British population has been estimated at 40,000-46,000, and this takes into account animals missed during the counting (SCOS 2009).

Approximately 20% of the eastern Atlantic harbour seal subspecies breeds in Orkney and Shetland and along the east coast of Scotland (Hammond *et al.*, 2004).

Surveys of the east coast populations in 2008 showed continuing declines in the Firth of Tay population and a continued lack of recovery in the Moray Firth; the reasons causing this recent decline are not known at present. The lack of recovery contrasts with the apparent rapid growth in populations in the nearest European populations in the Wadden Sea which increased by 15% between 2007 and 2008 and has grown by approximately 13% per annum since the 2002 PDV epidemic (SCOS 2008).

Due to declines in the numbers of harbour seals counted in Shetland, Orkney, the Moray Firth and the Firth of Tay, the Scottish Executive put in place a Conservation Order protecting harbour seals on the east coast and Northern Isles in March 2007. The Order covers the coast from Garron Point by Stonehaven to Torness Point, south of Dunbar on the south side of the Firth of Forth. Seals in the Moray Firth are already protected by a Conservation of Seals (Scotland) Order 2004.

6.1.4 Haul-out sites and breeding

Harbour seals come ashore in sheltered waters, typically on sandbanks and in estuaries, but also in rocky areas. They tend to be more localised than grey seals, staying in the same general area to breed, feed and rest, and do not form as large breeding colonies. Harbour seals haul out on land regularly in a pattern that is often related to the tidal cycle (SCOS, 2006).

Pupping occurs on land from June to July during which time females and pups spend a high proportion of their time ashore. The moult is centred around August and extends into September. Moulting seals also spend a high proportion of their time ashore, so from June to September harbour seals are ashore more often than at other times of the year (Hammond *et al.*, 2004).

6.1.5 Movements and foraging

The radio-tracking of adult female seals in the inner Moray Firth (1988, 1989, 1992) during the breeding season indicated that seals foraged up to 45 km from the haul-out site, but females with pups restricted their range markedly during the early part of the lactation period (Thompson *et al*., 1994).

Generally it has been thought that harbour seals forage relatively close inshore within a range of 60 km from their haul-out sites (Thompson *et al.*, 1996). However, recent information on foraging movements and the distribution at sea of harbour seals has highlighted greater travel distances, ranging from 10 km to 120 km, with a mean of 46 km (Hammond *et al*., 2004).

Data from satellite relay data loggers (SRDLs) have highlighted different foraging behaviour of harbour seals off southeast Scotland and around Orkney and Shetland. Off southeast Scotland, animals were found to be very faithful in their use of haul-out sites on land, and moderately site-faithful in the areas individuals used to forage. Duration of trips ranged from less than one day to 23 days, with a mean of 4.5 days. Foraging in the Moray Firth was mostly closer to the shore. Around Orkney and Shetland there are indications that seals tend to move between haul-outs sites within a 40 km radius of where they were captured with one animal hauling out as far as 200 km from where it was initially tagged. Foraging behaviour is also much more variable both in distance travelled and in the duration of trips. Most foraging trips are within 40 km of haul-outs but there are also longer distance trips to areas more than 200 km from haul-out sites (Hammond *et al*., 2004).

6.1.6 Diet

Harbour seals take a wide variety of prey including sandeels, whitefish, herring and sprat, flatfish, octopus and squid. Diet varies seasonally and from region to region (Hammond *et al*., 2004; SCOS, 2006). In Shetland, Brown and Pierce (1998) found that gadids accounted for an estimated 53.4% of the annual diet by weight, sandeels 28.5% and pelagic fishes 13.8%. The dominant gadid fishes were whiting and saithe. There were strong seasonal patterns in the contribution of sandeels and gadids, with sandeels being important in spring and early summer, and gadids in winter. Pelagic species (mainly herring, garfish and mackerel) were important in late summer and autumn (Hammond *et al*., 2004).

In the Moray Firth, Tollit andThompson (1996) found the key prey during 1989-1992 to be sandeels, lesser octopus, whiting, flounder, and cod. Significant between-year and seasonal fluctuations were evident. In another study in the same area between 1992 and 1994, Tollit *et al*. (1997) found the diet composition was almost totally dominated by either pelagic species or species dwelling on or strongly associated with the seabed, depending upon the relative abundance of pelagic schooling prey (Hammond *et al*., 2004).

In the Firth of Tay, unpublished SMRU data from 1998-2003 show that the diet comprised primarily sandeels, gadids and flatfish. Gadid prey was dominated by whiting, followed by cod and haddock. Plaice was the main flatfish consumed followed by dab, flounder and lemon sole. Strong seasonal patterns in prey consumption were evident (Hammond *et al*., 2004).

During observation at the estuaries of the Rivers Don and Dee, the seals were observed to eat mostly salmonids, *Salmo salar* and *S. trutta*, unidentified roundfish and founder, *Pleuronectes flesus*, there were also observations of seals taking starfish and crabs. Predation on salmonids was observed more frequently on the Dee than the Don, while the reverse was true for predation on flounder. The otoliths identified in scats collected at the mouth of the River Don belonged to marine species, including whiting, sandeels, cod,

Trisopterus spp., haddock, plaice and lemon sole, as well as three octopus beaks, indicating that the seals were also feeding outside the estuaries (Carter *et al*., 2001).

6.1.7 Special Areas of Conservation

Designated coastal SACs for harbour seals include Yell Sound and Mousa on Shetland, Sanday on Orkney, Wash and North Norfolk coast on the east coast of England, Dornach Firth and Morrich More, in the Moray Firth, and Firth of Tay and Eden Estuary on the Scottish east coast (JNCC, 2011).

6.2 GREY SEAL (*HALICHOERUS GRYPUS*)

6.2.1 Distribution

Grey seals are restricted to the North Atlantic and adjacent seas. There are three recognised populations: the northwest Atlantic (breeding primarily on Sable Island, Canada and in the Gulf of St Lawrence); the Baltic Sea; and the northeast Atlantic (breeding primarily on offshore islands around the British Isles but also in Iceland, the Faroe Islands, France, the Netherlands, central and northern Norway, and around the Kola peninsula in Russia) (Hammond *et al*., 2004). Figure 43 shows the tracks of 108 grey seals recorded over a period of about 10 years and the locations at which it has been determined that the seals were foraging, the specific locations are shown in Figure 44 (McConnell *et al.*, 1999; taken from Hammond *et al*., 2004). More recent analysis of grey seal movements in the Pentland Firth area has been provided by SMRU Ltd, which further illustrates the large scale seasonal movements that occur between seals occurring at spatially separate haul out colonies in the North Sea.

Figure 43 Tracks of 108 grey seals fitted with satellite-relay data loggers over a period of about 10 years (McConnell *et al.,* 1999; SMRU unpublished data)

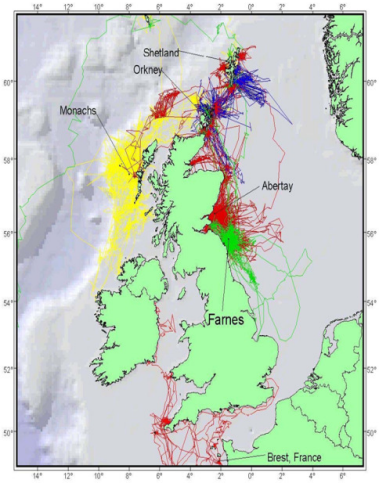


Figure 44 Locations of 108 grey seals fitted with satellite-relay data loggers over a period of about 10 years (McConnell *et al.,* 1999)

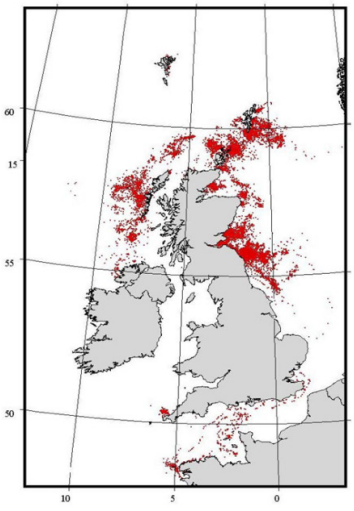
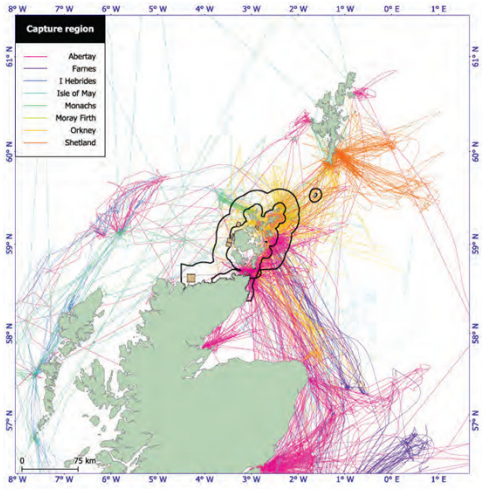


Figure 45 Grey seals tagged with SMRU Argos and SMRU GSM/GPS tags, the tracks are colour coded by capture region (SMRU 2011c)



6.2.2 Abundance

The Grey seal population of the UK is significant in a global context as the UK population represents approximately 45% of the world population on the basis of pup production (SCOS 2009). Over 90% of British grey seals breed in Scotland, the majority in the Hebrides and in Orkney (SCOS, 2006).

Combining the abundance estimates for the annually monitored seal colonies with the sites which are monitored less frequently provides an estimated seal population of 205,000, with a large confidence interval of (96,500; 405,000). A large proportion of the populations are associated with the colonies in Orkney, Shetland, and the east coast of Scotland (Hammond *et al*., 2004).

The latest population estimate has suggested an increase of around 2.8% between 2007 and 2008. The British grey seal population has been increasing by around 6% annually since the 1960s.

6.2.3 Occurrence in Aberdeen Bay area

Grey seals are frequently observed at sea during vessel-based cetacean surveys carried out by the Sea Watch Foundation, including large bulls, females and immature animals. Seals use the waters between Stonehaven and Aberdeen as a feeding area, since animals are often observed eating fish at the surface.

Grey seals are frequently observed hauled out on the Skerry just outside Peterhead harbour and may be expected to occur year-round in the area. Grey seals have important haul-out sites at Pennan Head, Rattray Head, Boddam, Catterline and Donmouth.

Grey seal sightings recorded during project VPS surveys (August 2005 – March 2008) are summarised in Table 25.

Table 25 Grey seal sightings recorded during Vantage Point surveys (August 2005 – March 2008)

VP site	Observations
Donmouth	August 2006, December 2006, March 2007, May 2007, August 2007, September 2007
Blackdog	August 2006, December 2006, January 2007, March 2007, May 2007, August 2007, December 2007
Balmedie	December 2006, February 2007, August 2007
Drums	February 2007, August 2007, September 2007

The nearest grey seal haul-out sites identified during the SMRU seal surveys in August 1997 and 2005 were located 7.9 km from the proposed wind farm site (presented in Figure 48 and Figure 49).

Grey seals were present throughout the survey area during all the boat based survey months and the results are presented in Section 6.3.

6.2.4 Haul-out sites and breeding

Grey seals haul out between foraging trips and for pupping and moulting, when they can form large colonies or aggregations (Hammond *et al*., 2004). Grey seals generally form breeding colonies on rocky shores, beaches and in caves, and on small, largely uninhabited, islands (JNCC, 2011). Large rookeries are located in the Inner and Outer Hebrides, Orkney, Isle of May, Farne Islands and Donna Nook (JNCC, 2011).

In Northern Britain, pupping occurs from October to late November and the moulting season is February-April, when they spend more time ashore than at other times of the year (Hammond *et al*., 2001).

Numbered tags attached to the flippers of pups indicate that young seals disperse widely in the first few months of life. Pups marked in the UK have, for example, been recaptured or recovered along the North Sea coasts of Norway, France and The Netherlands, mostly during their first year of life (Hammond *et al*., 2004).

6.2.5 Movements

Adult grey seals routinely move large distances. Grey seal movements have been studied in the North Sea using satellite-linked telemetry. In a study of animals at the Farne Islands and Abertay Sands, McConnell *et al.* (1999) found that movements were on two geographical scales: long and distant travel (up to 2,100 km away) to known haul-out sites; and local, repeated trips from haul-out sites to discrete offshore areas. Long-distance travel included visits to Orkney, Shetland, the Faroes, and far offshore into the Eastern Atlantic and the North Sea (Hammond *et al*., 2004). Recent telemetry studies have found that seals tagged as far south as the Farne Islands, Isle of May and Moray Firth have been found to enter the Pentland firth area (SMRU 2011c).

In 88% of trips to sea, individual seals returned to the same haul-out site from which they departed. The durations of these return trips were short (typically 2-3 days) and their destinations at sea were often localized areas characterized by a seabed of gravel/sand. This is the preferred burrowing habitat of sandeels, an important component of grey seal diet. The limited distance from a haul-out site of return trips (about 40 km) indicates that the seals were foraging within the coastal zone, rather than further offshore (Hammond *et al*., 2004).

The analysis of the seal telemetry data has shown that grey seals tagged in both the Isle of May SAC and Berwickshire and North Northumberland coast SAC appear to routinely travel past Aberdeen through the proposed location on the way to the Pentland Firth.

6.2.6 Diet

Grey seals feed mostly on fish that live on or close to the seabed. The diet is composed primarily of sandeels, whitefish (cod, haddock, whiting, ling), and flatfish (plaice, sole, flounder, dab) but varies seasonally and from region to region (SCOS, 2006).

Studies in 1985 showed that in Orkney sandeels accounted for almost 50% of the diet; the remainder was mostly cod, ling and plaice (Hammond, *et al.*, 1994). In the central North Sea, studies have shown that the diet was dominated by sandeels, cod and whiting (Hammond and Prime, 1990; Hall and Walton, 1999). Overall, grey seal diet comprises primarily sandeels, gadoids and flatfish, in that order of importance (Hammond *et al*., 2004).

Sandeel, cod, other gadoids and plaice are the most important prey of grey seals in the North Sea (Hammond and Grellier, 2006). There were marked changes in grey seal diet composition between 1985 and 2002. In the east coast region, the percentage of gadoids in the diet was lower and the percentage of sandeels was higher in 2002 compared with 1983-88, and within the gadoids the percentage of cod in the diet overall declined almost 5-fold and the percentage of haddock increased by an order of magnitude (Hammond and Grellier, 2006).

6.2.7 Special Areas of Conservation

Designated coastal SAC sites for grey seals include the Berwickshire and North Northumberland Coast in north-east England, Faray and Holm of Faray on Orkney and the Isle of May at the entrance to the Firth of Forth (JNCC, 2011).

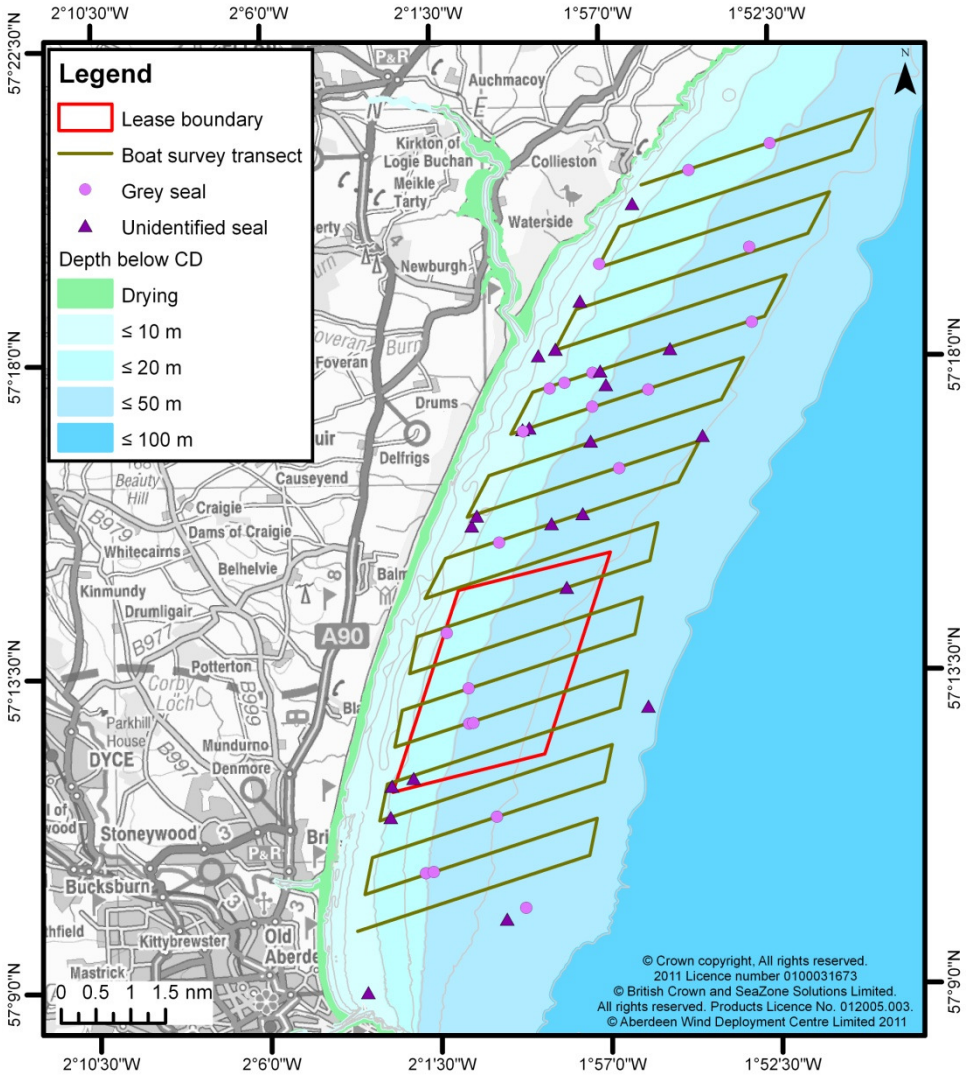
6.3 BOAT BASED SURVEY SEAL COUNTS

A summary of the seal species that were recorded during the project boat based surveys are provided in Table 26. A total of 114 individual seals, of which a total of 44 were grey seals, 27 harbour seals and 37 were unidentified seals were observed (Figure 46 and Figure 47).

Table 26 Summary of the seal observations during the IECS (2007-2008) and SMRU Ltd (2010-2011) surveys (collected on and off effort).

Survey	Grey Seal	Harbour Seal	Unidentified
IECS -2007-2008	21	0	25
SMRU Ltd 2010-2011	23	27	18
Totals	44	27	43

Figure 46 Grey and unidentified seals observed during the EOWDC boat based surveys during 2007-2008 (collected on and off-effort)



6.3.1 Grey seals

The grey seal was the most frequently recorded species, with a total of 21 individuals recorded on effort during the boat based surveys 2007-2008 (Figure 46). The grey seal was sighted throughout the survey period with no apparent increase in frequency of sightings with any particular season. There were a higher number of grey seals (n=13) observed in the control area in comparison to the wind farm area (n=8). Despite a lower survey effort there were a higher number (n=24) of grey seals recorded during the 4 months of boat based surveys carried out during 2010-2011 (Figure 47).

6.3.2 Common seals

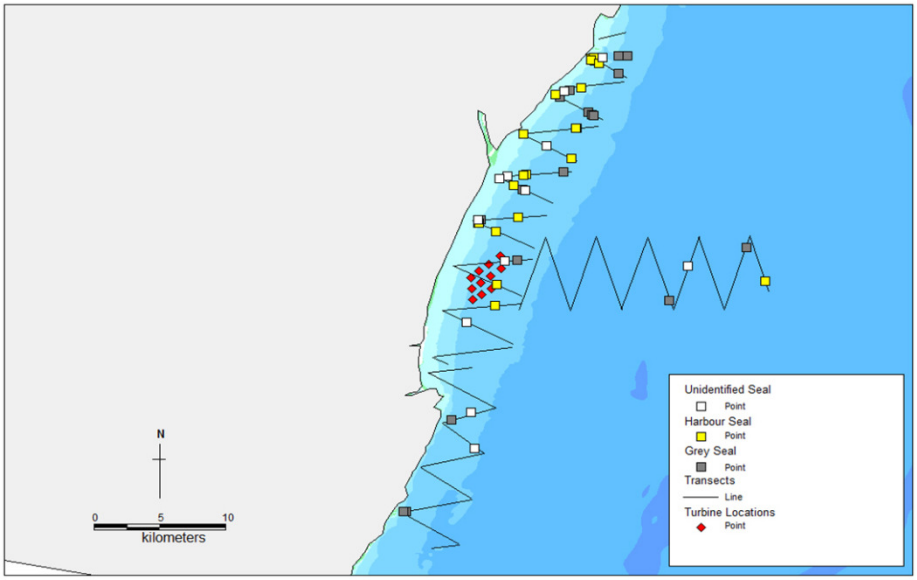
Surprisingly no harbour seals were observed during the boat based surveys carried out during 2007-2008. In the four months of boat based surveys carried out during 2010-2011 there were 27 harbour seals observed;

this suggest that either common seals were present at a lower abundance in Aberdeen Bay during this time, or a proportion of the unidentified seal species that were common seals.

6.3.3 Unidentified seals

During the boat based surveys carried out during 2007-2008 there were 25 seals observed that could not be identified to a species level, three of which were observed off transect (Figure 46). A greater number of sightings of unidentified seals (n=18) were observed in the wind farm area that the control site. There were 15 unidentified seals recorded during the boat based surveys carried out during 2010-2011.

Figure 47 On-effort observations of seals along transects during August, September and November 2010, and January 2011



6.4 Aerial Survey Data Seal Counts

The Sea Mammal Research Unit (SMRU) has surveyed harbour seals along the east coast of Scotland as part of their routine monitoring of seal populations around the UK. Surveys were carried out in 1997 and 2005, 2007 and 2008 (Figure 48 and Figure 49). The surveys were conducted during the harbour seal annual moult, in August, when the most consistent numbers of harbour seals are hauled ashore. The surveys were conducted using a helicopter equipped with a thermal imaging camera which can detect seals hauled ashore up to a 3 km distance. For consistency, surveys are restricted to within two hours either side of afternoon low tides on days with no rain.

Grey seals were also counted during these August surveys. The two species are determined using their thermal profiles and their group structure on shore and species identity is confirmed using a 'real' image from a camcorder and directly using binoculars. However, in some cases this it is not possible and the seals are classified as 'species unknown'. Additional information on grey seals is also obtained during their breeding season, September to November, using fixed wing aerial photography. Repeat surveys are made of the breeding colonies which allow subsequent estimates of pup production to be made on a colony-by-colony basis.

6.4.1 Counts and distribution of seals Fraserburgh to Montrose

The numbers of seals counted during the August thermal imaging surveys between Fraserburgh and Montrose are provided in Table 27. The sections of coast for which numbers of seals are supplied extend from Fraserburgh to Aberdeen and from Aberdeen to the mouth of the River North Esk (SMRU, 2007).

Table 27 Numbers of harbour and grey seals counted between Fraserburgh and Montrose in 1997 and 2005

Date	Region	Harbour Seals	Grey Seals	Species Unknown
Aug-97	Fraserburgh to Aberdeen	0	131	
Aug-97	Aberdeen to North Esk	15	14	
	Total	15	145	
Aug-05	Fraserburgh to Aberdeen	14	400	3
Aug-05	Aberdeen to North Esk	22	11	
Total		36	411	3

In the survey during August 2005 harbour seals were hauled out at the mouth of the River Ythan and at Catterline. Only small numbers of seals were at these haul-out sites at the time of survey. Another group of nine harbour seals were hauled out in the Montrose Basin, just outside the area covered by Table 27 (Figure 49).

Small numbers of grey seals were also hauled out at Catterline and at the mouth of the River Ythan but there were considerably more hauled out between the south end of Cruden Bay and Fraserburgh. The main haul-out sites were: The Scares at the south end of Cruden Bay; around Boddam, south of Peterhead; at the mouth (north side) of Peterhead Bay; Scotstown Head; and at Cairnbulg Point. Another group of grey seals was hauled out just outside this area, at Sandhaven, just to the east of Fraserburgh (Figure 48 and Figure 49).

Variable, but very small, numbers of grey seal pups are born at a number of sites along this section of the east coast of Scotland. The most well established colony is at Catterline, where up to five pups may be born each autumn.

6.4.1.1 Counts and distribution of seals in the wider area Nairn to Kincardine Bridge

Outside the Fraserburgh to Montrose area, but still along the east coast of Mainland Scotland, larger numbers of seals can be found. Information from at-sea tagging studies show the east coast of Scotland is used by individuals of both species which move and forage along this coast. Under the EU's Habitats Directive, the Firth of Tay has been designated a Special Area of Conservation (SAC) for harbour seals and the Isle of May in the Firth of Forth, an SAC for grey seals. Animals from these areas will potentially move along the coast between Fraserburgh and Montrose.

Consequently, survey data from a wider area (Nairn to Kincardine Bridge) is provided in Table 28, to allow the numbers of seals in the area of concern (Fraserburgh to Montrose) to be put into context.

Table 28 Numbers of harbour and grey seals counted between Nairn and the Kincardine Bridge from surveys carried out in the Augusts of 1997 and 2005 (SMRU, 2007)

Date	Region	Harbour Seals	Grey Seals	Species Unknown
Aug-97	Nairn to Fraserburgh	47	65	-
Aug-97	Fraserburgh to Aberdeen	0	131	-
Aug-97	Aberdeen to North Esk	15	14	-
Aug-97	North Esk to Buddon Ness	0	0	-
Aug-97	Buddon Ness to Newburgh	92	61	-
Aug-97	Newburgh to Tayport	56	0	-
Aug-97	Tayport to Fife Ness	485	1,849	-
Aug-97	Fife Ness to Kincardine Bridge	76	176	-
Aug-97	Isle of May	0	46	-
	Total	771	2,342	-
Aug-05	Nairn to Fraserburgh	77	245	-
Aug-05	Fraserburgh to Aberdeen	14	400	3
Aug-05	Aberdeen to North Esk	22	11	-
Aug-05	North Esk to Buddon Ness	9	0	-
Aug-05	Buddon Ness to Newburgh	92	43	-
Aug-05	Newburgh to Tayport	48	0	-
Aug-05	Tayport to Fife Ness	221	530	-
Aug-05	Fife Ness to Kincardine Bridge	176	73	8
Aug-05	Isle of May	0	18	
Total		659	1,320	-

Between Nairn and Kincardine Bridge, the main harbour seal haulout sites are at Findhorn Bay, in the Firth of Tay and the Eden Estuary and between Kirkaldy and Dalgety Bay on the Fife (north) shore of the Firth of Forth.

The main grey seal haulout sites used during August are scattered along the north Grampian coast at Findhorn Bay, Covesea and Halliman Skerries off Lossiemouth, Craigenroan Skerries near Findochty and Strahangles Point near Rosehearty. South of the North Esk, the Firth of Tay and the River Eden are the main grey seal haul out sites, with smaller numbers also using the small islands in the Firth of Forth. The Isle of May, as already mentioned, is a SAC for grey seals, which has supported a total pup production of over 1,800 seals since 1998. It should be noted that the numbers of grey seals counted here during the August surveys are very low.

6.4.1.2 Cautionary note on the counts of seals calculated from aerial surveys

These counts represent the seals that were counted ashore. They do not represent the total size of the local population, since a number of seals would have been at sea at the time of the survey.

Please note that these data refer to the numbers of seals found within these areas in August only; numbers are likely to vary at other times of the year. For instance, small numbers of harbour seals haul out during the winter on the small island at the mouth of the River Don, in Aberdeen. In addition, the numbers of grey seals ashore during the summer can be highly variable from day to day and the numbers presented above should be interpreted with caution.

Figure 48 Haul out locations of harbour and grey seals August 1997

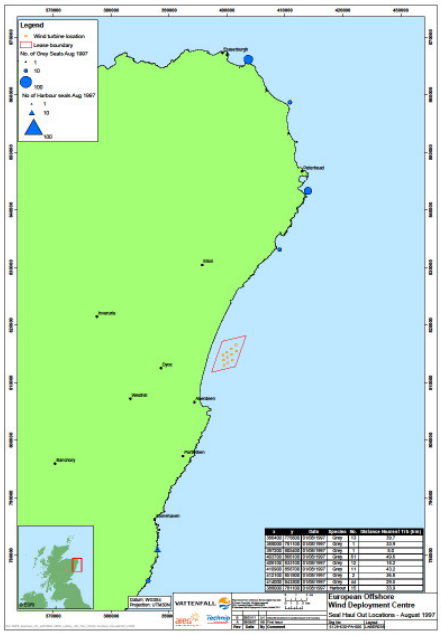
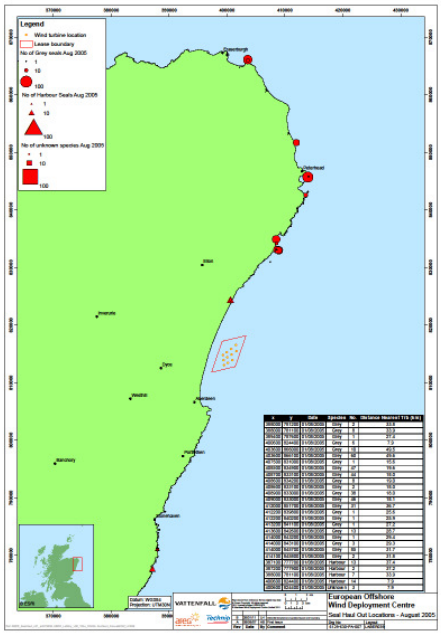


Figure 49 Haul out locations of grey and harbour seals in August 2005



6.4.2 Other seal species

There are occasional records of hooded seal, bearded seal, ringed seal and walrus in the north-east Scotland area (Hammond *et al.*, 2004). All these species are considered to be rare visitors to Aberdeen bay area.

7. SUMMARY

The marine mammal environmental baseline is based on available information on marine mammals relevant to the proposed EOWDC and surrounding area, as the project develops and more information becomes available from the additional boat based surveys carried out, the marine mammal environment baseline could be updated.

The review of the distribution of each marine mammal species indicates that although several marine mammals have the potential to be in the area, for the majority of these species the area is only a marginal part of their habitat. Most species, with the exception of bottlenose dolphins, have a wide range and regularly occur throughout the northern and central North Sea, both along the coast and in offshore areas.

Sightings and strandings data provide useful information on the occurrence of marine mammals in the area and indicate that bottlenose dolphins, harbour porpoises, white-beaked dolphins, minke whales, harbour and grey seals have been regularly recorded in the area throughout most the year. Most other marine mammal species have been recorded infrequently and at certain times of the year, suggesting that the area is a small part of their range for a limited time and that relatively low numbers may be present in the area.

In order to understand why marine mammal species may be present in the area it is important to have information on their diet and examine what prey species may be attracting them to the area. The diet of marine mammal species regularly recorded in the area is varied and diverse; however, it is apparent that bottlenose dolphins are feeding on salmon at the mouth of the River Dee, harbour porpoises are probably feeding on whiting and sandeels and the seasonal occurrence of white-beaked dolphins may be linked to seasonal availability or movements of prey, such as mackerel. Harbour and grey seals have been observed feeding on salmonids and flatfish at the estuaries of the Rivers Dee and Don. Although this is a comprehensive baseline assessment, there are some areas for which there is currently limited information, such as what prey several of the marine mammal species that are regularly present in the area are feeding on. Cetacean species are particularly difficult study subjects to collect dietary information on, although strandings data has provided some useful snapshots of prey items consumed prior to beaching events, this data may not always be representative of healthy adults prey choice.

Examination of the life history of marine mammals regularly occurring in the area highlights the seasonal sensitivities, such as calving periods, of these species. Young bottlenose dolphin calves have been observed in the area during spring and early summer. The calving period of harbour porpoises in Scottish waters is estimated to be between April and June, with calves being observed in the area between May and September. White-beaked dolphin calves have been observed in the area between June and August. Seals spend a higher proportion of their time ashore and in coastal waters during the pupping and moulting seasons, for harbour seals pupping occurs from June to July and moulting occurs from June to September and for grey seals pupping occurs from October to November and the moulting season is between February and April.

The main findings from this review indicate that of the marine mammal species recorded in the area, bottlenose dolphins, harbour porpoises, white-beaked dolphins, minke whales, harbour and grey seals are regularly present in the area. Therefore, these species, could be affected by potential impacts associated with the proposed development, such as underwater noise disturbance, changes in prey availability and foraging areas, displacement and barrier effects. These potential impacts and possible mitigation measures will be addressed in the EIA technical report.

Bottlenose dolphin were the second most frequently sighted cetacean species during the surveys carried out as part of the EOWDC, with a total of 200 individuals being detected. The majority of the sightings occurred in the spring and summer months. A higher number of bottlenose dolphins were recorded in the wind farm area in comparison to the control site and in the vicinity of the entrance to Aberdeen harbour, which is a known hotspot for dolphin sightings.

The bottlenose dolphin population of the Moray Firth has recently been expanding its range in a southerly direction, beyond the boundaries of the Moray Firth SAC, with an increasing in sightings and identified individuals along the east coast of Scotland as far as St Andrews and the Firth of Forth. Although Aberdeen is recognised as an important area for bottlenose dolphins, further studies are required to more accurately determine the proportion of the population that utilises this area throughout the year.

Harbour porpoises were the most recorded cetacean species during the EOWDC boat surveys and was the only species that was detected in sufficient numbers to allow a detection function to be applied that would allow for abundance and density estimates to be generated. The density of harbour porpoises was higher in the control area in all seasons except summer. Lowest densities occurred during May and June. The density estimates produced for harbour porpoise all show considerable error margins which is a reflection of the sampling effort, further surveys would reduce this. In the four surveys carried out during 2010-2011 the northern transect had the highest proportion of harbour porpoises, except in January when highest densities were recorded in the southern transect.

The harbour porpoise, as expected, was the most frequently detected cetacean species during the acoustic surveys. In agreement with the results of the visual surveys the control area recorded more acoustic detections than the wind farm survey area. In the acoustic surveys carried out during 2010-2011 higher numbers of detections were made in the offshore survey area during the August and September surveys, although it is too early to conclude whether this represents a movement of animals further offshore during the summer months.

White beaked dolphins have been detected during the EOWDC surveys over the course of several years during the month of August; this data supports the occurrence of this dolphin as a seasonal summer visitor that possibly moves to coastal waters following prey such as mackerel and or for calving purposes.

Six minke whales have been observed as part of the EOWDC surveys. Minke whales are thought to have a preference for water depths of 38 m or deeper, these depths are generally found further offshore and beyond the EOWDC crown estate licence area, although a minke whale was detected within the EOWDC crown estate lease area during the boat based surveys.

Only one solitary short-beaked common dolphin was detected during the boat based surveys. Other cetacean species that were detected were Risso's dolphins during vantage point surveys, but not during any of the EOWDC boat surveys. The increase in sightings of Risso's dolphins may point towards an increase in the use of the Aberdeen area in comparison to historic levels.

Both species of seal grey and harbour seals are regularly present and frequently sighted in Aberdeen bay, especially at the entrances to the Rivers Dee and the Don. Grey seals were the most frequently observed seal species recorded during the boat surveys carried out in 2007-2008. Almost equal proportions of grey and common seals were recorded during boat surveys carried out during 2010-2011.

Designated coastal SACs for harbour seals are present along the east coast of mainland Scotland, these are situated in the Dornoch Firth and Morrich Moore in the Moray Firth and Firth of Tay and Eden estuary. Designated SAC's for coastal seals along the east coast of Scotland include the Isle of May at the entrance of the Firth of Forth, and it can be expected that individual seals from these colonies may be passing through the EOWDC development area.

8. APPENDICIES

8.1 THE EFFECTS OF G(0) < 1

This section explains the influence that defining the number of 'missed animals' has on the abundance estimates generated from transect surveys. The probability of detecting an animal on the transect line, g(0), is normally assumed to be 1 which would be for a certain detection, but for marine mammals, which spend a proportion of the time below the surface, this assumption is not generally valid. Double observer methods are needed to accurately calculate the g(0) value specific to each species and survey vessel, and thus for this study, the influence of differing g(0) values on the density and abundance estimates generated are discussed. The study are and month used to illustrate the effects of altering the g(0) <1 value was the survey occurring in the Northern transect, in November 2010).

This area and month had the highest number of observations of harbour porpoises, thus providing the most robust sub-set for demonstration. The detection probability used in they analyses will therefore have a key influence on resulting estimates as is illustrated in Table 29. Detection values that are assigned a certain probability of detection g(0) are associated with the lowest standard error (165) and also the lowest abundance estimates (568).

Table 29 Density and abundance estimates with Standard Errors, generated for the North Strata in November, when assuming a range of g(0) values.

g(0)	Density estimate	SE	Abundance estimate	SE
0.2	18.84	5.45	2841	824
0.34	11.08	3.21	1671	485
0.4	9.42	2.73	1421	412
0.6	6.28	1.82	947	275
0.8	4.71	1.36	710	206
1	3.77	1.09	568	165

8.2 DETECTION RATES OF ODONTOCETE SPECIES DURING ACOUSTIC BOAT SURVEYS

Dolphin detections were recorded on a number of occasions during the EOWDC boat based surveys. It is currently not possible to identify, to a species level, clicks and whistles of the dolphin species that are likely to present in the EOWDC area, although corroboration with observations of cetaceans during visual searches does support species identifications.

Delphinid detections were only made during one of the seven surveys in which the hydrophone array was deployed in the boat based surveys carried out during 2007-2008. This was made during the December 2007 survey on transect CA. The position of the detection is shown on Figure 23. The very low number of detections

means that the detection rates for all but one of the surveys are 0. Detection rates (where available) are displayed in Table 30.

Table 30 Whistle detection rates for the survey and transect containing a single whistle detection.

Number of detections	Effort (km)	Detection rate
December survey – all transects combined		
1	127	0.008
December survey – control site transects only		
1	63	0.016
December survey – wind farm transects only		
0	64	0
Detection rates – transect CA (combined all months)		
1	42	0.024

During the four months of boat based surveys deploying a hydrophone array during August, September, November 2010 and January 2011, dolphin detections were made during all 4 surveys; although only during "off effort" sections of the September 2010 and January 2011 surveys. Most of the detections were made during August 2010 survey. Locations of dolphin detections during the August survey are shown in Figure 50 and during all other surveys are shown in Figure 51.

Figure 50 Delphinid click and whistle detections made during the August 2010 survey

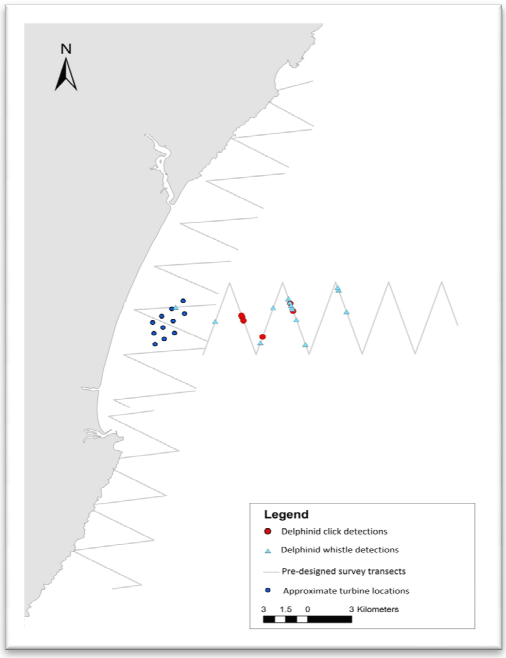
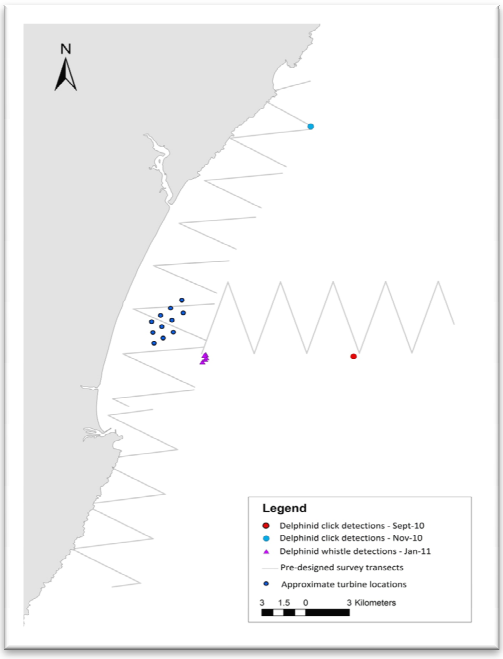


Figure 51 Delphinid click and whistle detections made during the September, November 2010 and January 2011 surveys



Only the dedicated acoustic effort (Table 6) was used to assess the acoustic detection rates of marine mammals across all three survey strata, for each of the four surveys. The September 2010 detections occurred

during periods when the vessel was not sailing a pre-designed survey transect, and these have not therefore been analysed further. Detection rates (detections per km dedicated effort) have been calculated for the remaining click detections that were recorded during August and November 2010 (Table 31).

Whilst whistles were detected on both the August 2010 and January 2011 surveys, all of the January detections occurred during periods when the vessel was not sailing a pre-designed survey transect, and these have not therefore been analysed further. Due to the difficulty in meaningfully defining discrete encounters with dolphin groups when analysing whistles, the ”on effort” whistle data have been expressed as Whistle Positive Minutes”. These are defined as minutes which contain one or more whistle detections. The proportion of whistle positive minutes for each transect is shown in Table 32. It is probable that the click and whistle detections made during the August 2010 survey came from the same group of animals and it is likely that these were white beaked dolphins as they were present in the survey vicinity at the time.

Table 31 Detection rates for dolphin clicks during the August and November surveys- the only surveys on which dolphin clicks were detected during periods of dedicated effort

		August 2010			November 2010		
Strata*	Transect ID	Number of detections	km of survey effort	Detection rate	Number of detections	km of survey effort	Detection rate
North	10	0	1.422	0	0	1.234	0
	11	0	6.032	0	0	5.810	0
	12	0	5.986	0	0	5.804	0
	13	0	6.030	0	0	5.824	0
	14	0	5.749	0	0	5.767	0
	15	0	5.839	0	0	5.784	0
	16	0	3.965	0	0	5.035	0
	17	0	4.074	0	0	5.441	0
	18	0	3.279	0	0	4.573	0
	19	0	3.814	0	0	5.536	0
	20	0	4.727	0	0	4.609	0
	21	0	5.821	0	0	5.664	0
	22	0	4.208	0	0	4.108	0
	23	0	5.059	0	0	5.458	0
	24	0	2.557	0	2	3.133	0.638
	25	0	0	0	0	3262	0
	26	Not surveyed					
Offshore	27	0	6.255	0	0	5.953	0
	28	3	6.207	0.483	0	5.907	0
	29	1	6.028	0.166	0	5.966	0
	30	2	5.963	0.335	0	6.196	0
	31	0	6.143	0	0	5.807	0
	32	0	6.151	0	0	5.913	0
	33	0	6.135	0	0	6.033	0
	34	0	6.145	0	0	5.664	0
	35	0	6.187	0	0	5.957	0
	36	0	4.817	0	0	3.749	0

**the southern transects are not listed as no dolphin clicks were detected here during periods of dedicated effort*

Table 32 Proportion of dedicated effort found to be positive for dolphin whistles during the August surveys- the only survey on which dolphin whistles were detected during periods of dedicated effort

Strata*	Transect ID	Number of whistle positive minutes	Total number of minutes on transect	Proportion of whistle positive minutes
North	10	0	00:25:20	0
	11	0	00:06:10	0
	12	0	00:25:34	0
	13	0	00:25:36	0
	14	0	00:24:10	0
	15	0	00:25:02	0
	16	0	00:16:40	0
	17	0	00:17:20	0.058
	18	0	00:13:39	0
	19	0	00:16:30	0
	20	0	00:19:19	0
	21	0	00:25:00	0
	22	0	00:16:58	0
	23	0	00:21:20	0
	24	0	00:10:20	0
	25	0	0	0
	26	Not surveyed		
Offshore	27	1	00:25:12	0.04
	28	0	00:24:58	0
	29	2	00:24:00	0.08
	30	7	00:23:45	0.29
	31	0	00:26:26	0
	32	3	00:22:27	0.13
	33	0	00:22:48	0
	34	0	00:27:05	0
	35	0	00:22:27	0
	36	0	00:22:00	0

**the southern transects are not listed as no dolphin clicks were detected here during periods of dedicated effort*

9. REFERENCES

ACC (2008) Aberdeenshire Cetacean Catalogue (ACC): Photo-identification catalogue for bottlenose dolphins (*Tursiops truncatus*) and other cetacean species off the coast of Aberdeenshire, NE Scotland. Version 1: June 2007.

Baird, R. W. (2000) The killer whale - foraging specializations and group hunting. In *Cetacean societies: field studies of dolphins and whales*, (eds J. Mann et al., eds.), pp. 127-153. University of Chicago Press

Bjørge, A. and Øien, N. (1995) Distribution and abundance of harbour porpoise, *Phocoena phocoena*, in Norwegian waters. Rep. Int. Whal. Commn. (Special Issue 16): 89-98.

Bjørge, A. and Tolley, K.A. (2002) Harbour Porpoise. Encyclopedia of Marine Mammals. Perrin, W. F., Würsig, B. and Thewissen, J. G. M. (eds.), San Diego, Academic Press: 549-551.

Brown, E.G. and Pierce, G.J. (1998) Monthly variation in the diet of harbour seals in inshore waters along the southeast Shetland (UK) coastline. Mar. Ecol. Prog. Ser. 167: 275-289.

Buckland, S. T., Cattanach, K. L. and Lens, S. 1992 Fin whale abundance in the eastern North Atlantic, estimated from Spanish NASS-89 data. *Report of the International Whaling Commision*, 42, pp. 457-460

Carter, T.J., Pierce, G.J., Hislop, J.R.G., Houseman, J.A. and Boyle, P.R. (2001) Predation by seals on salmonids in two Scottish estuaries. Fisheries Management and Ecology, 8: 207-225.

Canning, S.J. (2007) Cetacean Distribution and Habitat Use along the North East of Scotland. PhD Thesis, University of Aberdeen.

Canning, S.J., Santos, M.B., Reid, R.J., Evans, P.G.H, Sabin, R.C. and Pierce, G.J. (2008) Seasonal distribution of white-beaked dolphins (*Lagenorhynchus albirostris*) in UK waters with new information on diet and habitat use. Journal of the Marine Biological Association of the UK 88: 1159-1166.

Cipriano F. (2002) Atlantic white-sided dolphin. In: Encyclopedia of marine mammals (Perrin WF, Würsig B, Thewissen JGM, eds.) Academic Press, San Diego, 49-51.

Connor, R.C. and Smolker, R.A. (1990) Quantitative description of a rare behavioural even: a bottlenose dolphin's behaviour toward her deceased offspring. In: The bottlenose dolphin (Eds, Leatherwood, S. and Reeves, R.R.) Academic Press, New York: 355-360.

Connor, R.C., Wells, R.S., Mann, J. and Read, A.J. (2000) The bottlenose dolphin: social relationships in a fission-fusion society. In: Cetacean Societies: field studies of dolphins and whales (Eds, Mann, J., Connor, R.C., Tyack, P.L. and Whitehead, H.) The University of Chicago Press, London: 91-126.

Desportes, G. and Mouritsen, R. (1993) Preliminary results on the diet of long-finned pilot whales off the Faroe Islands. Reports of the International Whaling Commission, Cambridge, Special Issue 14: 233-262.

Donovan, G.P. and Bjørge, A. (1995) Harbour Porpoises in the North Atlantic: edited extract from the Report of the IWC Scientific Committee, Dublin 1995. In: Biology of the Phocoenids. Special Issue 16. Bjørge, A. and Donovan, G.P. (eds.), Cambridge, International Whaling Commission: 3-25.

Durban, J.W., Elston, D.A., Ellifrit, D.K., Dickson, E., Hammond, P.S. and Thompson, P.M. (2005) Multi-site mark–recapture population estimates with Bayesian model determination. Marine Mammal Science 21: 80–92.

Earthwatch (2011). Article: Superpod sightings suggest dolphins are heading north due to climate change. http://www.earthwatch.org/europe/newsroom/science/news-3-dolphinpod.html Accessed 10/04/2011

Evans, P.G.H. (1980) Cetaceans in British Waters. Mammal Review 10(1): 1-52.

Evans, P.G.H. (1988) Killer whales (*Orcinus orca*) in British and Irish waters. Rit Fiskideildar XI: 42-54.

Evans, P.G.H. (1992) Status Review of Cetaceans in British and Irish waters. Report to UK Dept. of the Environment. UK Mammal Society Cetacean Group, Oxford.

Evans, P. G. H., Anderwald, P., and Baines, M. E. 2003 *UK Cetacean Status Review* . Report to English Nature and the Countryside Council for Wales.

Fisher, P.R. and Brown, E.G. (2001) Photo-identification of North Atlantic Killer whales. In. Shetland Wildlife.

Forcada, J., Aguilar, A., Evans, P.G.H. and Perrin, W.F. (1990) Distribution of common and striped dolphins in the temperate waters of the eastern North Atlantic. European Research on Cetaceans, 4: 64-66.

Fraser, F.C. (1946) Report on Cetacea stranded on the British coasts from 1933 to 1937. Report on Cetacea 12, British Museum (Natural History), London.

Fraser, F.C. (1974) Report on Cetacea stranded on the British coasts from 1948 to 1966. 14, British Museum (Natural History), London.

Gaskin, D. E. (1992) Status of the harbour porpoise, *Phocoena phocoena*, in Canada. Canadian Field-Naturalist 106(1): 36-54.

Grellier, K., Hammond, P.S., Wilson, B., Sanders-Reed, C.A. and Thompson, P.M. (2003) Use of photo-identification data to quantify mother-calf association patterns in bottlenose dolphins. Canadian Journal of Zoology 81: 1421-1427.

Gunnlaugsson, T. and Sigurjonsson, J. (1990) NASS-87: Estimation of whale abundance based on observation made onboard Icelandic and Faroese survey vessels ship-board. *Report of the International Whaling Commision*, 40, pp. 571-580.

Hall, A.J. and Walton, M.J. (1999) The diet of grey seals using faecal and fatty acid analysis. In: Harwood, J. (ed.) Effects of Large-scale Industrial Fisheries on Non-Target Species (ELIFONTS). Final report under contract 95/78 to DGXIV of the European Commission.

Hammond, P.S. and Prime, J.H. (1990) The diet of British grey seals (*Halichoerus grypus*). In W.D. Bowen (Editor) Population biology of sealworm (*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. Can. Bull. Fish. Aquat. Sci. 222: 243-254.

Hammond, P.S. Hall, A.J. and Prime, J. (1994) The diet of grey seals around Orkney and other island and mainland sites in northeastern Scotland. J. Appl. Ecol. 31: 340-350.

Hammond, P.S., Benke, H., Berggren, P., Borchers, D.L., Buckland, S.T., Collet, A. Heide-Jorgensen, M. P., Heimlich-Boran, S., Hiby, A.R., Leopold, M. F. and Oien, N. (1995) Distribution and abundance of the harbour porpoise and other small cetaceans in the North Sea and adjacent waters. Final Report to the European Commission LIFE 92-2/UK/027.

Hammond, P. S., Gordon, J. C. D., Grellier, K., Hall, A. J., Northridge, S. P., Thompson, D. and Harwood, J. (2001) Background Information on Marine Mammals relevant to SEA2. Technical report produced for Strategic Environmental Assessment - SEA2. DTI Technical Report TR_006.

Hammond, P.S., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Jorgensen, M.P., Heimlich, S., Hiby, A.R., Leopold, M.F. and Oien, N. (2002) Abundance of harbour porpoises and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology 39: 361-376.

Hammond, P.S., Northridge, S.P., Thompson, D., Gordon, J.C.D., Hall, A.J., Sharples, R.J., Grellier, K. and Matthiopoulos, J. (2004) Background Information on Marine Mammals relevant to SEA5. Technical report produced for Strategic Environmental Assessment – SEA5 to the DTI. Sea Mammal Research Unit.

Hammond, P.S. and Grellier, K. (2006) Grey seal diet composition and prey consumption in the North Sea. Final report to Department for Environment Food and Rural Affairs on project MF0319.

Harmer, S.F. (1927) Report on Cetacea stranded on the British coasts from 1913 to 1926. Report on Cetacea 10, British Musuem (Natural History), London.

Hastie, G.D., Barton, T.R., Swift, R.J., Grellier, K., Hammond, P.S., Thompson, P.M. and Wilson, B. (2003a) Distribution of small cetaceans within a candidate Special Area of Conservation; implications for management. Journal of Cetacean Research and Management. 5, 261-266

Hastie, G.D., Wilson, B. and Thompson, P.M. (2003b) Fine-scale habitat selection by coastal bottlenose dolphins: application of a new video montage technique. Canadian Journal of Zoology, 81: 469-478.

Hastie, G.D., Wilson, B., Wilson, L.J., Parsons, K.M. and Thompson, P.M. (2004) Functional mechanisms underlying cetacean distribution patterns: hotspots for bottlenose dolphins are linked to foraging. Marine Biology. 144: 397-403.

Hastie, G.D., Wilson, B. and Thompson, P.M. (2006) Diving deep in foraging hotspot: acoustic insights into bottlenose dolphin dive depths and feeding behaviour. Marine Biology, 148: 1181-1188.

Travers, S. Thomson, S. and.Mander, L 2008. Ship based survey results for the Aberdeen Offshore Wind farm 2007-2008. The Institute of Estuarine and Coastal Studies. The University of Hull.

IWC (1996) Report of the Sub-Committee on Small Cetaceans. Report of the International Whaling Commission 46: 160-170.

IWC (2007) Report of the joint NAMMCO/IWC scientific workshop on the catch history, stock structure and abundance of North Atlantic fin whales. *Journal of Cetacean Research and Management*, 9.

Jackson D.L. and McLeod C.R. (2002) Handbook on the UK status of EC Habitats Directive interest features: provisional data on the UK distribution and extent of Annex I Habitats and the UK distribution and population size of Annex II species. Version 2. JNCC, Report 312. www.jncc.gov.uk/publications/JNCC312/

JNCC (2010) *Protection of marine European Protected Species from the offences of injury and disturbance.* Joint Nature Conservation Committee.

JNCC (2011). The Joint Nature Conservation Committee (JNCC). Annex II species accounts, http://jncc.defra.gov.uk/ProtectedSites/SACselection/SAC_species.asp Accessed 11/04/2011

JNCC (2010) *Protection of marine European Protected Species from the offences of injury and disturbance.* Joint Nature Conservation Committee.

Kinze, C.C., Addink, M., Smeenk, C., Hartmann, M.G., Richards, H.W., Sonntag, R.P. and Benke, H. (1997) The white-beaked dolphin (*Lagenorhynchus albirostris*) and the white-sided dolphin (*Lagenorhynchus acutus*) in the North and Baltic Seas: review of available information. Report to the International Whaling Commission 47: 675-681.

Klinowska, M. (1991) Dolphins, porpoises and whales of the world. The IUCN Red Data Book. Gland, Switzerland, IUCN: 1-429.

Kuiken, T. and Hartmann, M. G. (1991) Cetacean pathology: dissection techniques and tissue sampling. Proceedings of the first European Cetacean Society workshop on cetacean pathology: dissection techniques and tissue sampling, Leiden, The Netherlands.

Law, R. J. (1994) Collaborative UK marine mammal project: summary of data produced 1988-1992. Fish. Res. Tech. Rep. 97. Lowestoft: MAFF Directorate of Fisheries Research.

Learmonth, J.A. (2006) Life History and Fatty Acid Analysis of Harbour Porpoises (*Phocoena phocoena*) from Scottish Waters. PhD Thesis, University of Aberdeen.

Learmonth, J.A., MacLeod, C.D., Santos, M.B., Pierce, G.J., Crick, H.Q.P. and Robinson, R.A. (2006) Potential effects of climate change on marine mammals. Oceanography and Marine Biology: An Annual Review 44: 431-464.

Lusseau, D., Bailey, H., and Thompson, P.M. (2005) AU 1: Sensitive area for marine mammals. Report for the EU-supported DOWNVInD project. Lighthouse Field Station, University of Aberdeen.

Lusseau, D., Wilson, B., Hammond, P.S., Grellier, K., Durban, J.W., Parsons, K.M., Barton, T.R. and Thompson, P.M. (2006) Quantifying the influence of sociality on population structure in bottlenose dolphins. Journal of Animal Ecology 75: 14-24.

Luque, P.L., Davis, C.G., Reid, D.G., Wang, J. and Pierce, G.J. (2006) Opportunistic sightings of killer whales from Scottish pelagic trawlers fishing for mackerel and herring off North Scotland (UK) between 2000 and 2006. Aquatic Living Resources, 19: 403-410.

MacLeod, C.D., Santos, M.B. and Pierce, G.J. (2003) Review of data on diets of beaked whales: evidence of niche separation and geographic segregation. Journal of the Marine Biological Association of the United Kingdom 83: 651-665.

Macleod, K. (2004) The abundance of the Atlantic white-sided dolphin (*Lagenorhynchus acutus*) during summer off north-west Scotland. *Journal of Cetacean Research and Management*, **6**, pp. 33-40.

MacLeod, C.D., Bannon, S.M., Pierce, G.J., Schweder, C., Learmonth, J.A., Reid, R.J. and Herman, J.S. (2005) Climate change and the cetacean community of northwest Scotland. Biological Conservation 4: 477 - 483.

MacLeod, C.D., Hay, I. and Hepworth, K. (2007) Northern North Sea Cetacean Ferry Surveys (NORCET): An Analysis of Cetacean Information Collected in the First Five Years (2002-2006). (University of Aberdeen; East Grampian Coastal Partnership; South Grampian Seawatch Group). Unpublished Report.

MacLeod, K., Simmonds, M. P. and Murray, E. (2003) Summer distribution and relative abundance of cetacean populations off north-west Scotland. Journal of the Marine Biological Association of the United Kingdom 83: 1187-1192.

MacLeod, K., Fairbairns, R., Gill, A., Fairbairns, B, Gordon, J., Blair-Myers C. and Parsons, E.C.M. (2004) Seasonal distribution of minke whales *Balaenoptera acutorostrata* in relation to physiography and prey off the Isle of Mull, Scotland. Marine Ecology Progress Series 277: 263–274.

Macleod, K., Burt, M. L., Canadas, A., Rogan, E., Santos, M. B., Uriarte, A., Van Canneyt, O., Vazquez, J. A., and Hammond, P. S. 2008 Preliminary abundance estimates of cetaceans in offshore European Atlantic waters. Report of the IWC Scientific Committee, SC/60/O2.

Martin, A.R. Reynolds, P. and Richardson, M.G. 1987. Aspects of the biology of Pilot whales (*Globicephala melaena*) in recent mass strandings on the British coast. J. Zool. (Lond.) 211: 11-23.

McConnell, B.J. Fedak, M.A. Lovell, P. and Hammond, P.S. (1999) Movements and foraging areas of grey seals in the North Sea. Journal of Applied Ecology 36: 573-590.

McKenzie, C., Reid, R.J., and Wells, D.E. (1997) Organochlorine contaminants and trace metals in bottlenose dolphins (*Tursiops truncatus*) stranded in the Moray Firth, Scotland. In The influence of environmental contaminants on skin disease in bottlenose dolphins (ed P.S. Hammond), pp. 60-85. Ministry of Agriculture, Fisheries and Food, London.

Mendes, S., Turrell, W., Lütkebohle, T. and Thompson, P. (2002) Influence of the tidal cycle and a tidal intrusion front on the spatio-temporal distribution of coastal bottlenose dolphins. Marine Ecology Progress Series, 239: 221-229.

Nature in Shetland website. Accessed April 2011. http://www.nature-shetland.co.uk/index.htm

Northridge, S.P. (1988) Marine mammals and fisheries: a study of conflicts with fishing gear in British waters. International Institute for Environment and Development, London.

Northridge, S.P., Tasker, M.L., Webb, A. and Williams, J.M. (1995) Distribution and relative abundance of harbour porpoises (*Phocoena phocoena* L.), white-beaked dolphins (*Lagenorhynchus albirostris* Gray), and minke whales (*Balaenoptera acutorostrata* Lacepède) around the British Isles. ICES Journal of Marine Science 52: 55-66.

Northridge, S., Tasker, M., Webb, A., Camphuysen, K. and Leopold, M. (1997) White-beaked *Lagenorhynchus albirostris* and Atlantic white-sided dolphin L. *acutus* distributions in Northwest European and US North Atlantic waters. Report of the International Whaling Commission 47: 797–805.

Øien, N. (1991) Abundance of the northeastern Atlantic stock of minke whales based on shipboard surveys conducted in July 1989. Rep. Int. Whal. Commn. 41: 433-7.

Parsons, K.M., Noble, L.R., Reid, R.J. and Thompson, P.M. (2002) Mitochondrial genetic diversity and population structuring of UK bottlenose dolphins (*Tursiops truncatus*): is the NE Scotland population demographically and geographically isolated? Biological Conservation 108: 175-182.

Patterson, I.A.P., Reid, R.J., Wilson, B., Grellier, K., Ross, H.M., and Thompson, P.M. (1998) Evidence for infanticide in bottlenose dolphins: An explanation for violent interactions with harbour porpoises? Proceedings of the Royal Society of London Series, B-Biological Sciences 265, 1167-1170.

Pierce, G.J., Santos, M.B., Reid, R.J., Patterson, I.A.P. and Ross, H.M. (2004) Diet of minke whales *Balaenoptera acutorostrata* in Scottish (UK) waters with notes on strandings of this species in Scotland 1992-2002. Journal of the Marine Biological Association of the United Kingdom 84: 1241-1244.

Pierpoint, C. (2001) Harbour porpoise distribution in the coastal waters of SW Wales. Report to the International Fund for Animal Welfare.

Pollock, C.M. Mavor, R. Weir, C.R. Reid, A. White, R.W. Tasker, M.L. Webb, A. and Reid, J.B. (2000) The distribution of seabirds and marine mammals in the Atlantic Frontier, north and west of Scotland. Joint Nature Conservation Committee. 92 pp.

Rae, B.B. (1965) The food of the common porpoise (*Phocaena phocaena*). Journal of Zoology 146: 114-122.

Rae, B.B. (1973) Additional notes on the food of the Common porpoise (*Phocoena phocoena*). Journal of Zoology, London 169: 127-131.

Read, A.J. and Westgate, A.J. (1997) Monitoring the movements of harbour porpoise (*Phocoena phocoena*) with satellite telemetry. Marine Biology 130: 315-322.

Reeves, R.R., Smeenk, C., Kinze, C.C., Brownell, R.L. and Lien, J. (1999a) White-beaked dolphin. In: S. H. Ridgway and R. Harrison (eds). Handbook of Marine Mammals. Academic Press, London: 1-30.

Reeves, R.R., Smeenk, C., Brownell, R.L. and Kinze, C.C. (1999b) Atlantic white-sided dolphin. In: S. H. Ridgway and R. Harrison (eds). Handbook of Marine Mammals. Academic Press, London: 31-56.

Reid, R.J. and Patterson, T. (1998) Cetacean strandings in Scotland 1997. Soundings (Newsletter for the Sea Watch Foundation), 4 (1/2): 8.

Reid, R.J., Kitchener, A., Ross, H.M. and Herman, J. (1993) First records of the striped dolphin, *Stenella coeruleoalba*, in Scottish waters. Glasgow Naturalist part 3.

Reid, J.B., Evans, P.G.H. and Northridge, S.P. (Ed.) (2003) Atlas of cetacean distribution in north-west European waters. Peterborough, Joint Nature Conservation Committee, 75pp.

Reijnders, P.J.H., Verriopoulos, G. and Brasseur, S.M.J.M. (Eds). (1997) Status of pinnipeds relevant to the European Union. IBN Scientific Contributions 8. DLO Institute for Forestry and Nature Research, Wageningen.

Robinson, K.P., Eisfeld, S.M., Baumgartner, N., Culloch, R.M., Gimenez-Reguera, B. and K. Margaris (2006) A catalogue of individually-recognisable bottlenose dolphins using the southern coastline of the outer Moray Firth. Unpublished report. Cetacean Research and Rescue Unit, Banff. 42pp.

Robinson, K.P., Baumgartner, N. and Tetley, M.J. (2007) Fine-scale studies of coastal minke whales in north-east Scotland. In: Proceeding of the ECS workshop on An Integrated Approach to Non-lethal Research on Minke whales in European Waters. Held at the 21st Annual Meeting of the European Cetacean Society San Sebastian, Spain, 22 April 2007

Robinson, K.P., Baumgartner, N., Eisfeld, S.J., Clark, N.M., Culloch, R.M., Haskins, G.N., Zapponi, L., Whaley, A.R., Weare, J.S. and Tetley, M.J. 2008. The summer distribution and occurrence of cetaceans in the coastal waters of the outer southern Moray Firth in northeast Scotland (UK). Lutra. Marine Biodiversity Records 3: 1-4.

Rogan, E. and Berrow, S.D. (1996) A Review of harbour porpoises, *Phocoena phocoena*, in Irish Waters. Report of the International Whaling Commission 46: 595-605.

SAC (2006) Unpublished data for cetaceans stranded around Scotland (January 1992- August 2006). Scottish Agricultural College, Inverness.

Sanders-Reed, C.A., Hammond, P.S., Grellier, K., and Thompson, P.M. (1999) Development of a population model for bottlenose dolphins. Report No. 156. Scottish Natural Heritage, Edinburgh.

Santos, M.B., Pierce, G.J., Ross, H. M., Reid, R. J. and Wilson, B. (1994) Diets of small cetaceans from the Scottish coast. International Council for the Exploration of the Sea, Marine Mammal Committee, C.M. 1994/N:11.

Santos, M.B., Pierce, G.J., Wijnsma, G., Ross, H.M. and Reid, R.J. (1995) Diets of small cetaceans stranded in Scotland 1993-1995. International Council for the Exploration of the Sea, Marine Mammal Committee, C.M. 1995/N:6.

Santos, M.B., Pierce, G.J., Boyle, P.R., Reid, R.J., Ross, H.M., Patterson, A.P., Kinze, C.C., Tougaard, S., Lick, R., Piatkowskie, U., Hernández-García, V. (1999) Stomach contents of sperm whales *Physeter macrocephalus* stranded in the North Sea 1990-1996. Marine Ecology Progress Series, 183: 281-294.

Santos, M.B., Pierce, G.J., Reid, R.J., Patterson, I.A.P., Ross, H.M. and Mente, E. (2001a) Stomach contents of bottlenose dolphins (*Tursiops truncatus*) in Scottish waters. Journal of the Marine Biological Association of the United Kingdom, 81: 873-878.

Santos, M.B., Pierce, G.J., Smeek, C., Addink, M.J., Kinze, C.C., Tougaard, S. and Herman, J. (2001b) Stomach contents of northern bottlenose whaler *Hyperoodon ampullatus* stranded in the North Sea. Journal of the Marine Biological Association of the United Kingdom, 81: 143-150.

Santos M.B. and Pierce G.J. (2003) The diet of harbour porpoise (*Phocoena phocoena*) in the northeast Atlantic. Oceanography and Marine Biology 41: 355-390.

Santos, M.B., Pierce, G.J., Learmonth, J.A., Reid, R.J., Ross, H.M., Patterson, I.A.P., Reid, D.G. and Beare, D. (2004a) Variability in the diet of harbour porpoises (*Phocoena phocoena*) in Scottish waters 1992-2003. Marine Mammal Science 20(1): 1-27.

Santos, M.B., Learmonth, J.A., Pierce, G.J., Moffat, C.F., Rogan, E., Murphy, S., Ridoux, V., Meynier, L., Lahaye, V., Pusineri, C. and Spitz, J. (2004b) Dietary studies of small cetaceans in the NE Atlantic using stomach contents and fatty acid analysis. BIOCET Workpackage 6 Deliverable Report.

Santos, M.B., Pierce, G.J., Learmonth, J.A., Reid, R.J., Patterson, I.A.P and Ross, H.M. (2008) Strandings of striped dolphin *Stenella coeruleoalba* in Scottish waters (1992-2003) with notes on the diet of this species. Journal of the Marine Biological Association of the UK 88: 1159 - 1166.

SCANS-II 2008. Small Cetaceans in the European Atlantic and North Sea (SCANS-II). Final report to the European Commission LIFE Nature programme on project LIFE04NAT/GB/000245.

Schweder, T., Skaug, H.J., Dimakos, X.K., Langaas, M. and Øien, N. (1997) Abundance of northeastern Atlantic minke whales, estimates for 1989 and 1995. Rep. Int. Whal. Commn. 47: 453-483.

SCOS (2006) Scientific Advice on Matters Related to the Management of Seal Populations: 2006. Report of the Special Committee on Seals (http://smub.st-and.ac.uk/CurrentResearch.htm/scos.htm).

Scott, M.D., Wells, R.S and Irvine, A.B. (1996) Long-term studies of bottlenose dolphins in Florida. IBI Rep. No. 6. International Marine Biological Institute, Kamogawa, Japan: 73-81.

Sheldrick, M.C. (1976) Trends in the strandings of Cetacea on the British coast 1913-72. Mamm. Rev. 61: 15-23.

Sini, M.I., Canning, S.J., Stockin, K.A. and Pierce, G.J. (2005) Bottlenose dolphins around Aberdeen harbour, north-east Scotland: a short study of habitat utilization and the potential effects of boat traffic. Journal of the Marine Biological Association of the United Kingdon, 85: 1547-1554.

Skaug, H.J., Øien, N., Scweder, T. and Bøthun, G. (2003) Current abundance of minke whales in the northeastern Atlantic: variability in time and space. Paper SC/55/NAM1 presented to the Annual Meeting of the IWC Scientific Committee, Berlin, Germany.

Smolker, R.A., Richards, A.F., Connor, R.C. and Pepper, J.W. (1992) Sex differences in patterns of association among Indian Ocean bottlenose dolphins. Behaviour, 123: 38-69.

SMRU Ltd (2007) Harbour and grey seal haul out survey data for the period 1997 and 2005. Sea Mammal Research Ltd.

SMRU Ltd (2011a). Boat based survey report for the EOWDC surveys carried out during 2010-2011. Sea Mammal Research Ltd.

SMRU Ltd (2011b). Analysis of 1st year IECS survey data collected during 2007-2008. Sea Mammal Research Ltd.

SMRU Ltd (2011c). Utilisation of space by grey and harbour seals in the Pentland Firth and Orkney waters. *Scottish Natural Heritage Commissioned Report No. 441*

Söhle, I., Wilson, L.J., Dean, B.J., O'Brien, S.H., Webb, A. and Reid, J.B. (2006) Wintering sea ducks, divers and grebes in UK inshore areas: Aerial surveys and shore-based counts 2005/06. JNCC Report, No. 392

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

Stone, C.J. (1997) Cetacean observations during seismic surveys in 1996. JNCC Report, No. 228.

Stone, C.J. (1998) Cetacean observations during seismic surveys in 1997. JNCC Report, No. 278.

Stone, C.J. (2000) Cetacean observations during seismic surveys in 1998. JNCC Report, No. 301.

Stone, C.J. (2001) Marine Mammal Observations during Seismic Surveys in 1999. JNCC Report No. 316.

Stone, C.J. (2003a) Marine mammal observations during seismic surveys in 2000. JNCC Report No. 322.

Stone, C.J. (2003b) The effects of seismic activity on marine mammals in UK waters, 1998-2000. JNCC Report No. 323.

Swift, R.J., Hastie, G.D., Barton, T.R., Clark, C.W., Tasker, M.L. and Thompson, P.M. (2002) Studying the distribution and behaviour of cetaceans in the northeast Atlantic using passive acoustic techniques. Report to AFEN. University of Aberdeen.

Talisman Energy (UK) Limited (2005) Beatrice Wind Farm Demonstrator Project. Environmental Statement. DTI Project Reference: D/2875/2005.

Thompson, P.M. and Hammond, P.S. (1992) The use of photography to monitor dermal disease in wild bottlenose dolphins (*Tursiops truncatus*). Ambio 21: 135-137.

Thompson, P.M., Miller, D., Cooper, R. and Hammond, P.S. (1994) Changes in the distribution and activity of female harbour seals during the breeding season: implications for their lactation strategy and mating patterns. Journal of Animal Ecology, 63: 24-30.

Thompson, P.M. McConnell, B.J. Tollit, D.J. Mackay, A. Hunter, C. and Racey, P.A. (1996) Comparative distribution, movements and diet of harbour and grey seals from the Moray Firth, NE Scotland. Journal of Applied Ecology, 33: 1572-1584.

Thompson, P.M., Lusseau, D. Corkrey, R. and Hammond, P.S. (2004a) Moray Firth bottlenose dolphin monitoring strategy options. Scottish Natural Heritage Commissioned Report No. 079 (ROAME No. F02AA409).

Thompson, P., White, S. and Dickson, E. (2004b) Co-variation in the probabilities of sighting harbour porpoises and bottlenose dolphins. Marine Mammal Science, 20(2): 322-328.

Thompson, P.M., Corkrey, R., Lusseau, D., Lusseau, S.M., Quick, N., Durban, J.W., Parsons, K.M. and Hammond, P.S. (2006) An assessment of the current condition of the Moray Firth bottlenose dolphin population. Scottish Natural Heritage Commissioned Report No.175 (ROAME No. F02AC409).

Thompson, P.M., Mackey, B., Barton, T.R., Duck, C. and Butler, J. R. A. (2007) Assessing the potential impact of salmon fisheries management on the conservation status of harbour seals (*Phoca vitulina*) in north-east Scotland. Animal Conservation, 10: 48–56.

Tollit, D.J., Greenstreet, S.P.R. and Thompson, P.M. (1997) Prey selection by harbour seals, *Phoca vitulina*, in relation to variations in prey abundance. Can. J. Zool. 75: 1508-1518.

Tollit, D.J. and Thompson, P.M. (1996) Seasonal and between year variations in the diet of harbour seals in the inner Moray Firth, NE Scotland. Can. J. Zool. 74: 1110-1121.

Weir, C.R. and Stockin, K.A. (2001) The occurrence and distribution of the bottlenose dolphin (Tursiops truncatus) and other cetacean species in the coastal waters of Aberdeenshire. Sea Watch Foundation Report to Shell UK Exploration and Production.

Weir, C. A., Stockin, K. A. and Pierce, G. J. (2007) Spatial and temporal trends in the distribution of harbour porpoises, white-beaked dolphins and minke whales off Aberdeenshire (UK), north-western North Sea. Journal of the Marine Biological Association of the United Kingdom 87:327-338.

Wilson, B. (1995) The ecology of bottlenose dolphins in the Moray Firth, Scotland: A population at the northern extreme of the species range. PhD Thesis, University of Aberdeen.

Wilson, B., Black, A., Curran, S., Grellier, K., Thompson, P.M. and Hammond, P.S. (1995) The movements behaviour and characteristics of individually recognisable bottlenose dolphins in the Moray Firth. Unpublished Contract Report to Scottish Natural Heritage. 83pp.

Wilson, B., Thompson, P.M. and Hammond, P.S. (1997a) Habitat Use by Bottlenose Dolphins: Seasonal Distribution and Stratified Movement Patterns in the Moray Firth. Journal of Applied Ecology 34: 1365-1375.

Wilson, B., Thompson, P.M., and Hammond, P.S. (1997b) Skin lesions and physical deformities in bottlenose dolphins in the Moray Firth: Population prevalence and age-sex differences. Ambio 26, 243-247.

Wilson, B., Hammond, P.S., and Thompson, P.M. (1999a) Estimating size and assessing trends in a coastal bottlenose dolphin population. Ecological Applications 9, 288-300.

Wilson, B., Arnold, H., Bearzi, G., Fortuna, C.M., Gaspar, R., Ingram, S., Liret, C., Pribanic, S., Read, A.J., Ridoux, V., Schneider, K., Urian, K.W., Wells, R.S., Wood, C., Thompson, P.M., and Hammond, P.S. (1999b) Epidermal diseases in bottlenose dolphins: impacts of natural and anthropogenic factors. Proceedings of the Royal Society of London, Series B-Biological Sciences 266, 1077-1083.

Wilson, B., Grellier, K., Hammond, P.S., Brown, G., and Thompson, P.M. (2000) Changing occurrence of epidermal lesions in wild bottlenose dolphins. Marine Ecology-Progress Series 205, 283-290.

Wilson, B., Reid, R.J., Grellier, K., Thompson, P.M. and Hammond, P.S. (2004) Considering the temporal when managing the spatial: a population range expansion impacts protected areas based management for bottlenose dolphins. Animal Conservation 7: 331–338.

Wilson, L. J., Dean, B. J., Webb, A., McSorley, C. A. and Reid, J. B. (2006) Wintering seaducks, divers and grebes in UK inshore areas: Aerial surveys and shore-based counts 2004/05. JNCC Report No. 371.

Thomas, L., S.T. Buckland, E.A. Rexstad, J.L. Laake, S. Strindberg, S.L. Hedley, J.R.B. Bishop, T.A. Marques and K.P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47:5-14.

Thompson, P., Brookes, K., Cheney, B., Bates, H., Richardson, N. and Barton T. (2010) Assessing the potential impact of oil and gas exploration operations on cetaceans in the Moray Firth. University of Aberdeen, Institute of Biological and Environmental Sciences, Lighthouse Field Station, Cromarty, Ross-shire IV11 8YJ. 1st year Report for DECC, Scottish Government, COWRIE, and Oil and Gas UK.

Thompson, P., Brookes, K., Cheney, B., Bates, H., Richardson, N. and Barton T. (2011) Assessing the potential impact of oil and gas exploration operations on cetaceans in the Moray Firth. University of Aberdeen, Institute of Biological and Environmental Sciences, Lighthouse Field Station, Cromarty, Ross-shire IV11 8YJ. Second year Report for DECC, Scottish Government, COWRIE, and Oil and Gas UK.