Marine mammal surveys in Dutch waters in 2012

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Summary

In 2012 aerial surveys using distance sampling methods to estimate the abundance of Harbour porpoises *Phocoena phocoena* on the Dutch Continental Shelf were conducted in March and November. These surveys were conducted along predetermined track lines in four areas: A "Dogger Bank", B "Offshore", C "Frisian Front" & D "Delta". In March 2012 the complete Dutch Continental Shelf (DCS) was surveyed. Due to adverse weather conditions it was not possible to find a suitable time window to conduct aerial surveys of the entire Dutch Continental Shelf in summer. Therefore a late autumn survey was conducted in November. In this period surveys could be conducted in three areas (A-C), but abundance estimates could only be made for area B and C.

In total, 260 sightings of 320 individual Harbour Porpoises were collected. The majority of these sightings (n = 232) was collected in March. Densities in March varied between 0.70–1.44 animals/km² in the areas A-D. The overall density on the entire Dutch Continental Shelf was 1.12 animals/km². In November densities were lower, with densities of 0.50 and 0.64 animals/km² in area B and C.

The total numbers of Harbour Porpoise on the Dutch Continental Shelf (areas A-D) in March were estimated at ca. 66 000 animals (C.I.: 37 000-130 000). Though this number seemed lower than the population estimate in March 2011 (85 572 C.I.: 49 000-165 000) the confidence intervals greatly overlap. Therefore these numbers can be considered of comparable size.

Harbour Porpoises were widely distributed in March with higher densities in a broad band from the southern border of the DCS to the southern half of areas B "Offshore" and C "Frisian Front". In the northern part of the DSC the distribution seemed more patchy, with a high density in area A "Dogger Bank".

In total 16 sightings of other marine mammal species were made in March. These comprised 4 sightings of in total 11 White-beaked Dolphins *Lagenorhynchus albirostris*. in the northern and western part of the DCS. Apart from White-beaked Dolphins 12 single seals were seen, which remained unidentified except 1 Grey Seal *Halichoerus grypus* on 15 March.

This research is part of the Beleidsondersteunend Onderzoek (BO) of program of the Ministry of Economic Affairs (EZ).

1. Introduction

In the Dutch Harbour porpoise conservation plan (Camphuysen & Siemensma 2011) abundance estimates of the Dutch population have been identified as one of the research needs with the highest priority. These population assessments are needed to evaluate potential impacts on the population level. Abundance estimates for the entire Dutch Continental Shelf were lacking until 2010. In July 2010-March 2011, under the umbrella of the Shortlist Masterplan Wind programme, dedicated aerial surveys of the entire Dutch Continental Shelf were conducted for the first time, in three different seasons (Geelhoed et al., 2011). These surveys resulted in abundance estimates and distribution maps of Harbour Porpoises, thus providing a baseline for other surveys in order to answer questions if numbers and distribution in Dutch waters show annual variations.

As a follow-up two complete surveys of the Dutch Continental Shelf were planned in 2012. In this report we present the results of the aerial surveys that took place in March and in November. These surveys were part of the BO project (4308201100) funded by the Ministry of Economic Affairs (EZ) of The Netherlands. Apart from aerial surveys this project contains diet studies, and studies on contaminants. The results of these studies will be published separately.

2. Assignment

This report presents the aerial survey results using line transect distance sampling as described in the original assignment, which consisted of aerial surveys of the entire DCS in March and in July. The original assignment was altered due to adverse weather conditions and plane availability, rendering it impossible to conduct a complete DCS-wide survey in July. Therefore the second survey of the DCS was postponed to the autumn in October-November.

3. Materials and Methods

Study area, survey design and data acquisition

The study area included the entire Dutch section of the continental shelf. The study area was divided into four sub-areas: A ("Dogger Bank", 9 615 km²), B ("Offshore", 16 892 km²), C ("Frisian Front", 12 023 km²) and D ("Delta", 20 797 km²) (Figure 1). The design of the track line set-up was chosen to be parallel in areas C and D and zigzag in area A and B to ensure a representative coverage of the sub-areas. The direction of transects followed depth gradients in order to get a better sample by minimising variance in encounter rate between transect lines (Buckland et al., 2001). The survey design is the same since 2008 (Scheidat et al., 2012).

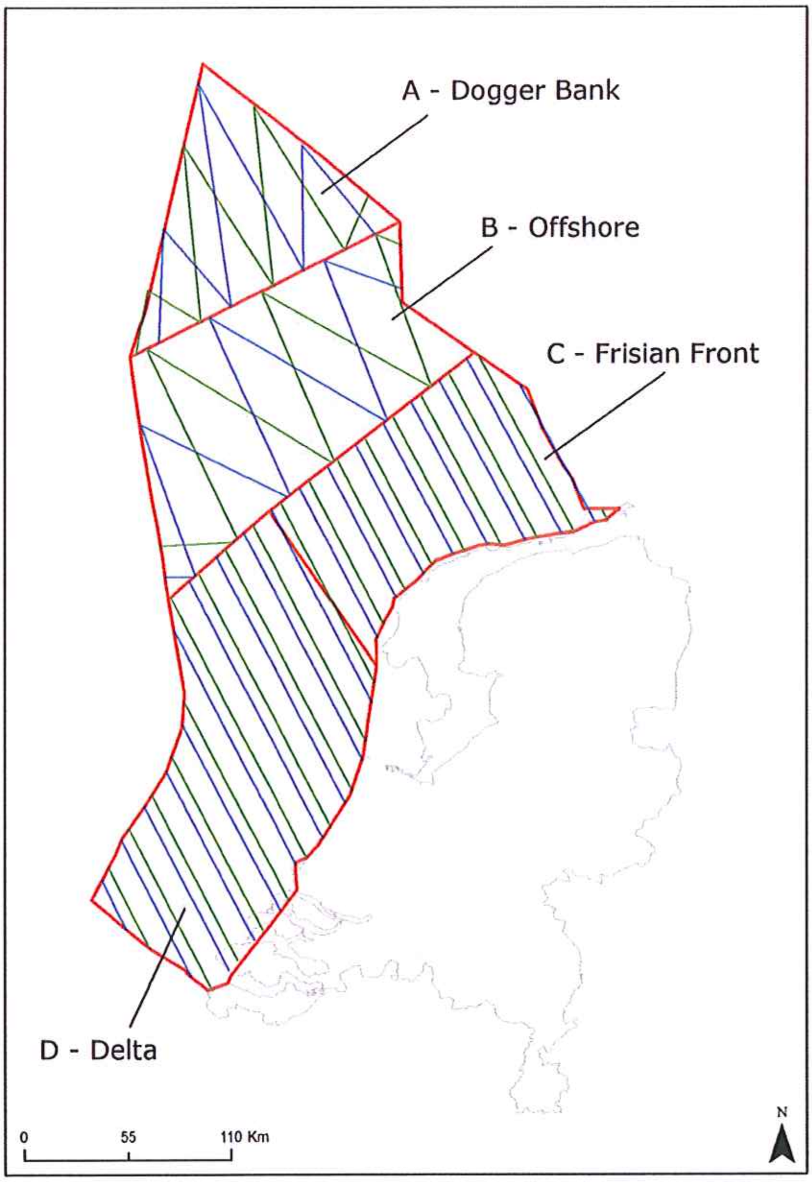

Figure 1. Map of the Dutch Continental Shelf with the planned track lines in study areas A ("Dogger Bank"), B ("Offshore"), C ("Frisian Front") & D ("Delta"). Track lines from the same survey set are shown in the same colour.

Two types of aircraft were used: a Partenavia 68 and a Partenavia 68 Observer, both high-winged two-engined airplanes equipped with bubble windows (Figure 2), flying at an altitude of 183 m (600 feet) with a speed of ca. 186 km/hr (ca. 100 knots). Every four seconds the aircraft's position and time (to the nearest second) was recorded automatically onto a laptop computer connected to a GPS. Surveys were conducted by a team of three people. Sighting information and details on environmental conditions were entered by one person (the navigator) at the beginning of each transect and whenever conditions changed. Observations were made by two dedicated observers located at the bubble windows on the left and right sides of the aircraft. For each observation the observers acquired sighting data including species (all cetaceans and seals), declination angle measured with an inclinometer from the aircraft abeam to the group, group size, presence of calves, behaviour (Table 1), swimming direction, cue, and reaction to the survey plane. The perpendicular distances from the transect to the sighting were later calculated from aircraft altitude and declination angle. Environmental data included sea state (Beaufort scale), turbidity (4 classes, assessed by visibility of objects below the sea surface), cloud cover (in octaves), glare and subjective sighting conditions (Table 2). These sighting conditions represent each observer's subjective view of the likelihood that the observer would see a harbour porpoise within the primary search area should one be present, and could differ between left and right.

Figure 2. The survey aircrafts used. Top: a Partenavia 68. Bottom: a Partenavia 68 Observer.

Table 1. Behavioural codes and description for marine mammals.

Behaviour	Description
Swim	directional swimming
Slswim	slow directional swimming
Fasw	fast directional swimming or porpoising
Mill	milling, non-directional swimming
Rest	resting/logging: not moving at the surface
Feed	Feeding
Headup	spy hop of seals vertically in the water column
Other	other behaviour, noted down in comments

Table 2. Description of sighting conditions.

Sighting condition	Description
Good (G)	Observer's assessment that the likelihood of seeing a porpoise, should one occur within the search strip, is good. Normally, good subjective conditions will require a sea state of two or less and a turbidity of less than two.
Moderate (M)	Observer's assessment that the likelihood of seeing a porpoise, should one occur within the searching area, is moderate.
Poor (P)	Observer's assessment that it is unlikely to see a porpoise, should one occur within the search strip.
Exceptional (X)	Observer off effort due to adverse circumstances

Surveys were conducted in weather conditions safe for flying operations (no fog or rain, no chance of freezing rain, visibility >3km) and suitable for porpoise surveys (Beaufort sea state equal or less than 3). Whenever possible, surveys were co-ordinated with other aerial surveys conducted by the department Management Unit of the North Sea Mathematical Models (MUMM) in Belgian waters, and by the Institute of Terrestrial and Aquatic Wildlife Research (ITAW) in German waters. Results of the different surveys will be presented separately for now.

Surveys were conducted by Geert Aarts, Martin Baptist, Sophie Brasseur, Rob van Bemmelen, Steve Geelhoed, Meike Scheidat and Hans Verdaat.

Data quality check and data storage

All collected data was checked, e.g. for consistency of codes, and subsequently stored in the Dutch database.

Data analysis

The survey data were collected using distance sampling techniques. The collected sightings are used to calculate densities and abundance estimates, and to produce distribution maps. Only data from transect lines flown in good or moderate conditions were considered in the analyses.
Densities and abundance estimates were calculated according to distance sampling methods, that yield obtaining absolute densities, i.c. the number of animals/km² with the associated 95% confidence interval (C.I.) and coefficient of variation (C.V.; Buckland et al. 2001). To do this the so called effective strip

width (ESW), the strip along the track line in which all animals are counted, is calculated. To obtain the first component the perpendicular distance of a sighting to the track line is measured. To calculate the distance of the sighting to the track line from air, the plane flies at a constant height (600 feet = 183m) and the vertical or 'declination' angle to the animal is measured when it comes (or is estimated to come) abeam. By modelling a detection curve to all these distances the effective strip width is obtained.
One of the assumptions of line-transect distance sampling is that all animals are detected on the track line, which would mean that the chance to see all animals at a distance of 0 m from the track line is 1 (100%). For most animals, but in particular for cetaceans, this assumption is not true and a correction factor, called g(0), needs to be obtained to correct for the proportion of animals missed on the track line. In practice there are two reasons why animals are not recorded: 1. the animals are not "available" to be seen, (e.g. because they are sub-merged) or 2. they are missed by the observers ("observer bias"). To obtain a reliable estimate of absolute abundance (the number of animals in a given area e.g. the DCS) it is therefore needed to estimate the proportion of animals actually seen on the track line: the true value of g(0), and use this value to correct the ESW. In the analysis g(0) values of 0.37 for good conditions and 0.14 for moderate conditions are used.
Animal abundance in each stratum v (i.c. area) was estimated using a Horvitz-Thompson-like estimator as:

$$\hat{N}_v = \frac{A_v}{L_v}\left(\frac{n_{gsv}}{\hat{\mu}_g} + \frac{n_{msv}}{\hat{\mu}_m}\right)\overline{s}_v \qquad (1)$$

where Av is the area of the stratum, L_v is the length of transect line covered on-effort in good or moderate conditions, n_{gsv} is the number of sightings that occurred in good conditions in the stratum, n_{msv} is the number of sightings that occurred in moderate conditions in the stratum, $\hat{\mu}_g$ is the estimated total effective strip width in good conditions, $\hat{\mu}_m$ is the estimated total effective strip width in moderate conditions and $\overline{s}_v$ is the mean observed school size in the stratum.

Group abundance by stratum was estimated by $\hat{N}_{v(\text{group})} = \hat{N}_v / \overline{s}_v$. Total animal and group abundances were estimated by

$$\hat{N} = \sum_v \hat{N}_v \quad \text{and} \quad \hat{N}_{(\text{group})} = \sum_v \hat{N}_{v(\text{group})} \qquad (2)$$

respectively. Densities were estimated by dividing the abundance estimates by the area of the associated stratum. Mean group size across strata was estimated by $\hat{E}[s] = \hat{N} / \hat{N}_{(\text{group})}$.
Coefficients of variation (C.V.) and 95% confidence intervals (C.I.) were estimated by a non-parametric bootstrap (999 replicates) within strata, using transects as the sampling units. The variance due to estimation of ESW was incorporated using a parametric bootstrap procedure which assumes the ESW estimates to be normally distributed random variables. More details on this method can be found in Scheidat *et al.* (2008).

Distribution maps were created using ESRI ArcMap 9.3 software. Densities were represented spatially in the 1/9 ICES grid. This grid has latitudinal rows at intervals of 30', and longitudinal columns at intervals of 1°. To allow for more detail, these blocks are divided into nine sub-rectangles, which have latitudinal intervals of 10' and longitudinal intervals of 20'. ICES 1/9 rectangles intersecting with the DCS measure approximately 20x20km, resulting in areas ranging from 388 to 409 km^2.

Densities per 1/9 ICES grid cell were calculated by dividing the total number of animals observed during good and moderate conditions by the total surveyed area. The surveyed area is the distance travelled multiplied by the total effective strip width (ESW). The effective strip half-width (ESW corrected for g(0) values) was defined as 76.5 m for good sighting conditions and 27 m for moderate sighting conditions on each side of the track line (Gilles et al., 2009; Scheidat et al., 2008). Densities in grid cells extending outside the borders of the surveyed area (e.g. the Wadden Sea) could be less reliable due to lower effort. Grid cells with an effort less than 1 km^2 were omitted from the density calculations.

4. Results

Weather conditions and survey effort

Between 6 and 17 March the entire Dutch Continental Shelf could be surveyed (Figure 3, Table 3), resulting in a total covered distance of 3 666 km. Of this distance 99.6% (3653.0 km) was surveyed with good or moderate conditions on at least one side of the plane (Table 4). Due to adverse weather only a little more than half of the Dutch Continental Shelf could be surveyed between 14 and 18 November. Track lines in areas A, B and C were surveyed (Figure 4, Table 3), resulting in a total surveyed distance of 1 200 km. Sighting conditions were predominantly moderate; 94.8 % (1157.4 km) was surveyed with moderate conditions on at least one side of the plane (Table 4).

Table 3. Survey dates and surveyed areas.

Survey date	Surveyed area
6 March	Area D "Delta"
13 March	Area A "Dogger Bank"
14 March	Area B "Offhore"
15 March	Area D "Delta"
17 March	Area C "Frisian Front"
14 November	Area A "Dogger Bank" and Area B "Offhore"
16 November	Area C "Frisian Front"
18 November	Area C "Frisian Front"

Table 4. Total survey days, effort (surveyed distance), sighting conditions (g – good, m – moderate, p – poor, x – not possible to observe) and Harbour Porpoise sightings during the aerial surveys. Calves are included in the number of individuals. Navigator sightings are excluded.

		Sighting conditions (%)			Harbour Porpoise sightings (n)		
Dates	**Effort (km)**	**g**	**m**	**p/x**	**Sightings**	**Individuals**	**Calves**
6, 13-15 & 17 Mar	3 666.2	25.3	70.2	4.5	232	285	-
14, 16 & 18 Nov	1 157.4	0	83	17	28	35	-
Total	4 823.6				260	320	-

Harbour Porpoise sightings – pod size

In total, 260 sightings of 320 individual Harbour Porpoises were collected (Table 4). These sightings are shown on the maps on the following pages (Figure 3, Figure 4). The majority of the sightings was done in March (n = 232). Most sightings concerned single individuals, with a maximum pod size of 5 in March and a maximum pod size of 3 in November. Average pod size in March and November did not differ however: respectively 1.23 and 1.25 individuals.

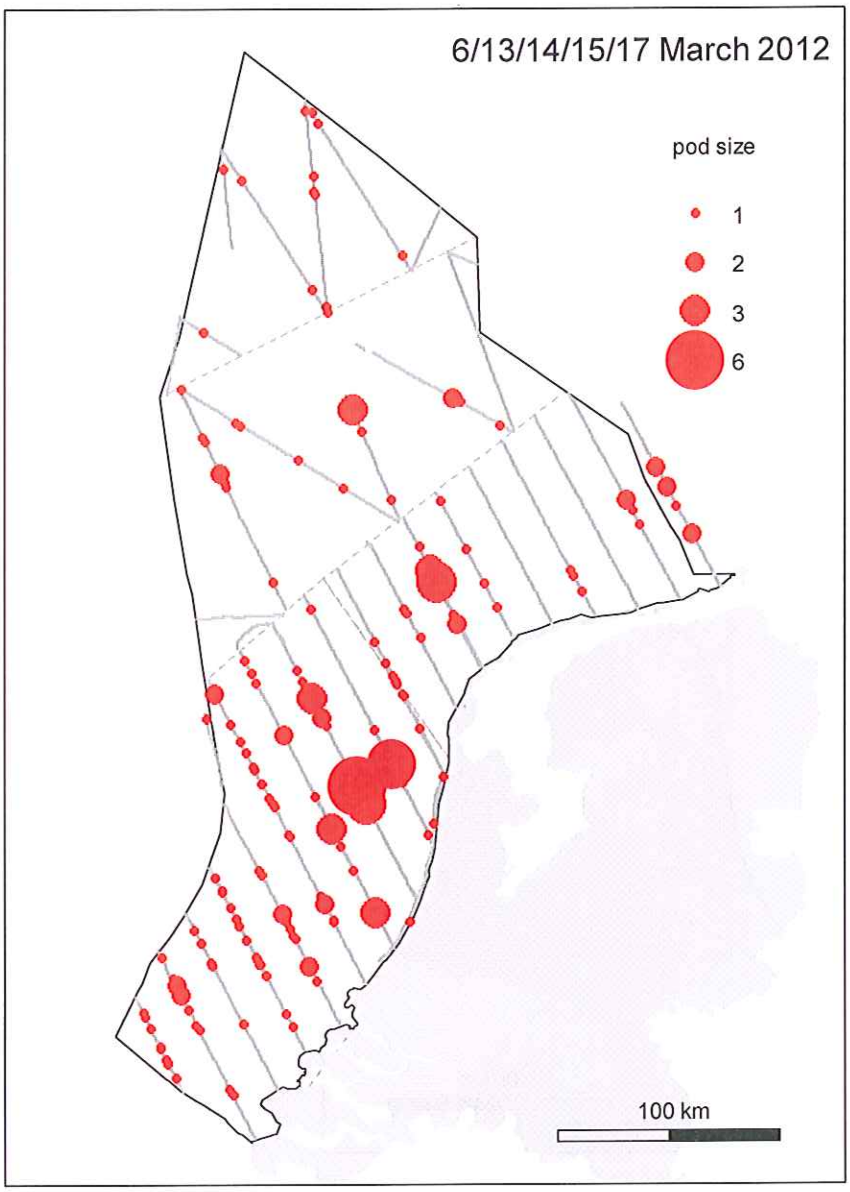

Figure 3. Effort and Harbour Porpoise sightings during the DCS survey in March 2012.

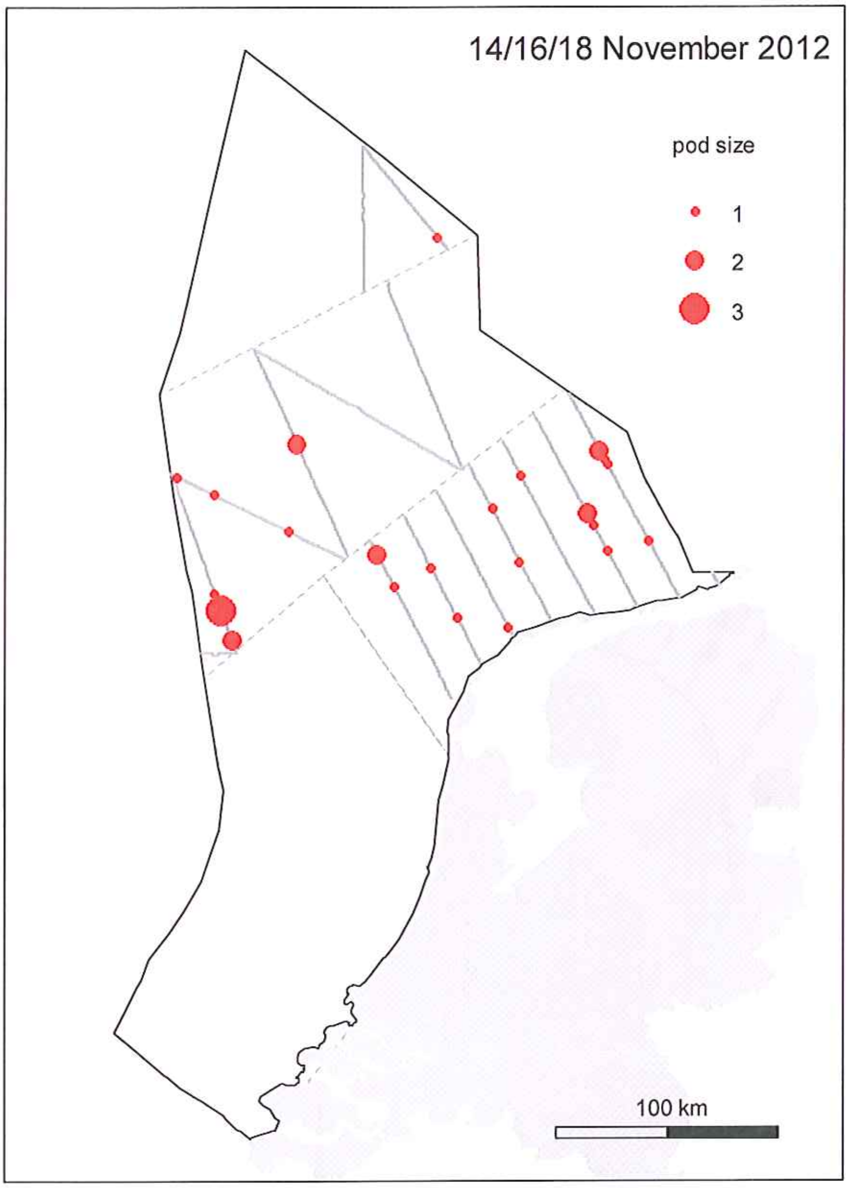

Figure 4. Effort and Harbour Porpoise sightings during the DCS survey in November 2012.

Harbour Porpoise - distribution

Using the effectively covered strip width during the survey, a grid map was created showing the distribution pattern density of porpoises (animals/km²) per 1/9 ICES grid cell in March 2012 (Figure 5). The coverage of the DCS and the number of sightings in November are too low to warrant sensible density distribution maps.

Harbour Porpoises were widely distributed in March with higher densities in a broad band from the southern border of the DCS to the southern half of areas B "offshore" and C "Frisian Front". In the northern part of the DSC the distribution seemed more patchy. Although the density in area A "Dogger Bank" was high.

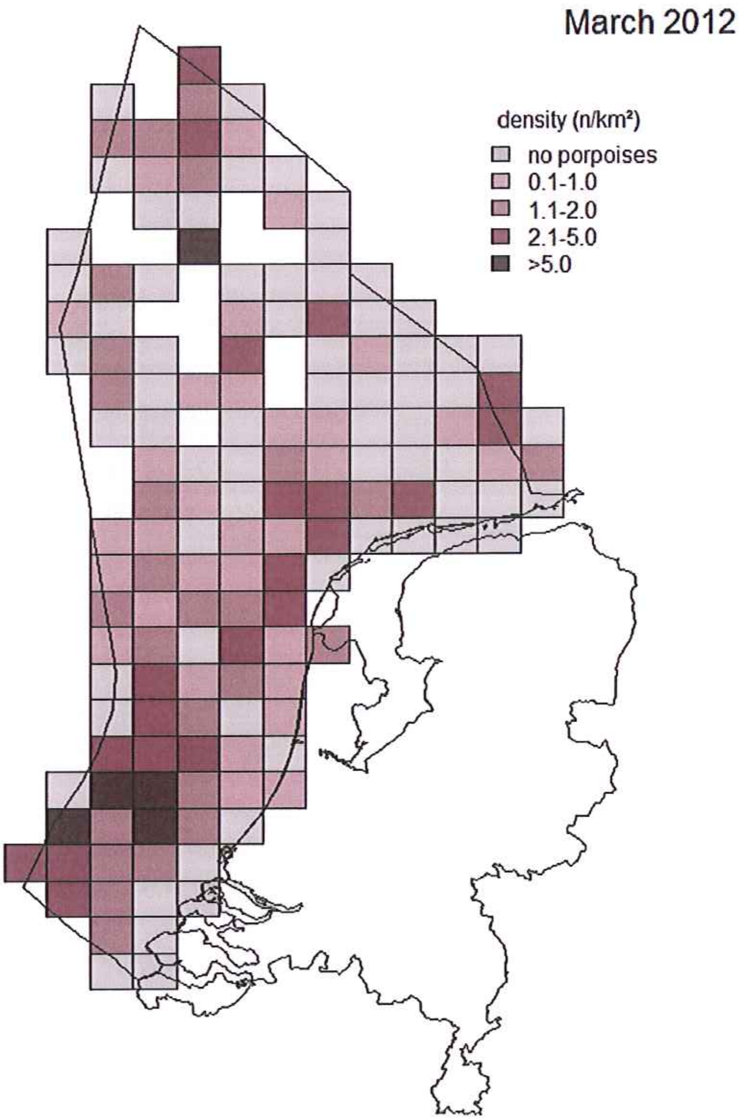

Figure 5. Spring density distribution of Harbour Porpoises (animals/km²) per 1/9 ICES grid cell, March 2012. Grid cells with low effort (< 1 km²) are omitted.

Harbour Porpoise - densities and abundance estimates

Densities of Harbour Porpoises were estimated for each survey stratum (areas A-D) as well as for the whole DCS. This was done for all areas in March and areas B-C in November. Figure 5 gives an overview of density (animals/km²) as well as abundance (number of animals) per survey area and survey period. The overall density in March was 1.12 animals/km². The highest average densities were found in area A, "Dogger Bank", and D "Delta", 1.44 and 1.42 animals/km² respectively. In November densities for area B and C were 0.50 and 0.64 animals/km² respectively (Table 5).

The total numbers of Harbour Porpoises on the Dutch Continental Shelf (areas A-D) in March were estimated at ca. 66 000 animals (C.I.: 37 000-130 000, Table 5).

Table 5. Abundance estimates of Harbour Porpoises for March and November 2012 per area.

	Density (animals/km^2)	C95% CI	Abundance (n animals)	95% CI	CV
March					
A	1.44	0.69-2.72	13 860	6 601-26 156	0.36
B	0.70	0.25-1.51	11 877	4 285-25 557	0.42
C	0.94	0.33-2.09	11 252	4 023-25 079	0.48
D	1.42	0.77-2.91	29 696	15 992-60 810	0.35
Total	1.12	0.63-2.20	66 685	37 284-130 549	0.33
November					
B	0.50	0.10-1.31	8 469	1 741-22 117	0.58
C	0.64	0.35-1.29	7 735	4 231-15 455	0.34
Total	NA	NA	NA	NA	NA

Other marine mammals - sightings

During the surveys 16 sightings of other marine mammal species were made in March (Table 6). The only other cetacean species that was sighted during the surveys was the White-beaked Dolphin *Lagenorhynchus albirostris*. In total 4 sightings of 11 animals were made in the northern and western part of the DCS (Figure 6). Group sizes varied from 1 to 6.

Apart from White-beaked Dolphins, 12 single seals were seen, which mostly were left unidentified except 1 Grey Seal *Halichoerus grypus* on 15 March. The distribution of the sightings is shown in Figure 6.

Table 6. Total survey days, effort (surveyed distance), and sightings of other marine mammals during the aerial surveys.

		White-beaked Dolphin		Seals	
Dates	**Effort (km)**	**Sightings**	**N**	**Sightings**	**N**
6, 13-15 & 17 Mar	3 666.2	4	11	12	12
14, 16 & 18 Nov	1 157.4	-	-	-	-
Total	4 823.6	4	11	12	12

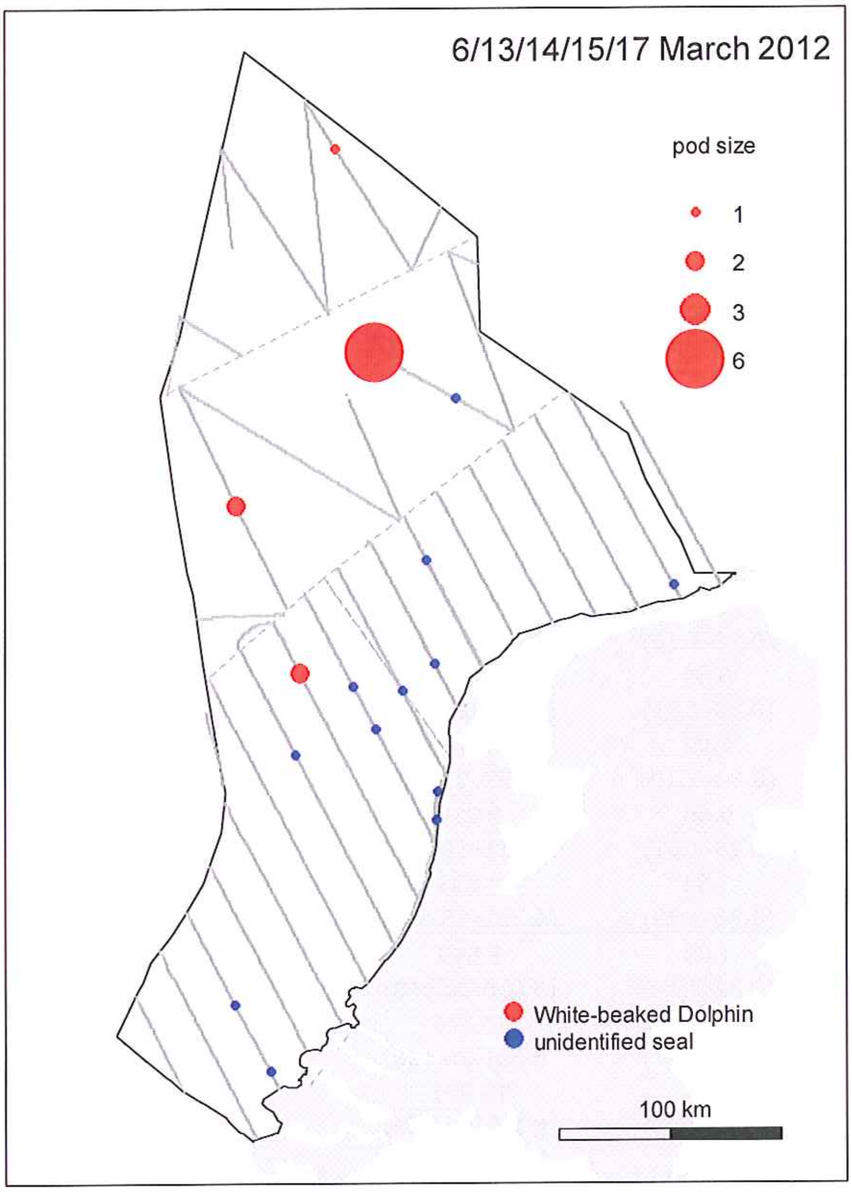

Figure 6. Effort and sightings of marine mammal sightings other than Harbour Porpoises during the DCS survey in March 2012. Grey Seal is included in unidentified seals. During the November surveys, no seals or White-beaked Dolphins were observed.

Comparison with previous surveys

Prior to the present study, IMARES has been conducting aerial surveys in Dutch waters since May 2008 . From May 2008 to December 2011 19 598 km were covered on effort during 47 survey days in three different seasons: March, July and October/November. Complete DCS wide surveys could be made in all three seasons between July 2010-November 2011. During the other periods it was not possible to cover the entire DCS.

The abundance estimates of Harbour Porpoises in March 2011 and March 2012 were 85 572 (CI 49 324-165 443) and 66 685 (CI 37 284-130 549) respectively (Table 7). These numbers are of comparable size given the overlap in confidence intervals of both estimates The distribution of animals seemed to have shifted from area B and C to area A and D.

A comparison of the density and abundance estimate per sub-area shows no clear trends over the years (Table 7). Compared to 2008 the autumn surveys indicate somewhat lower densities and estimates in area C in 2010 and 2012, whereas the March surveys indicate higher figures in 2011 compared to 2010 and 2012 for areas C. In area D the March densities and abundance estimate is highest in 2010 and lowest in 2011, whereas the 2009 and 2012 numbers are in the same order of magnitude. All in all, numbers showed no clear trends and confidence intervals show considerable overlap.

Table 7. Comparison between density and abundance estimates obtained in the same areas and months (2008 to 2012) using results from Geelhoed et al. (2011) and Scheidat et al. (2012).

		Density (animals/km²)	Abundance (n animals plus C.I.)	C.V.
DCS (A-D)	March 2011	1.44	85 572	0.32
		(0.83-2.78)	(49 324-165 443)	
	March 2012	1.12	66 685	0.33
		(0.63-2.20)	(37 284-130 549)	
Area B	Nov 2010	0.57	9 679	0.35
		(0.30-1.16)	(5 025-19 543)	
	Nov 2012	0.50	8 649	0.58
		(0.10-1.31)	(1 741-22 117)	
Area C	Nov 2008	1.02	12 227	0.42
		(0.34–2.10)	(4 038–25 285)	
	Oct/Nov 2010	0.68	8 216	0.46
		(0.29-1.61)	(3 451–19 351)	
	Nov 2012	0.64	7 735	0.34
		(0.35-1.29)	(4 231–15 455)	
Area A	March 2011	1.03	9 890	0.39
		(0.52-2.14)	(5 018-20 618)	
	March 2012	1.44	13 860	0.36
		(0.69-2.72)	6 601-26 156	
Area B	March 2011	0.91	15 331	0.31
		(0.52-1.79)	(8 795-30 249)	
	March 2012	0.70	11 877	0.42
		(0.25-1.51)	(4 285-25 557)	
Area C	March 2010	1.11	13 309	0.44
		(0.48–2.49)	(5 819–29 918)	
	March 2011	2.98	35 850	0.33
		(1.65-5.81)	(19 772–69 808)	
	March 2012	0.94	11 252	0.48
		(0.33-2.09)	(4 023–25 079)	
Area D	Feb/March 2009	1.47	30 534	0.33
		(0.78-2.70)	(16 265–56 161)	
	March 2010	2.01	41 878	0.39
		(0.82–4.04)	(17 145–84 302)	
	March 2011	1.17	24 501	0.34
		(0.66-2.39)	(13 726–49 833)	
	March 2012	1.42	29 696	0.35
		(0.77-2.91)	(15 992–60 810)	

5. Conclusions

The complete Dutch Continental Shelf was surveyed in March 2012, resulting in an abundance estimate of 66 000 (C.I.: 37 000-130 000) Harbour Porpoises. Though this number seemed lower than the abundance estimate in March 2011 (85 000 C.I.: 49 000-165 000), the confidence intervals greatly overlap and therefore these numbers can be considered of comparable size.

Due to weather conditions it was not possible to conduct aerial surveys of the entire Dutch Continental Shelf in summer, therefore a late autumn survey was conducted. In this period surveys could be conducted in three areas, but abundance estimates could only be made for area B and C. These numbers seemed lower than during the previous surveys, but the confidence intervals overlap.

6. Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

References

Buckland ST, Anderson DR, Burnham KP, Laake JL, Borchers DL & Thomas L, 2001. Introduction to Distance Sampling, Vol. Oxford University Press, Oxford.

Camphuysen CJ & Siemensma ML, 2011. Conservation plan for the Harbour Porpoise *Phocoena phocoena* in The Netherlands: towards a favourable conservation status. NIOZ Report 2011-07, Royal Netherlands Institute for Sea Research, Texel.

Geelhoed S, Scheidat M, Aarts G, van Bemmelen R, Janinhoff N, Verdaat H & Witte, R, 2011. Shortlist Masterplan Wind – Aerial surveys of harbour porpoises on the Dutch Continental Shelf. Research Report IMARES Wageningen UR - Institute for Marine Resources & Ecosystem Studies, Report No. C103/11.

Gilles A, Scheidat M & Siebert U, 2009. Seasonal distribution of harbour porpoises and possible interference of offshore wind farms in the German North Sea. Marine Ecology-Progress Series 383: 295-307.

Scheidat M, Verdaat H & Aarts G. 2012, Using aerial surveys to estimate density and distribution of harbour porpoises in Dutch waters. Journal of Sea Research 69: 1-7.

Justification

Rapport C038/13
Project Number: 430 08201 106

The scientific quality of this report has been peer reviewed by the a colleague scientist and the head of the department of IMARES.

Approved: Erwin Winter
Researcher

Signature:

Date: 5 March 2013

Approved: Jakob Asjes
Department Head

Signature:

Date: 5 March 2013