DOGGER BANK
TEESSIDE A & B

March 2014

Environmental Statement Chapter 14 Appendix C Dogger Bank Creyke Beck Telemetry Report

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Authors: Dr Carol Sparling, Eilis Cox and Dr Debbie Russell

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1. Introduction

The aim of this study was to use existing seal telemetry data to quantify seal activity at the proposed Dogger Bank Tranche A site (including a 10km buffer around it). The analysis was to provide basic quantification of the connectivity between seals using the area likely to be affected by wind farm construction and haulouts at designated Special Areas of Conservation (SACs) for seals.

2. Methods

2.1. Definition of areas for examining overlap

Wind farm boundary

For the purposes of this study, the development area was supplied by Forewind and consists of the Dogger Bank Tranche A boundary plus a 10km buffer (Figure 1).

2.2. Telemetry data

In the UK, the Sea Mammal Research Unit (SMRU) has deployed telemetry tags on grey seals (*Halichoerus grypus*) and harbour seals (*Phoca vitulina*) since 1988 and 2001, respectively. These tags transmit data on seal locations with the tag duration (number of days) varying between individual deployments. There are two types of telemetry tag which are associated with two types of data transmission. Data transmission can be through the Argos satellite system (Argos tags) or mobile phone network (phone tags). Both types of transmission result in location fixes, but data from phone tags comprise better quality and more frequent locations. All telemetry data used in this report have been cleaned according to SMRU protocol (Russell *et al.* 2011). Location data resulting from Argos tags were then corrected for positional error using a linear Gaussian state space Kalman filter (Royer & Lutcavage, 2008; Jones *et al*. 2011).

Any seals which had any degree of overlap with the Dogger Bank site were identified (from SMRU's database of 235 grey seals and 246 harbor seals) and the locations at which they were tagged identified. Grey seals have been tagged at haul-outs at a total of three SAC's relevant to the Dogger Bank site; the Berwickshire and North Northumberland Coast (Farnes

Island haul out and breeding colony), the Humber Estuary (Donna Nook haul out and breeding colony), and the Isle of May (Figure 1). Grey seals have also been tagged within the Firth of Tay and Eden Estuary SAC (Abertay haul out region) although this site is designated for its breeding population of harbour seals, large numbers of grey seals also haul out there. Connectivity was also examined with the Faray and Holm of Faray SAC. No seals which had locations within the Dogger Bank site also had locations at this SAC therefore it was scoped out of the study.

Harbour seals have also been tagged within the Wash and North Norfolk SAC – the tracks from these animals were included here because one tagged seal entered the region of interest. Harbour seals have also been tagged at the Firth of Tay and Eden Estuary SAC, however none of these animals travelled close to the Dogger Bank site.

For each of the haul-outs described above, the number of seals which have location fixes within or tracks crossing the Dogger Bank Tranche A plus buffer area is described.
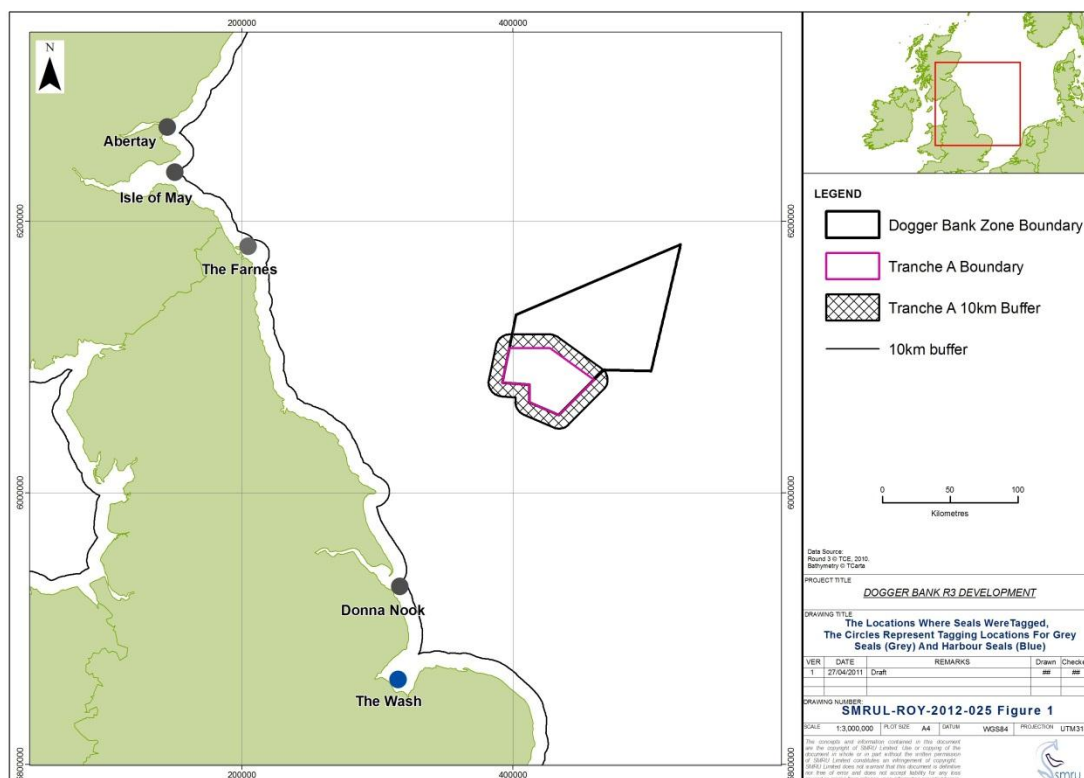

Figure 1. The locations where seals were tagged, by species (grey circle = grey seals, blue circle = harbour seals). The Dogger Bank Tranche A boundary plus 10km buffer is also shown as well as the 10 km buffer used to define at-sea locations.

At-sea locations

For all tagged animals which had locations within the Dogger Bank Tranche A plus buffer polygon, the percentage of at-sea locations within were calculated. To do this, locations had to be defined as on-land (hauled-out) or at-sea. Two datasets were used to define locations: activity data and a land mask.

Activity data

The tags record haul-out events. A haul-out event is recorded when the tag, which is located on the back of the neck, has been dry for 10 minutes. Not all haul-out events are transmitted, but the data transmitted allowed an activity status to be attributed to all locations: hauled-out, not hauled-out or unknown.

It should be noted that tags can record haul-outs associated with at-sea locations. This can occur if an animal's head is above the surface of the water for a prolonged period of time. Thus the activity status of locations cannot be used, alone, to attribute locations to on-land or at-sea. In addition, for some tags there is no haul-out data available.

Land mask

A land mask can be used to define locations as being on-land/at-sea. However, this mask must have a buffer associated with it, for three reasons. First, despite filtering there will be some error in the tag locations and thus using a land mask without a buffer may result in locations being wrongly defined. Second, despite the use of a high resolution map, some details including small islets would not be on such maps and thus not defined as land. Third, animals typically haul-out at low tide, on tidal rocks and sand banks, which would not be defined as land on maps. The third reason is particularly apparent when using data from the Wash. This area is very tidal, with some sandbanks up to 8 km off the coast being used as haul-outs at low tide. Thus a buffer was generated which included the Wash as land. For the rest of the coast, a buffer which extended 10 km from land was generated. The extent of the buffer was decided based on the frequency of known haul-out locations (from the activity data) which were near land and thus likely to be on land.

Definition

Using an activity and land mask, two scenarios were defined to generate the number of at-sea locations. The locations within the proposed wind farm development area plus buffer were then calculated as a percentage of these totals, incorporating uncertainty in the status

of locations. This resulted in minimum and maximum percentages of locations which were within the site.

Minimum percentage overlap (maximum number of at-sea locations)

This was based on the largest number of potential at-sea locations. Locations were defined as at-sea if they were

> 1) Outside the 10 km land buffer irrespective of activity status

> 2) Within the 10 km land buffer with a status of not hauled-out or unknown.

In other words, only locations within the buffer, which had an activity status of hauled-out, were defined as on-land locations.

For tags which had no activity data the minimum percentage calculated in this way is unrealistic as this would result in all locations being defined as at-sea – some unknown proportion of locations would be hauled out in reality.

Maximum percentage overlap (minimum number of at-sea locations)

This was based on the smallest number of potential at-sea locations. Locations were defined as at-sea if they were

> 1) Outside the 10 km land buffer irrespective of activity status

> 2) Within the 10 km land buffer with a status of not hauled-out.

In other words, locations within the buffer which had an activity status of hauled-out or unknown were defined as on-land locations.

It should also be noted that these estimates of overlap are of at-sea locations rather than time at-sea. Although there is likely to be a good relationship between the time an animal spends in an area and the number of location fixes, there are a number of other factors which can affect the rate at which location fixes are obtained and these are not controlled for here. As such there may be unquantifiable biases in these metrics.

3. Results

3.1. Grey seals

Pups

A total of nine pups have been tagged (Argos) on the Farne Islands in 1993 (n = 5) and 1994 (n = 4). One of these animals, tagged in 1993, entered the area defined by the Dogger Bank Tranche A boundary buffer (Figure 2).

A total of 22 pups have been tagged (Argos) at the Isle of May in 2001 (n=9) and 2002 (n=12). One of these animals, tagged in 2001, entered the Dogger Bank Tranche A boundary buffer (Figure 2).

Adults

Farnes

There have been 29 Argos tags deployed on grey seals aged one year and over on the Farne islands. These animals were tagged in 1991 (n = 6), 1992 (n = 7), 1997 (n = 2), 2000 (n = 4) and 2008 (n = 10). The tags had a median duration of 106 days (range: 2 - 214).

Four animals (13%), one tagged in 1993 and three in 2008 entered the Dogger Bank site; (Figure 3).

Donna Nook

There have been 12 grey seals, aged one and over, tagged at Donna Nook. Most of these animals (n = 10) were tagged in 2005 with the remainder tagged in 1988 (n = 1) and 1989 (n = 1). These animals had a median tag duration of 153 days (range: 12 - 257 days).

Two of these animals (17%) entered the Dogger Bank Tranche A boundary buffer, as defined by the presence of locations or tracks within the area.

Abertay

There have been 38 grey seals, aged one and over, tagged at Abertay (24 Argos tags and 14 GPS phone tags). Argos tagged animals were tagged in 1993 (n=2), 1997 (n=8), 1998 (n=10) and 2003 (n=4). GPS phone tagged animals were tagged in 2005 (n=4) and 2008 (n=10). These animals had a median tag duration of 147 days (range: 2 - 250 days).

Five of these 38 animals (13%) entered the Dogger Bank site, as defined by the presence of locations or interpolated tracks between locations within the area.

Isle of May

11 adult grey seals have been tagged at the Isle of May SAC (grey seal breeding site), none of these entered the Dogger Bank Tranche A boundary plus buffer. However, 2 of the tagged seals that entered the Dogger Bank plus buffer polygon also had locations within 5km of the Isle of May. For context, a total of 33 out of 188 tagged grey seals had locations within 5km of the IOM. These 33 seals had been tagged at Abertay (15), The Isle of May (11), the Farnes (7) and Donna Nook (1).

(a)
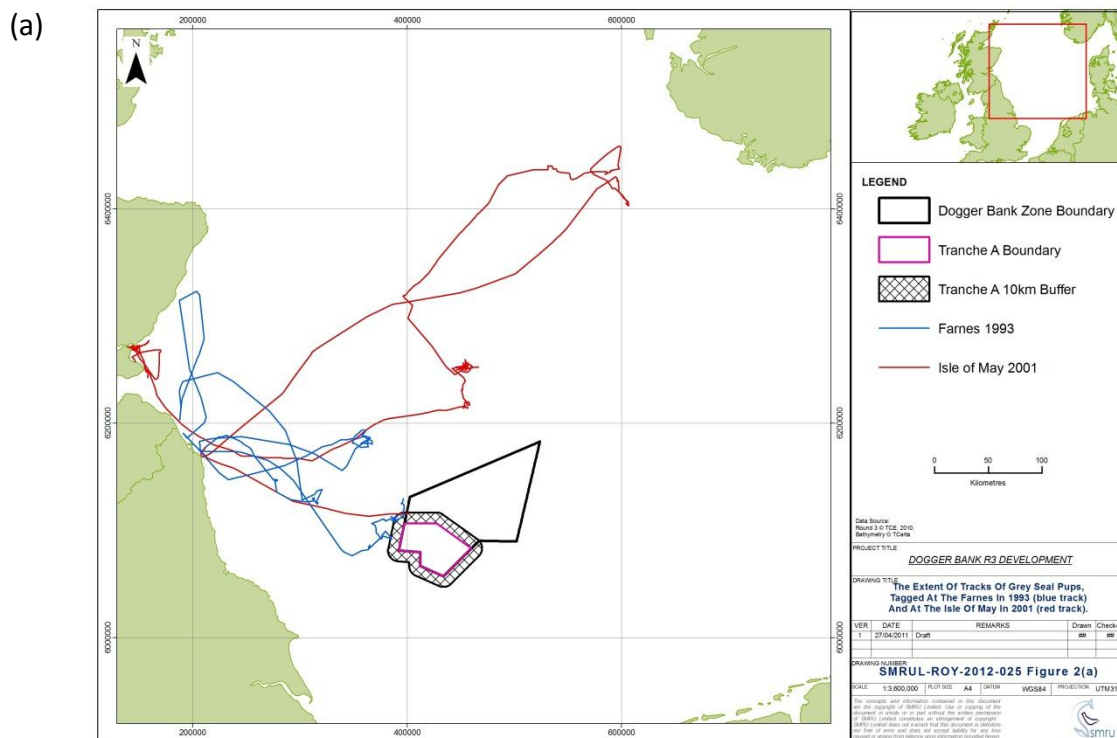
(b)
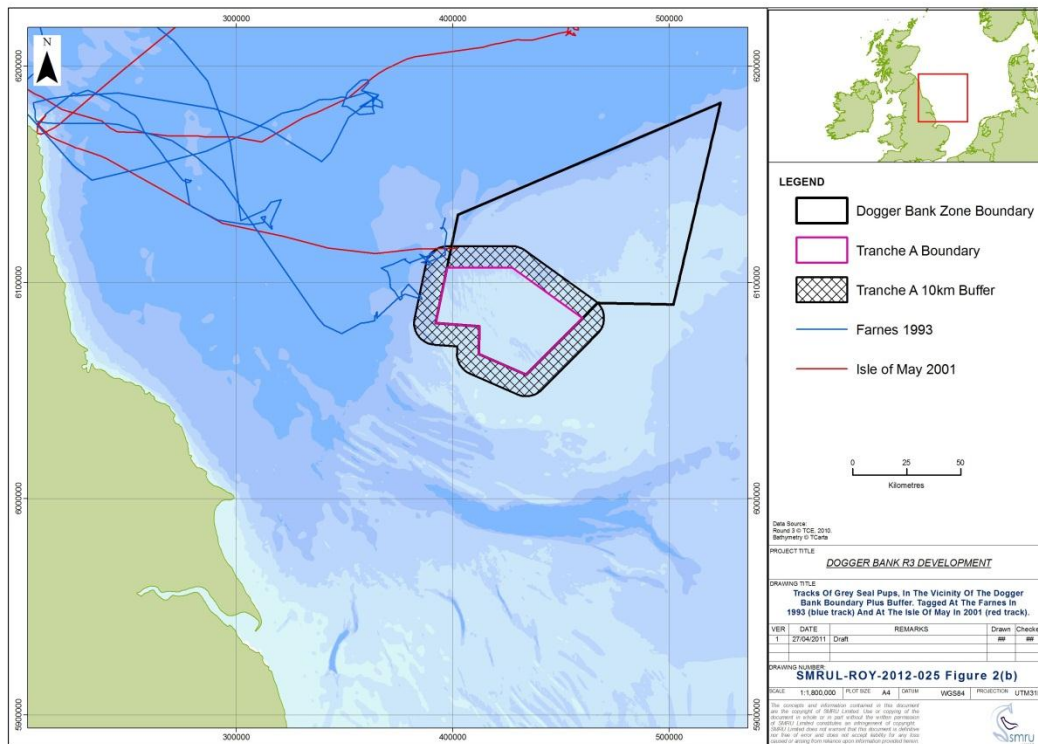
Figure 2. The tracks of grey seal pups, tagged at the Farnes in 1993 (blue track) and at the Isle of May 2001 (red track) which entered the Dogger Bank Tranche A boundary buffer. The figures show (a) the extent of tracks, and (b) tracks in the vicinity of the Dogger Bank Tranche A boundary buffer.

(a)
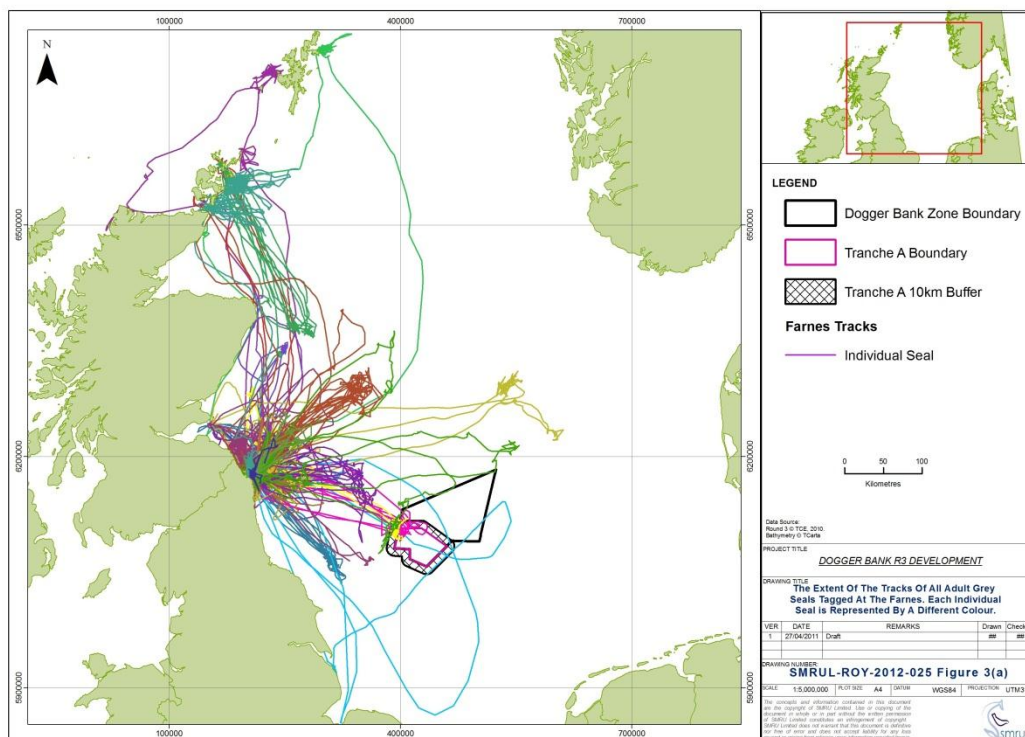
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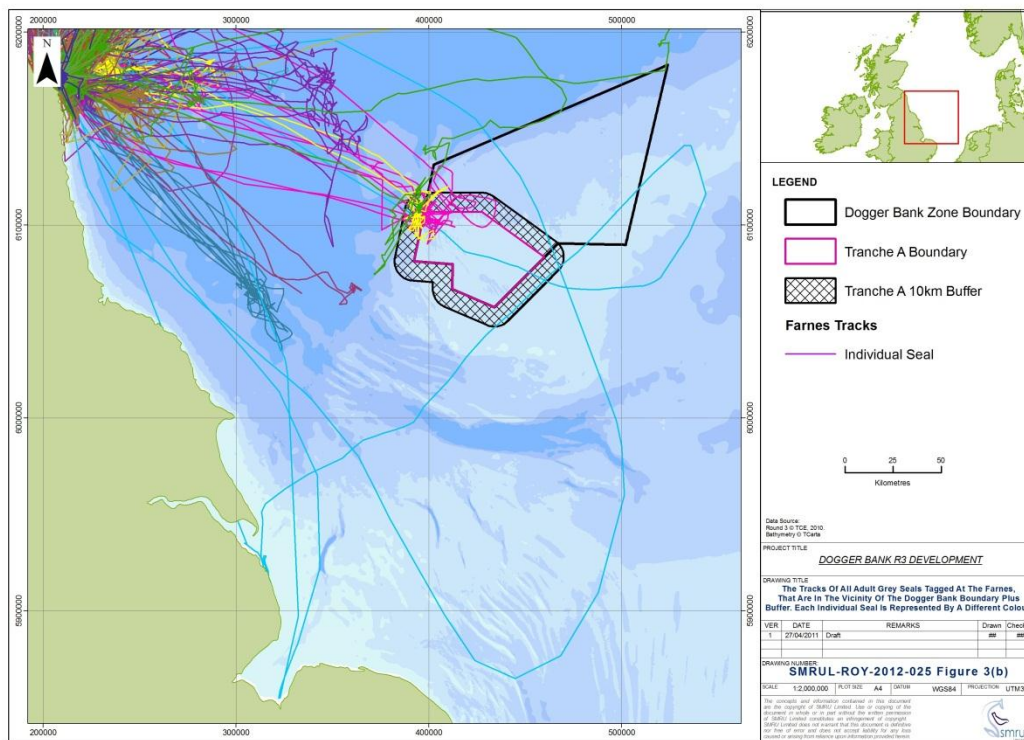
Figure 3. Tracks of all grey seals tagged at the Farnes. Each seal is represented by a different colour. The figures show (a) the extent of tracks, and (b) tracks in the vicinity of the Dogger Bank Tranche A boundary buffer.
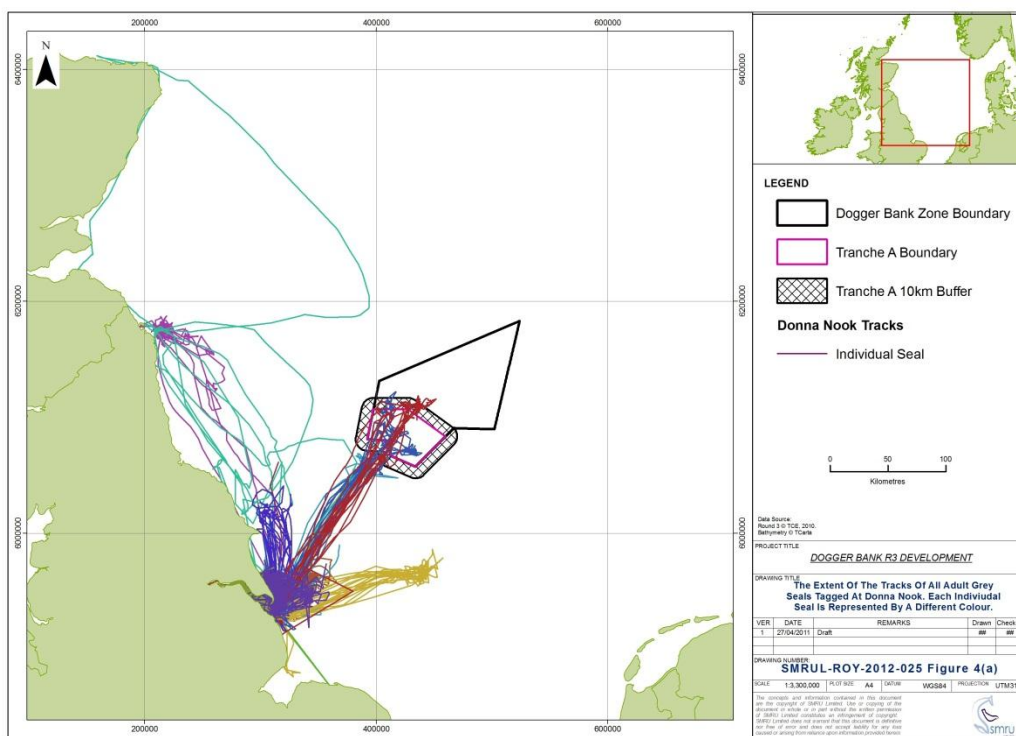
(b)
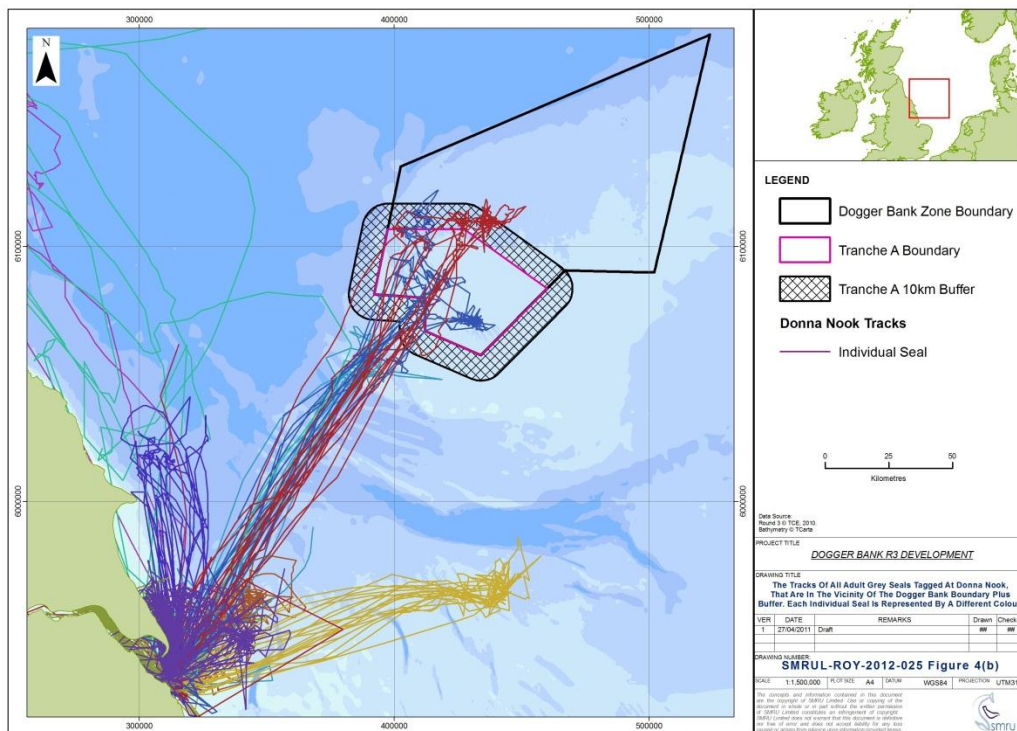
Figure 4. Tracks of all grey seals tagged at Donna Nook. Each seal is represented by a different colour. The figures show (a) the extent of tracks, and (b) tracks in the vicinity of the Dogger Bank Tranche A boundary buffer.

(a)
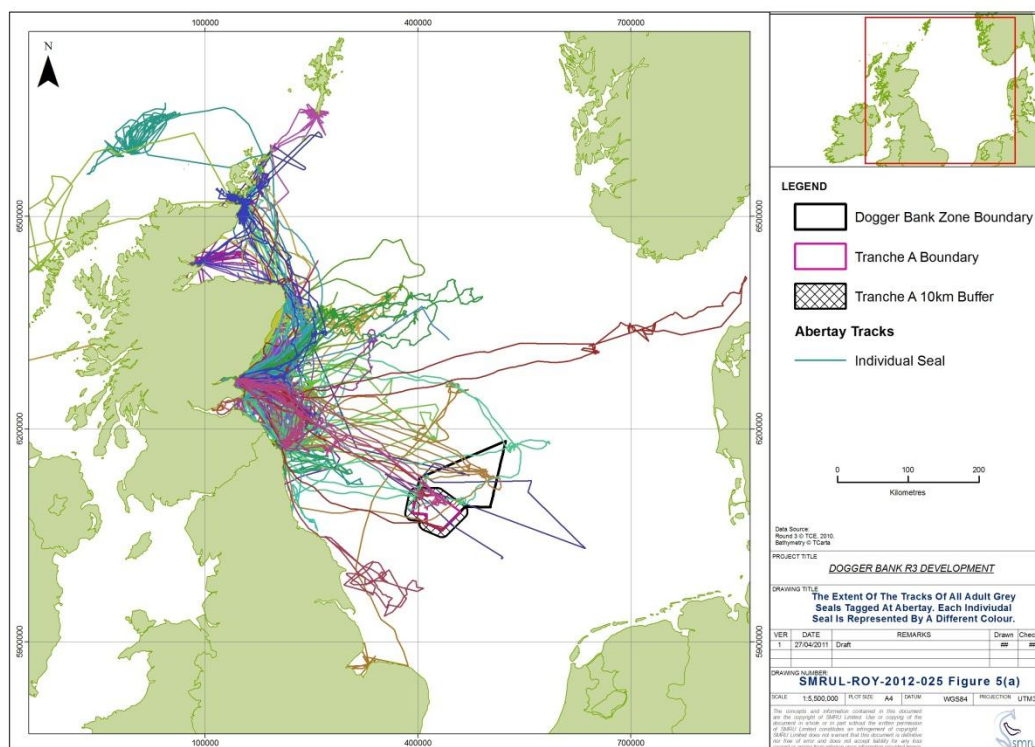
(b)
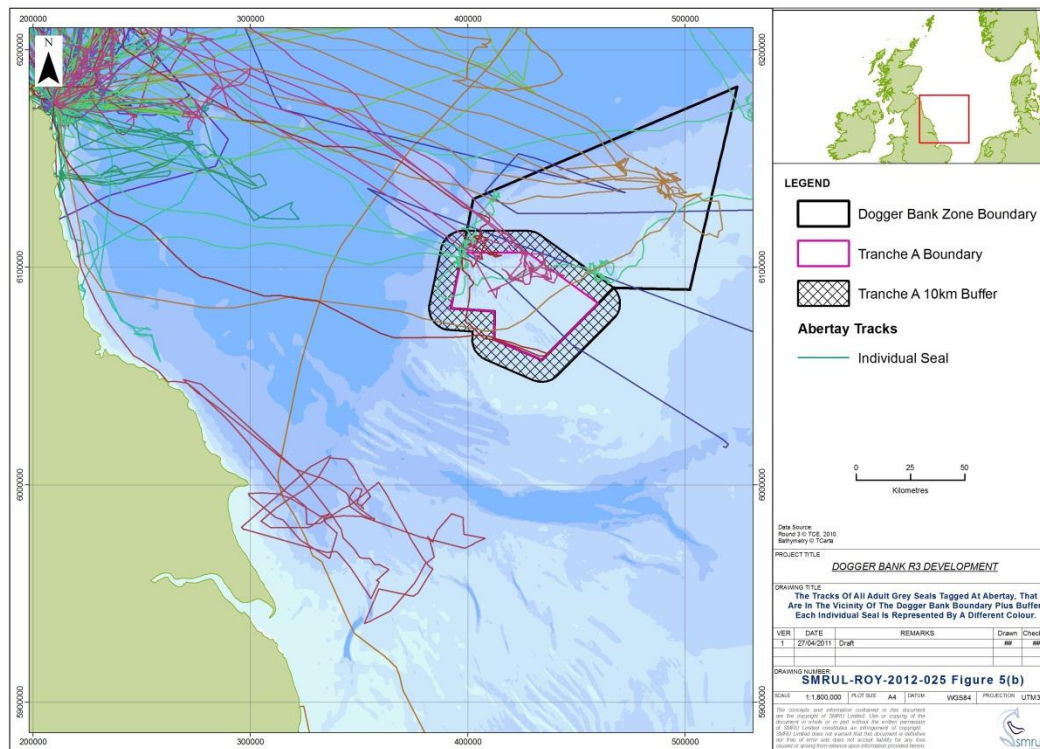
Figure 5. Tracks of all grey seals tagged at Abertay. Each seal is represented by a different colour. The figures show (a) the extent of tracks, and (b) tracks in the vicinity of the Dogger Bank Tranche A boundary buffer.

Grey seals: at-sea locations

Thirteen animals; two pups (one from the Farnes and one from the Isle of May) and 11 seals aged 1+ (four from the Farnes, two from Donna Nook and five from the Abertay region, had locations within the Dogger Bank Tranche A boundary 10km buffer (Table 1 and Table 2).

Pups

For the two pups whose tracks overlapped, the extent of overlap was relatively low, approximately 5% of locations for the pup tagged at the Farnes and <1% of locations for the pup tagged at the Isle of May were within the Dogger Bank Tranche A boundary 10km buffer (Table 1).

Farnes

For the four seals aged 1+ tagged at the Farnes, the percentage locations within the Dogger Bank Tranche A boundary buffer ranged from 2 to 37% (Table 2). The average across all seals was 13% or 14% depending on how at-sea locations were defined.

Donna Nook

For the two seals aged 1+ tagged at Donna Nook which entered the area, the average percentage overlap was 53 or 55% depending on how at sea locations were defined (Table 2).

Abertay

For the seals aged 1+ tagged at Abertay, the degree of overlap was lower, ranging from 1-30% across the five individual seals (Table 2).

The average across the five seals was approximately 10% regardless of how at-sea locations were defined.

It should be noted that these percentages are of at-sea locations rather than time at-sea. Locations are transmitted at irregular intervals, with between 1 to 21 locations transmitted per day for these animals. The median number of location fixes per day, for these tags, was between 5 and 12.

Isle of May – Adults

For the seals which had both locations within 5km of The Isle of May, and within the Dogger Bank Tranche A boundary plus buffer, the degree of overlap with the Isle of May was low – the seal that had 12% of it's at-sea locations in the Dogger site (ref 8 in Table 2), had only 0.2% of locations within 5km of the Isle of May. The seal that had 5% of at-sea locations in the Dogger site (ref 10 in Table 2) had 2.5% of locations within 5km of the Isle of May.

Table 1. This table includes tagged grey seal pups which had locations within the Dogger Bank Tranche A boundary 10km buffer. The tagging location, number of locations within the polygon, and the total number of location fixes are shown. The maximum and minimum numbers of at-sea locations are shown along with the resulting minimum and maximum percentage of at-sea locations which were within the polygon.

reference	tagging location	number of locations				percentage of at-sea locations within polygon (%)	
		Within polygon	total	minimum at-sea	maximum at-sea	minimum	maximum
1	Farnes	10	207	192	207	4.8	5.2
2	Isle of May	2	553	471	547	0.4	0.4

Table 2. This table includes tagged grey seals aged 1+ which had locations within the Dogger Bank Tranche A boundary 10km buffer. The tagging location, number of locations within the polygon, and total number of location fixes are shown. The maximum and minimum numbers of at-sea locations are shown along with the resulting minimum and maximum percentage of at-sea locations which were within the polygon. Mean values per region are also given. The seals in italics are those which also had locations within 5km of the Isle of May and the figure in brackets is the percentage of all locations that these represent.

| ref	tagging location	number of locations				percentage of at-sea locations within Polygon (%)	
		Within polygon	total	min at-sea	max at-sea	Min	Max
1	Farnes	14	854	291	794	1.8	4.8
2	Farnes	522	1634	1408	1438	36.3	37.1
3	Farnes	135	1539	1350	1370	9.8	10.0
4	Farnes	72	1566	1418	1444	5.0	5.1
	Farnes Mean					**13.2**	**14.2**
5	Donna Nook	583	1079	909	939	62.1	64.1
6	Donna Nook	445	1141	942	977	45.5	47.2
	Donna Nook Mean					**53.8**	**55.7**
7	Abertay	4	683	273	683	0.6	1.5
8	*Abertay (0.2%)*	*289*	*2607*	*2252*	*2350*	*12.3*	*12.8*
9	Abertay	17	1036	860	864	2.0	2
10	*Abertay (2.5%)*	*82*	*1820*	*1663*	*1678*	*4.9*	*4.9*
11	Abertay	155	636	523	555	27.9	29.6
	Abertay Mean					**9.5**	**10.2**

3.2. Harbour Seals

The Wash

There were 24 harbour seals, aged one year and above, tagged (Argos) in the Wash between 2003 and 2005. These animals had a median tag duration of 137 days (range: 77 – 226). There were locations or tracks recorded inside the Dogger Bank Tranche A boundary 10km buffer for one (4%) of these 24 seals (Figure 6).

Of the single seal that overlapped with the polygon, between 20% and 35% of at sea locations were within the windfarm depending how at sea locations were defined (Table 3).

There has been a more recent deployment of tags on harbour seals in the Wash – in January 2012 25 seals aged 1+ were tagged with GPS phone tags by the Sea Mammal Research Unit as part of a DECC funded study into the impact of pile driving on seal behaviour. These data are currently being analysed by the Sea Mammal Research Unit but were not available at for inclusion in this report.
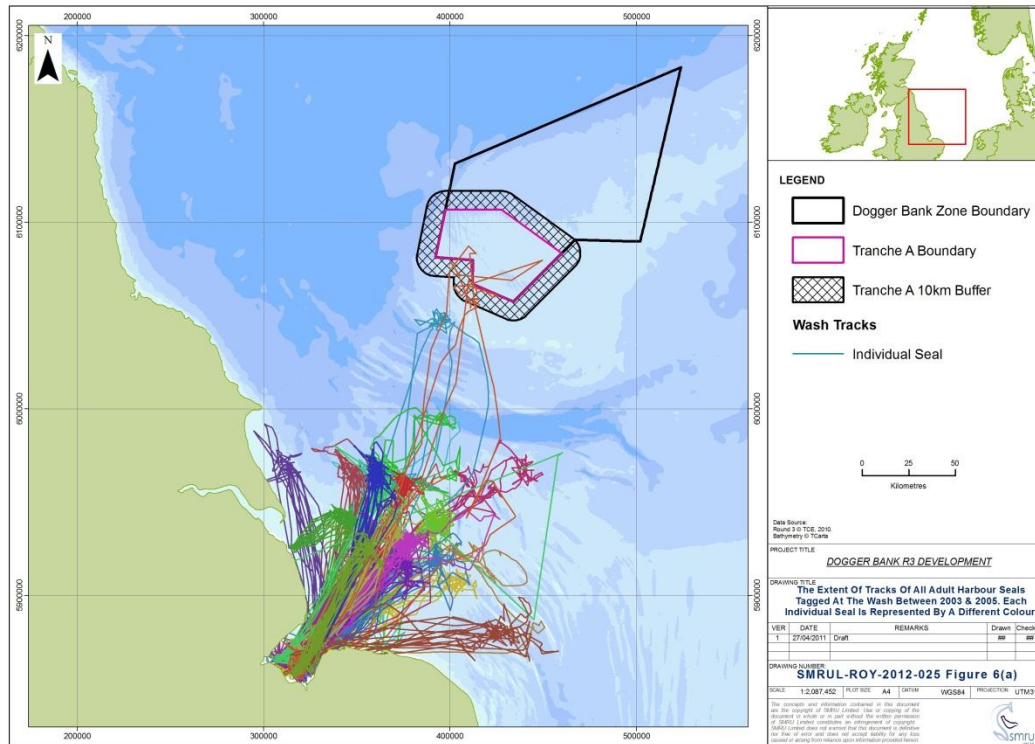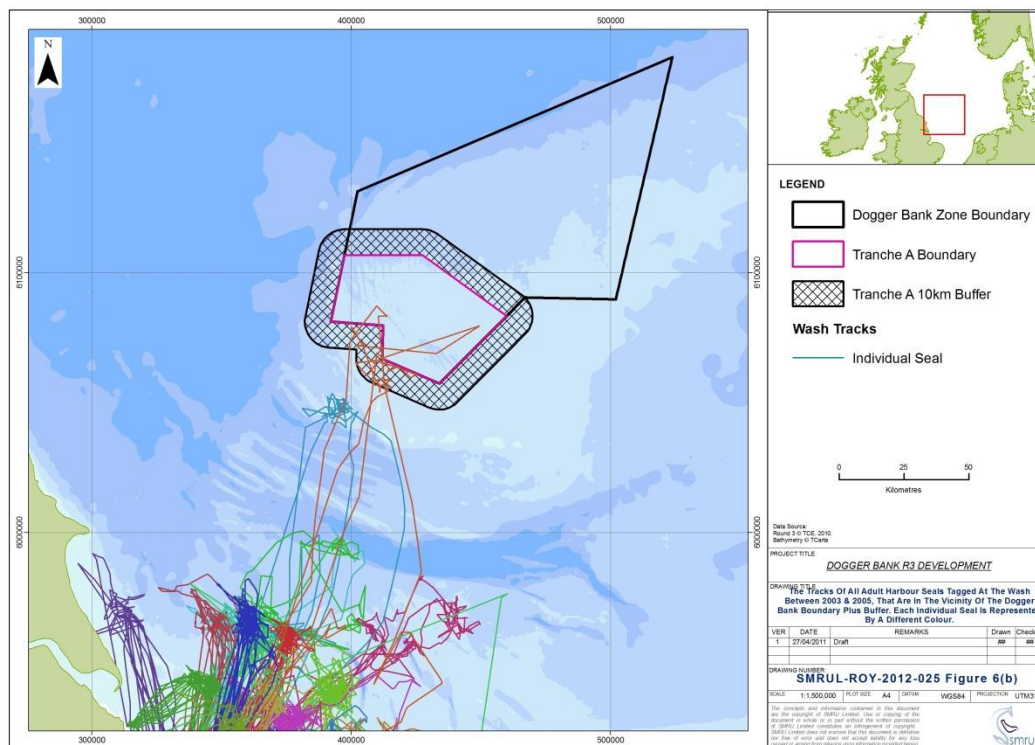
Figure 6. Tracks of all harbour seals tagged at the Wash. Each seal is represented by a different colour. The figures show (a) the extent of tracks, and (b) tracks in the vicinity of the Dogger Bank Tranche A boundary buffer.

Table 3. This table includes tagged harbour seals aged 1+ which had locations within the polygon. The tagging location, number of locations within the polygon (Dogger Bank Creyke Beck site boundary plus 10km buffer), and total number of location fixes are shown. The maximum and minimum numbers of at-sea locations are shown along with the resulting minimum and maximum percentage of at-sea locations within the polygon.

reference	tagging location	number of locations				percentage of at-sea locations within Polygon (%)	
		Within polygon	total	minimum at-sea	maximum at-sea	minimum	maximum
1	The Wash	59	388	220	168	20.1	35.1

4. Software

All data filtering and analyses were carried out using the statistical software R (R Development Core Team, 2008). A number of packages were used within R and are listed below. The maps were generated using ArcGIS 9.3.

5. Projection

All figures are in the projection Universal Transverse Mercator (UTM) - zone 31 North. Datum WGS 1984.

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