Agenda Item 5.1

Implementation of the Triennium Work Plan (2010-2012) – Other Issues
Review of New Information on Population Size, Distribution, Structure and Causes of Any Changes

Document 5-03 rev.1

A preliminary report on the presence and distribution of harbour porpoises (*Phocoena phocoena*) from visual and acoustic surveys over the Dogger Bank and surrounding waters, Southern North Sea in November 2011

Action Requested

- Take note of the report

Submitted by

IFAW

NOTE:
IN THE INTERESTS OF ECONOMY, DELEGATES ARE KINDLY REMINDED TO BRING THEIR OWN COPIES OF DOCUMENTS TO THE MEETING

A preliminary report on the presence and distribution of harbour porpoises (*Phocoena phocoena*) from visual and acoustic surveys over the Dogger Bank and surrounding waters, Southern North Sea in November 2011.

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ABSTRACT

Boat-based acoustic and visual line transect surveys for harbour porpoises were conducted during winter 2011 over the Dogger Bank and southern North Sea in UK, Dutch, Danish and German waters. The total log for the research cruise was 4222 km of which 2396 km was 'on track' with at least acoustic effort. The acoustic data was collected using a 200 metre single towed hydrophone array with an automatic high frequency click detector in PAMGUARD. During daylight hours and in sea states of four or less, two observers were stationed on a platform at an eye height of approximately 5.5 metres, at higher sea states observers worked from deck.

Porpoises, white-beaked dolphins (*Lagenorhynchus albirostris*), minke whales (*Balaenoptera acutorostrata*) and grey seals (*Halichoerus grypus*) were sighted during the survey; the majority of sightings of all marine mammal species were in the west of the study area. Thirteen sightings of harbour porpoises occurred during the survey, four of which were over the Dogger Bank itself, two in the UK candidate Special Area of Conservation (SAC) and two in Dutch waters. The sea states throughout the survey were rough, with an average sea state of three, hampering the possibility of sighting this small, cryptic animal. This limitation of sighting probability was expected during a winter survey in the North Sea. However, with so few sightings, very little information about the winter distribution of harbour porpoises can be assumed. Acoustic detection of harbour porpoises is less impacted by weather state and post process analysis of the acoustic data is underway. Preliminary analysis of acoustic data shows at least 50 times more detections than sightings.

INTRODUCTION

This report summarises the background, methods and initial findings for research conducted from IFAW's R/V *Song of the Whale* in November 2011 covering the Dogger Bank and surrounding waters of the southern North Sea, including waters under the national jurisdictions of the UK, the Netherlands, Germany and Denmark. The aim of the proposed survey conducted by IFAW, MCRI and partners was to investigate the winter presence, distribution and relative abundance of harbour porpoises (*Phocoena phocoena*) on and around the Dogger Bank.

Novel data on the abundance and distribution of harbour porpoises in the North Sea, particularly in winter, is potentially useful in investigating their current conservation status. In order to assess the impact of bycatch and other human activities on the population status, ongoing collection of such data is essential. Although stranding data and shore-based sightings provide invaluable insights into coastal distribution and behaviour, they do not provide a comprehensive picture of offshore distribution.

There is considerable concern for the conservation status of harbour porpoises in the North Sea and adjacent waters. From 1900 to the early 1950's, harbour porpoises were considered abundant in coastal waters throughout the southern North Sea (Haelters & Camphuysen, 2008). However, it appears that porpoise numbers started to decline in these waters and by the 1970's sightings of harbour porpoises were so rare that the animal could be considered locally extinct in Dutch and Belgian waters (Camphuysen, 1982). Conversely, at this time harbour porpoises were considered common throughout the rest of the North Sea (Reid *et al*., 2003). Following a virtual absence of strandings from the southern North Sea during the 1970s and 1980s, a steady increase between the 1990s and 2006 was observed (Haelters & Camphuysen, 2008; Haelters *et al*., 2011). This surge in stranding records is corroborated by large-scale surveys conducted in the eastern North Atlantic, which provided population estimates for harbour porpoises throughout the ASCOBANS region in July 1994 (SCANS survey, see Hammond *et al*., 2002) and July 2005 (SCANS-II, 2008). Although the overall numbers were comparable between the SCANS surveys, porpoise abundance in the northern North Sea and Danish waters had declined from 239,000 to 120,000, whereas in the central and southern North Sea, Channel and Celtic Shelf, numbers had increased from 102,000 to 215,000. This is thought to represent a southwards shift in range rather than actual changes in population size (Winship, 2009) and is consistent with recent stranding data and observations from seabird surveys, indicating a comeback in the species along the Dutch and Belgian coasts (Camphuysen, 2004; Haelters *et al*., 2011; Thomsen *et al*., 2006).

A priority area for survey effort in the North Sea is the Dogger Bank, currently a candidate Special Area of Conservation (cSAC) under the EC Habitats Directive (Natura 2000) and part of the OSPAR network of Marine Protected Areas in the North East Atlantic Ocean. The Dogger Bank is situated in the middle of the southern North Sea, approximately 150 miles east of the city of Sunderland, UK and is the largest single continuous expanse of shallow sandbank in UK waters (JNCC, 2010) (Figure 1). The bank is situated in the EEZs of the UK, the Netherlands, Germany and Denmark. The bank ranges in water depths between 20 - 40 metres in the UK sector to over 50 metres in the Dutch and German waters. Although the substantial wave action experienced by the bank prevents any colonisation by vegetation, the bank is of great importance to benthic and fish communities. Sand eels are plentiful over the Dogger Bank and the primary prey source for a variety of species including, fish, seabirds and cetaceans including harbour porpoise (Cefas, 2007). Harbour porpoises are distributed within the waters over and around the Dogger Bank and within the candidate SAC area. Results from the two SCANS surveys in 1994 and 2005 (Hammond *et al.,* 2002 and SCANS-II, 2008) and data from Reid *et al*. (2003) indicate porpoise presence throughout the year over the Dogger Bank (Todd *et al.*, 2009), however data from the Joint Cetacean Protocol Database indicate

that the designated UK cSAC area is no more important for harbour porpoises than other parts of the North Sea (JNCC, 2010). Harbour porpoises therefore have recently been removed as a qualifying feature of the site by the JNCC (JNCC, 2010) although they are still considered a feature of interest under the EU Habitats Directive.

In addition to harbour porpoises, white-beaked dolphins (*Lagenorhynchus albirostris*), minke whales (*Balaenoptera acutorostrata*) (ECS, 2008), grey (*Halichoerus grypus*) and common (*Phoca vitulina*) seals are all commonly sighted on the Dogger bank and southern North Sea area (Hammond *et al.*, 2002; SCANS II, 2008).

IFAW and Marine Conservation Research International (MCR International) conducted this survey to investigate the presence and distribution of harbour porpoises during November 2011, with the aim of providing baseline data on distribution and relative abundance in those periods that have traditionally received little survey effort. Therefore, survey results from this project will contribute to baseline data on the winter distribution of porpoises over the Dogger Bank, provide novel data to update the SCANS-II survey in 2005, and will supplement on-going research and conservation work in the region (for example, data will be contributed to the JNCC Joint Cetacean Protocol project to investigate the status of cetaceans within the ASCOBANS area).

Thus, the primary aims of survey work in the Dogger Bank and southern North Sea were to:
1. Detect harbour porpoises both visually and acoustically.
2. Investigate the winter presence and distribution of porpoises.
3. Derive estimates of relative abundance.

To maximise efficiency through the project, secondary aims included:
1. Taking high definition video of porpoise encounters from the A-frame enabling accurate range measurements to be made to correct distance estimates.
2. Recording sighting information and acoustic recordings for all species of marine mammal in the study areas.
3. Recording the presence and distribution of other odontocetes using acoustic detection systems.
4. Collect information on distribution of seabirds, turtles, sharks and sunfish.
5. Continuous logging of Automatic Identification System (AIS) information reporting on the presence distribution and identity of ships.

METHODOLOGY

The survey was conducted between 7th and 24th November 2011 from R/V *Song of the Whale,* a 21 metre auxiliary-powered cutter-rigged sailing research vessel, owned by the International Fund for Animal Welfare and operated by Marine Conservation Research (MCR) Ltd.

The Dogger Bank and surrounding water were treated as three survey blocks, the largest covering the bank itself and surrounding waters (including UK, Dutch, German and Danish portions of the bank) (split into two blocks to allow transects to be designed with favourable wind directions); and two smaller blocks to the west and south, covering the UK section of the Bank and the waters to the south, towards the north Norfolk coast. Using the programme *Distance 6.0* (Thomas *et al*., 2010), randomly generated tracklines were planned to provide equal coverage. Within each small block this amounted to around 600 km of trackline and approximately 1200 km in the larger block (in the east and west blocks combined) (see Figure 1). The tracklines were designed with the predominant wind direction as a factor for each block to allow for optimal sailing conditions. While on survey effort a single stereo hydrophone array was towed approximately 200 metres behind the research vessel. Acoustic surveys took place for 24 hrs/day in sea conditions up to Beaufort 6.

Observer effort followed distance sampling protocols. In daylight hours and in sea states below four, two visual observers were positioned on an A frame platform 5.5 metres above sea level to record any cetacean sightings; observers were not prompted by acoustic cues and/or deck observers. In higher sea states, observers kept a lookout from deck. Sightings were logged to a database via the Logger software (IFAW). Environmental and GPS data were logged automatically to the same database, including date, vessel position (lat-long), sea surface temperature (°C) and wind speed (knots). Manual updates of other environmental variables (such as sea state, wave and swell height) and survey effort (numbers of observers at which positions) were made hourly to the database.

Visual observers scanned out to 90 degrees either side of the trackline, and from close to the boat out to the horizon with the naked eye, using binoculars for species confirmation. Estimated distance and relative angles (using an angle board) to sightings were recorded. Whenever possible, a third observer took high definition video from the A-frame of porpoise encounters to calculate range independently.

Acoustic surveys were conducted using a 200 metre towed two-element broadband hydrophone array (SEICHE Ltd.). Continuous stereo 500 kHz recordings were made via a SEICHE buffer box passing signals to a National Instruments USB-6251 sound card. The buffers were configured to give a variable frequency response and the response of the system was 2 to 200 kHz (within 10 dB). However, in the bandwidth of interest for harbour porpoise clicks (approximately 115 to 180 kHz; (Villadsgaard *et al*., 2006), the response of the system was approximately flat. Recordings were made using PAMGUARD (Passive Acoustic Monitoring Guardianship) and written to hard drive as two-channel 16 bit wav files. As typical harbour porpoise clicks are distinctive high frequency, narrowband signals with a long duration (100 µs), a peak frequency of around 130 kHz, an inter-click interval of around 60 ms and a maximum source level of 172 dB re 1µPa pp @ 1 m (Møhl and Andersen, 1973; Akamatsu *et al*., 1994; Teilmann *et al*., 2002), it is possible to detect and extract potential harbour porpoise clicks from background noise using click detection algorithms. Thus, acoustic signals were monitored in real-time using a PAMGUARD click detector whereby sounds with significant energy (>8 dB above background noise) in the 100 to 150 kHz band were classified as potential harbour porpoise clicks.

A more thorough investigation of potential clicks will be conducted post-process on the recorded audio files. During post-processing, clicks will be classified as harbour porpoise clicks if they have significant energy in the 100 to 150 kHz energy band, have a waveform resembling that of published data for harbour porpoises and have a relatively flat structure revealed in a Wigner plot.

RESULTS

The total log for the harbour porpoise research cruise was 4222 km of which 2396 km was ‘on track’ with at least acoustic effort (Figure 1). Of the 366 hours of total cruise time, almost 25% (92.5 hours) included visual effort; visual effort increased slightly to 26% (71 hours) of the 278 hours spent on the survey track (Table 1).

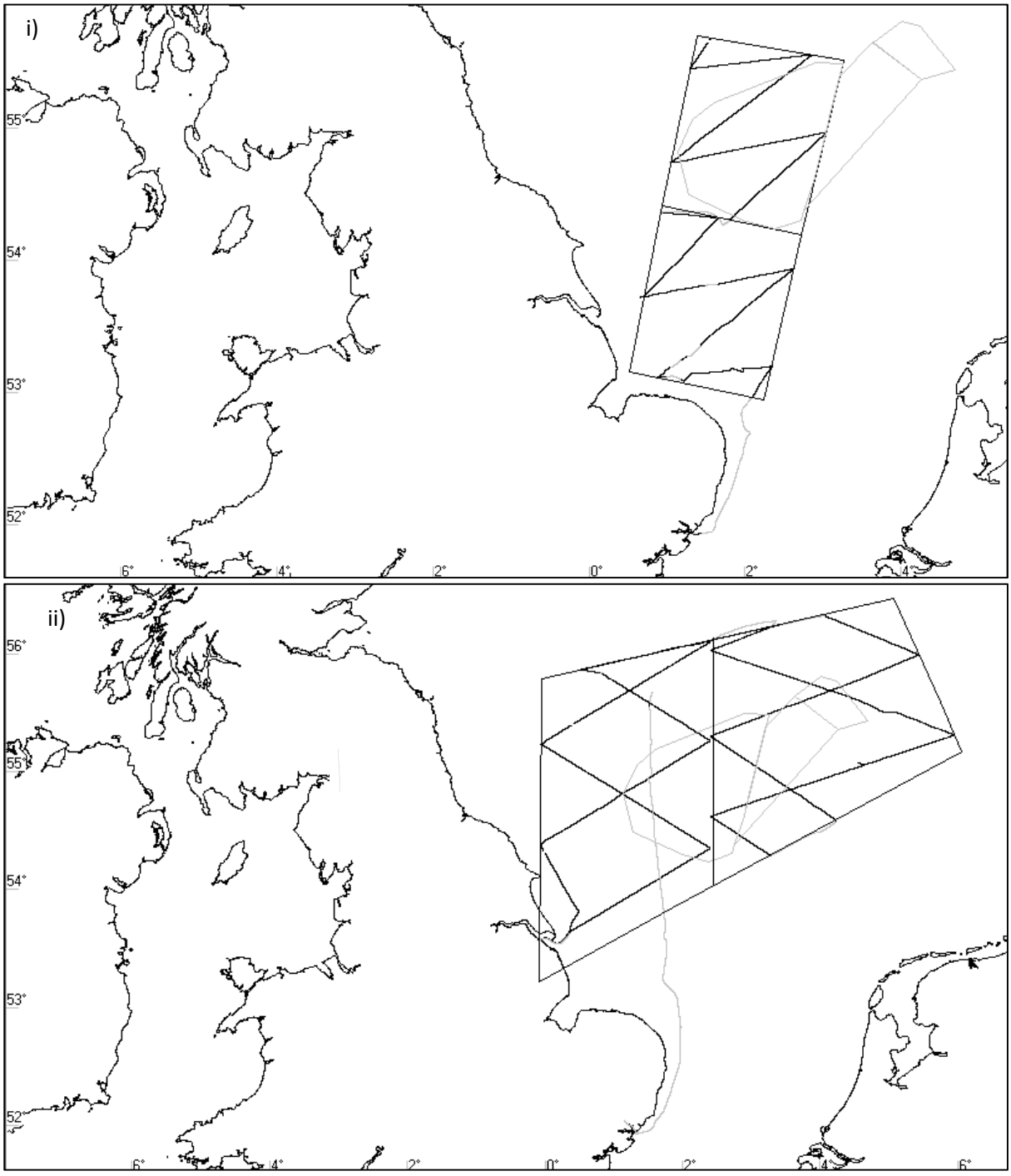

Figure 1: Survey effort from 7th – 24th November 2011. The cruise log was 4222 km of which 3229 km was 'on track' with acoustic effort. The black lines shows effort on-track and the grey effort off-track. Figure 1i) displays the track lines within the first two smaller blocks (the proposed Dogger SAC and off the Hornsea wind farm) and Figure 1ii) the track over the larger blocks (Dogger Bank and surrounding waters).

Table 1. Summary of research effort during the harbour porpoise survey.

	Nautical Miles	Km	Time (hhh:mm)
Total Track	2279.4	4221.5	365:42:13
Passage	76.8	142.3	12:44:02
Passage + acoustic	290.0	537.0	45:46:34
Passage + visual	0.0	0.0	00:00:00
Passage + acoustic + Visual	145.0	268.5	21:39:37
Track + acoustic	1293.7	2396.0	206:49:16
Track + visual	0.0	0.0	00:00:00
Track + acoustic + visual	449.9	833.2	70:50:24
Other	24.0	44.4	07:51:57

A total of three species of cetacean were identified visually in 27 separate encounters both on and off the survey trackline (Figure 2); harbour porpoise (*n* = 13 sighting), white-beaked dolphins (*n* = 11), minke whale (*n* = 2) and unidentified dolphin (n=1). Additionally there were 20 sightings of seals, 18 of which were confirmed grey seal sightings, and two unknown seal encounters.

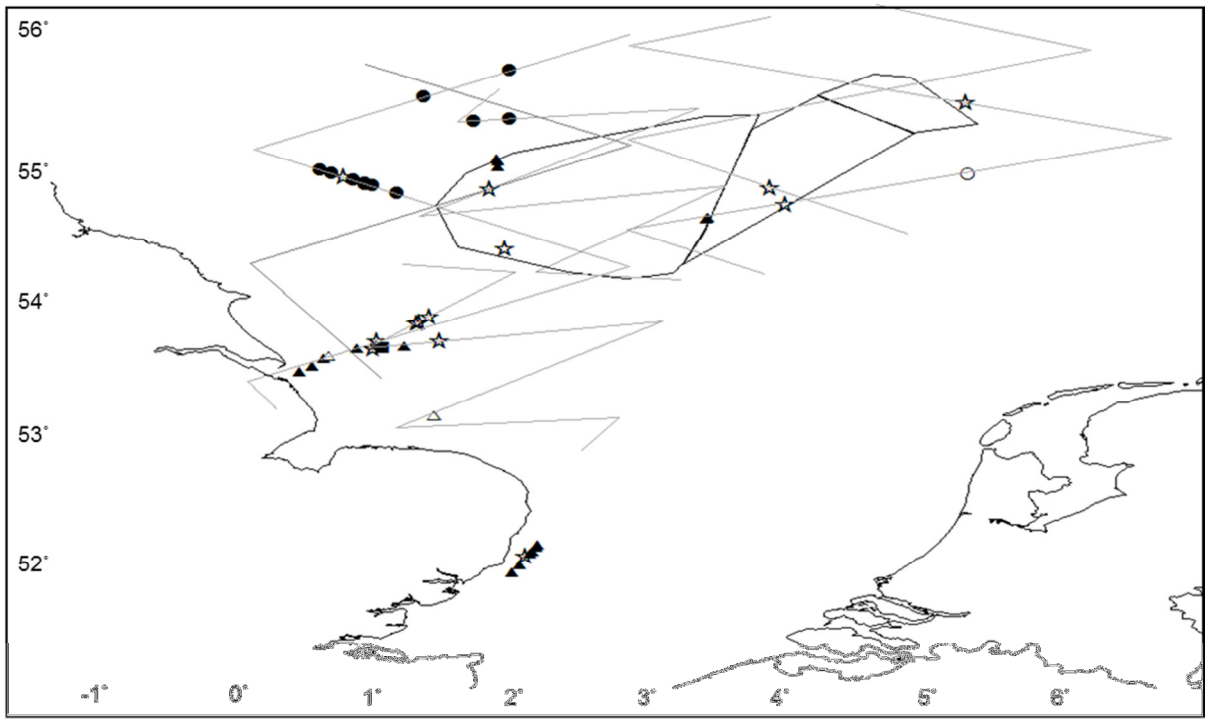

Figure 2: All 47 visual encounters with marine mammals during the survey; harbour porpoise=star outline, white beaked dolphin=filled circle, minke whale=filled square, unknown dolphin=outlined circle, grey seal=filled triangle and unknown seal=triangle outline. Grey lines show the transect lines covered and black area show the Dogger Bank candidate protected areas.

The number of individuals in each encounter was variable, but typically the harbour porpoises were in small groups of one to two individuals (although there was one sighting with five individuals) whilst the dolphins were typically in groups of seven or more. The seals tended to be sighted individually, although there were often several sightings over a short period of time.

In addition to continuous recording, the signal from the hydrophone array was monitored every 15 minutes (approximately 1.58 nautical miles at the average survey speed of 6.3 knots) for animal and ship noise. There were several dolphin detections while listening to the hydrophone and many harbour porpoise detections were noted also. Additionally, a few fishing vessels were recorded acoustically and one submarine was noted (visually and acoustically). Anthropogenic noise levels were particularly high near oil and gas installations.

DISCUSSION

The survey documented 47 sightings of marine mammals including sightings of harbour porpoise, white-beaked dolphin, minke whale and grey seals. Although the majority of sightings were on the western side of the study area, there were sightings of both harbour porpoises and grey seals over Dogger Bank itself.

Harbour porpoises were expected to be the most regularly observed cetacean as they are the most numerous cetacean in the North Sea (Geelhoed *et al.*, 2011). During this survey there were 13 sightings of harbour porpoises, totalling 21 animals sighted in groups of one to five individuals. There were no obvious groupings of harbour porpoise sightings across the survey area, however the majority of sightings were on the west side of the North Sea. Additionally, four of the harbour porpoise sightings were over the Dogger Bank, two over the UK portion and two over the Dutch portion of the bank.

The distribution of harbour porpoises is difficult to establish from sightings data as they are a cryptic, wide ranging species, with strong seasonal variation in density throughout the North Sea. Dutch waters have the highest density of harbour porpoise in March with fewer animals observed in summer and autumn months (Camphuysen, 2011; Geelhoed *et al*., 2011). The sightings of harbour porpoises in this survey were too few to draw any conclusions about abundance or distribution over the survey area. The limited number of sightings of harbour porpoises was expected in this winter survey as harbour porpoise sightings are very dependent on sea state. Palka (2006) suggests that detection probability of harbour porpoises decreases by 50% between Beaufort 0 and Beaufort 3 and continues to decrease substantially as sea state degrades. The vessel used for these findings had observers at 9 and 14 metres above sea level; observers aboard R/V *Song of the Whale* have an eye height of 5.5 metres above sea level, therefore causing sea state to have an even greater impact on sighting rates. The average sea state during the Dogger Bank survey was three and ranged up to sea state five, hampering the possibility of sightings. Post survey analysis of the acoustic recordings for harbour porpoises will likely reveal more detections as these are less impacted by the weather conditions. As harbour porpoises vocalise almost constantly (Villadsgaard *et al.*, 2006) to detect prey, navigate and communicate, it is assumed that most animals passing within 250 metres of the vessel should be detected regardless of the environmental conditions. An initial inspection of these acoustic data suggests at least 50 times more detections than sightings.

Two minke whales were seen very close together in the west of the North Sea, just off Grimsby. From previous research minke whales appear more prevalent in the west of the North Sea (Hammond *et al.*, 1995) and generally rare in the southern half of the North Sea south of Humberside in the summer months (Reid *et al.*, 2003). The second SCANS survey in 2005 recorded a shift in minke whales summer distribution in the North Sea to more northern and central latitudes (SCANS-II, 2008). In general, minke whales are thought to occur mainly in depths of 200 metres or less on the northwest European continental shelf year around, although the majority of sightings recorded between May and September with very few records at other times of year (Reid *et al.*,

2003). Those sightings that have been recorded in northwest Europe in autumn and winter months between October and April are mostly south of 50°N (Reid *et al*., 2003). The sightings from this survey in November are particularly interesting in terms of both the season and relatively high latitude (53°N), compared to other sightings recorded at this time of year.

There were 11 sightings of white-beaked dolphins during this survey, all closely grouped between 54.5° and 55.5° N and in the west of the North Sea. White beaked dolphins are believed to have a more limited range than most of the species present in the UK waters, being found only in cool temperate and subarctic waters of the north Atlantic (Reid et al., 2003). In contrast to the harbour porpoise, in the 1990's there was a general shift northwards in the geographical locations of reported strandings (Jepson, 2006) which has been linked to changing sea surface temperature, local primary productivity and prey abundance (MacLeod *et al.*, 2007; Weir *et al.*, 2007). White-beaked dolphins are thought to be most common in continental shelf waters with depths between 50 and 100 metres and rarely out to 200 metres (Northridge *et al.*, 1995; Reid *et al*., 2003; Weir et al. 2001). These dolphins are abundant in the central (Pollock *et al*., 1997; 2000; Coles *et al*., 2001) and northern (Northridge *et al*., 1995; Weir *et al.*, 2001; Reid *et al*., 2003) North Sea being much less common in the southern North Sea, the English Channel and Irish Sea. However, the white-beaked dolphins encountered during this survey were observed in the southern North Sea, as far south as 54.5°N. This westerly distribution is supported by previous research (Pollock *et al*., 1997; 2000; Coles *et al*., 2001). Although these dolphins have been noted to be present on the UK continental shelf year around, they have been reported most frequently between June and October (Evans 1992; Northridge *et al*., 1995).

There were 18 confirmed grey seal sightings. These were mostly found in the west of the UK sector of the study area, although were also found in smaller numbers in the east and over the Dogger Bank itself. Approximately 45% of the world's grey seal population breed in the UK, mostly in Scottish colonies (Thompson and Duck, 2010). Within the North Sea there is evidence of wide-spread movement between areas both within and outside the breeding season (Thompson and Duck, 2010), therefore many of the grey seals pupping in Scotland may visit other areas of the North Sea. In eastern England pupping occurs mainly between early November to mid-December (Thompson and Duck, 2010).

Additional surveys of the southern North Sea would be extremely beneficial to the understanding of cetacean distribution across the area as a whole, especially across different seasons and to gain more understanding of the southerly shift in the distribution of harbour porpoises which has been noted in recent decades. Analysis of acoustic data is now underway and further results will be available in due course.

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