Thanet Offshore Wind Farm

Ornithological Monitoring 2010-2011

Thanet Offshore Wind Limited

March 2012

Final Report

9W4696

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Rightwell House
Bretton
Peterborough PE3 8DW
United Kingdom
+44 (0)1733 334455 Telephone
01733 333348 Fax
info@peterborough.royalhaskoning.com E-mail
www.royalhaskoning.com Internet

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CONTENTS

1 INTRODUCTION

This report presents the results of the first winter of bird surveys that have been undertaken for the post-construction phase monitoring as part of the Thanet Offshore Wind Farm FEPA monitoring programme. The surveys reported here cover the monitoring work carried out between October 2010 and March 2011.

The main aim of the FEPA monitoring program is to determine the distribution and abundance of seabirds using the Thanet Offshore Wind Farm site and its surrounds before, during and post the construction phase of the wind farm. Standard survey methodologies have been used, following Camphuysen et al. (2004) and have remained consistent throughout the pre, during and post-construction monitoring.

The Thanet Offshore Wind Farm (Thanet) project is located in the Thames Estuary Strategic Environmental Assessment (SEA) area, approximately 11km off Foreness Point, within the Outer Thames Estuary. The Thanet project received consent in December 2006, with the most recent FEPA license being dated July 2010 (33119/10/1).

The Thanet project consists of 100 Vestas V90 3MW wind turbines located in water depths of 15-25m below chart datum, and extends over an area of 35km^2. Each turbine is 115m tall at its highest point, with a minimum clearance above sea level of 22m. The turbine separation is approximately 500m along rows and 800m between rows.

Construction at the site was initiated on 20th March 2009 and installation of the turbines, offshore substation, and cables was completed in September 2010. The turbines have been installed using monopile foundations, which vary in diameter from 4.1m to 4.9m and which are driven up to 40m into the seabed. Certain construction activities have continued since September 2010. These activities were associated with the export and interarray cable protection, a cable joint replacement and export cable repairs.

Activity	Start Date	End Date
• Export Cable Protection on midline joints and cable crossings	14 June 2011	9 September 2011
• Replacement of Export Cable Joint	7 October 2011	5 November 2011
• Inter-array Cable Protection	27 February 2012	Expected to be complete April 2012
• Replacement of Export Cable	1 December 2011	Expected to be completed by April 2012

The activities listed above were not undertaken during the period for which this report was prepared. The replacement of the export cable joint was close to the intertidal zone in Pegwell Bay but not situated in the post construction monitoring area. In addition, although vessels are associated with these activities and occur within the field, the impact to the bird species using the site is not expected to be significant. In addition, the majority of the work is associated with the cables on the seabed.

The FEPA Licence conditions relevant to ornithological monitoring are summarised in Section 4 of the Environmental Monitoring Plan for Thanet (Royal Haskoning 2011) and reported in the construction phase annual report (Royal Haskoning 2010). A number of conditions were imposed as part of the consents for the Thanet project, one of which relates to continued ornithological monitoring of the site, with the project’s FEPA Licence (33119/10/1) stating:

“9.11 Ornithological monitoring must be carried out as outlined in Annex 2 attached to this Schedule. The full specification for the monitoring programme will be subject to separate written agreement with the Licensing Authority following consultation with Natural England prior to the proposed commencement of the monitoring work; and

9.12 Post-construction monitoring during the operational phase of the wind farm must be undertaken annually for three years. The level of any subsequent ornithological monitoring, during the lifetime of the wind farm's operation, will be determined, in consultation with Natural England, having regard to the magnitude of any change in bird populations observed during the initial monitoring period.”

Further to this, Annex 2 of the FEPA Licence 33119/10/1 states that:

“Monitoring will comprise a Before and After Control Impact (BACI) design and will be undertaken at the survey areas consisting of the windfarm site, a 1km and 2–4km buffer zone surrounding the windfarm and the selected reference site. The monitoring programme will be implemented in advance of construction and continue through the construction phase. There is also a requirement to conduct post-construction monitoring to provide a minimum of three years data from the operating phase. These data will need to be empirically comparative with baseline data provided within the project's Environmental Statement. The detailed specification for the monitoring programme, including the location and extent of the reference site, will be subject to separate written agreement with the Licensing Authority following consultation with Natural England prior to the proposed commencement of the monitoring work (see licence condition 9.11).

The need for additional ornithological monitoring, on-going during the lifetime of the wind farm's operation, will be determined, in consultation with Natural England and DEFRA and reviewed at agreed periods. This will have regard to the magnitude of any change in bird populations observed during the initial three years operational monitoring period (as per licence condition 9.12). The ornithological monitoring programme may have to be adapted and amended as new technologies and research findings become available, as determined by Natural England and the Licensing Authority. Ornithological monitoring reports will be provided to Natural England on a quarterly basis as a draft report update and as a final annual report. This may be more frequent where the results of the data may trigger further, more intensive monitoring work. Monitoring of the agreed reference site will also continue parallel to the wind farm site and the 1km and 2 – 4km buffer zones surrounding the wind farm. Monitoring will need to fulfil the following objectives:

1. Determine whether there is change in bird use and passage, measured by species (with particular reference to red-throated diver), abundance and behaviour, of the wind farm site, 1km and 2 – 4km buffer zones and the reference site;

2. Determine whether there is a barrier effect to movement of birds through the wind farm site and the 1km and 2–4km buffer zones;

3. Continue to determine the distribution of wildfowl and divers in the Greater Thames estuary, covering the Thanet windfarm site, 1km and 2–4km buffer zones and the reference site; and

4. If objectives 1 or 2 reveal significant change of use of the wind farm site and 1km and 2–4km buffer zones by populations of conservation concern, at heights that could incur collision, a programme of collision monitoring will be implemented."

2 PREVIOUS SURVEYS

A programme of baseline bird surveys was undertaken for the ornithological impact assessment of the project that was reported in the Environmental Statement for the Thanet application (Royal Haskoning 2005). Surveys were then conducted during the construction phase of the project in February - March 2009 and October 2009 - March 2010, and were reported by Royal Haskoning (2009, 2010). The data available for comparison with the post-construction monitoring data therefore comprise:

Pre-construction:

- Boat-based surveys – twelve boat-based surveys were carried out at monthly intervals between November 2004 and October 2005; and
- Aerial surveys – four aerial surveys were carried out between November 2004 and March 2005.

Construction phase surveys:

- Boat-based surveys – one in February and two in March 2009; and
- Boat-based surveys – two per month from October 2009 – March 2010.

This report presents the ornithological data collected during the first winter of the post-construction monitoring during the phase completed over the period October 2010 to March 2011.

3 STUDY AREA

The pre-construction boat surveys reported in the ES covered a smaller area (100km^2) than that being surveyed in the construction and post-construction periods, comprising the wind farm site plus a 1km buffer (67km^2) and a control area to the south (33km^2). The transects used for those surveys are shown in Figure 1.

The survey area was expanded in 2009 to a total area of 149km^2, to include the wind farm site plus a 2km buffer (111km^2) and a separate control area of 38km^2 to the south (see Figure 1), as agreed with DEFRA[1].

[1] Gary James, DEFRA, email of 13/3/09.

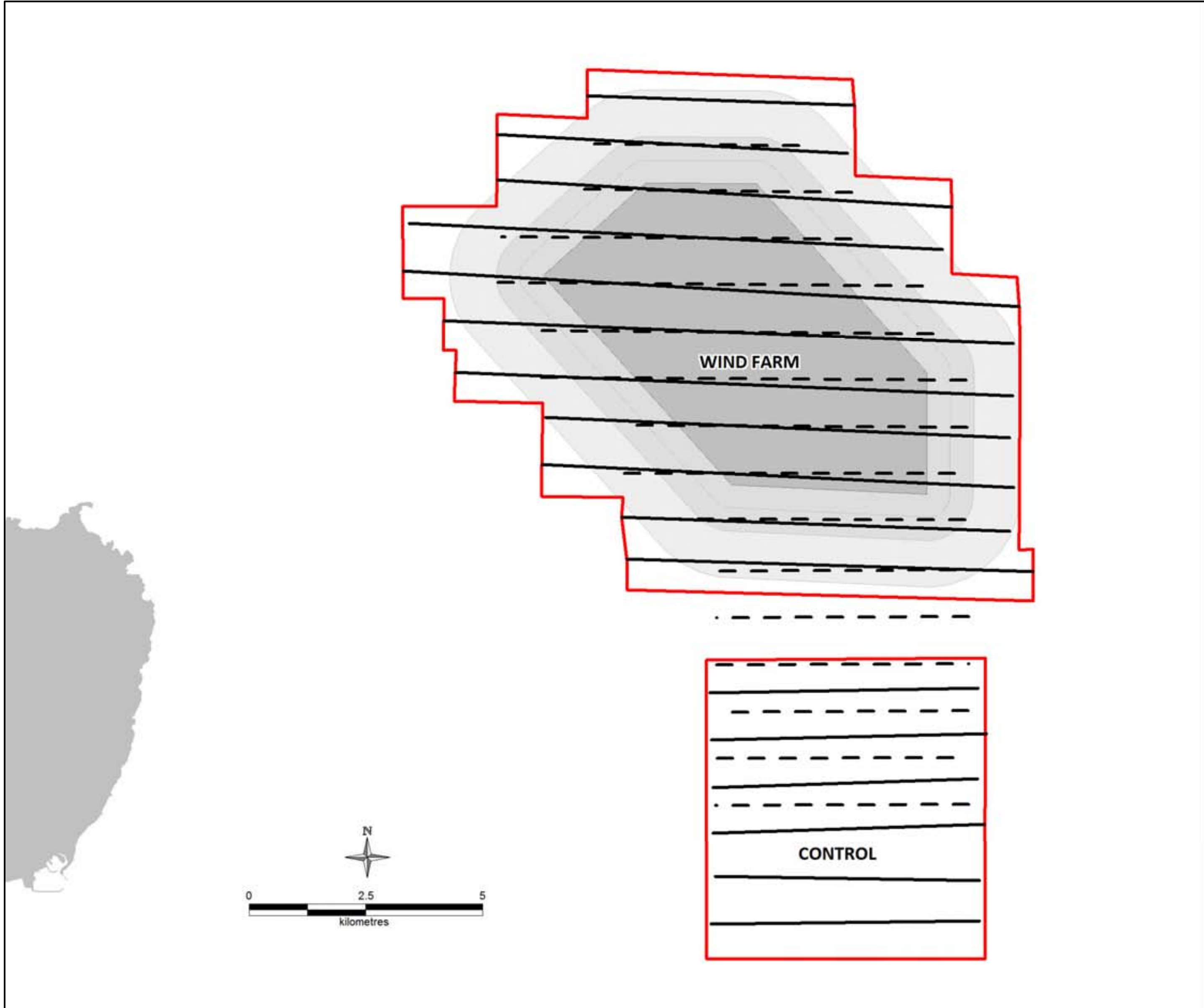

Figure 1. Thanet offshore wind farm boat survey area and transects, 2010-11 and ES survey transects

KEY:

- Wind farm site
- 0-0.5km buffer
- 0.5-1km buffer
- 1-2km buffer
- Survey area
- Boat survey transects
- ES boat survey transects

ECOLOGY CONSULTING

4 SURVEY METHODS

The survey methods follow those detailed in the Thanet Offshore Wind Farm – During and Post-Construction Bird Monitoring Protocol (‘the Protocol’) (Thanet Offshore Wind Limited (TOW), 2009). The Protocol was developed in consultation with Natural England and the Marine and Fisheries Agency (MFA) (now the Marine Management Organisation (MMO)) in order to meet the requirements of the Thanet FEPA licence. Further details of the survey methodology are provided in the Protocol.

The surveys comprise boat-based line transects of the study area, broadly following the methodology recommended in Camphuysen et al., (2004). The surveys in the first year of the post-construction phase were carried out using the same protocol as for the construction phase works, twice-monthly during the October – March period. Monitoring surveys will continue for a further two years during the project’s operation, continuing the pattern of two surveys per month between October and March, unless the results indicate the need for the Protocol to be adapted.

The same vessel was used for these surveys as for the pre-construction and the construction phase surveys, the ‘Arie Dirk’. This vessel cruises the transects at about 8 knots and has a viewing height of about 5m above the level of the sea. It is ideal for the work being of a size and a manoeuvrability (with an experienced local crew) to enable safe operation close inshore and around busy shipping channels.

The same survey transects were used as for the pre-construction baseline surveys and construction phase surveys (Figure 1). The survey route was designed to provide approximately a 1km interval between transects; a total of 17 transects were surveyed, all running approximately east-west. This separation distance was chosen to ensure that an adequate sample of the study area was covered for all species, whilst minimising the likelihood that birds may be displaced from one transect to the adjacent one (and hence double-counted).

A GPS record of the precise route was taken on each trip, so that the location at all times was known. A total of 12 surveys were undertaken during the 2010 -2011 winter on the following dates:

- 6 and 7 October 2010
- 31 October 2010
- 19 and 20 November 2010
- 28 November 2010
- 6 and 7 December 2010
- 12 and 13 December 2011
- 9 and 10 January 2011
- 9 and 10 February 2011

- 17 and 18 February 2011
- 22 and 23 February 2011
- 12 and 13 March 2011
- 18 and 19 March 2011

The observation team in 2010 -2011 comprised Jon Ford, Ian Harding and Peter Dodds, who were each involved in both observation and recording. Three surveyors were deployed at all times in order to allow rotation of duties and to enable one surveyor to be free to undertake continual forward scanning for the detection of species that may be flushed from the sea surface. The team are experienced ornithologists, well able to identify all the species encountered accurately. All observers also have a good knowledge of the area and its ornithological interests, and are also trained Marine Mammal Observers.

All birds encountered, their behaviour, flight height and approximate distance from the boat were recorded. Following the JNCC Seabirds at Sea recommendations, birds were recorded into five distance bands (0-50m, 50-100m, 100-200m, 200-300m and 300+m). Birds were recorded continuously, at a steady speed of approximately 8 knots, with the precise time of each observation recorded where possible to give as accurate a position as possible (linking to the GPS position information being recorded simultaneously). All records of birds observed flying as well as those on the sea were recorded. All sightings of marine mammals were also recorded during the surveys.

The approximate height above the sea of all flying birds was recorded. Flying birds were recorded using snapshot counts at one-minute intervals. Whilst all birds observed were recorded, a note of those "in transect" was made to facilitate later analysis. The flight height categories were as follows:

- <20m
- 20-120m
- >120m

5 SURVEY RESULTS

5.1 Study Area Population Estimates

The total population estimates within the study area for each survey, based on counts from the main survey transect sampling area (within 300m of the survey vessel) corrected for distance sampling and survey coverage, are shown in Table 1.

Table 1. Survey Area total population estimates corrected for distance sampling and survey coverage.

Species	6 and 7 Oct 2010	31 Oct and 1 Nov 2010	19 and 20 Nov 2010	28 Nov 2010	6 and 7 Dec 2010	12 and 13 Dec 2011	9 and 10 Jan 2011	9 and 10 Feb 2011	17 and 18 Feb 2011	22 and 23 Feb 2011	12 and 13 Mar 2011	18 and 19 Mar 2011
Brent goose	0	0	0	0	0	0	0	183	0	47	0	0
Shelduck	0	0	0	0	0	0	0	0	0	0	13	0
Wigeon	0	0	0	17	0	0	0	0	0	0	0	0
Teal	0	0	0	2	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	5	0
Common scoter	0	0	0	0	0	0	0	0	0	0	3	8
Red-breasted merganser	0	0	0	5	0	0	0	0	0	0	0	0
Red-throated diver	0	0	3	5	12	12	102	63	3	3	44	51
Black-throated diver	2	0	2	8	2	7	7	2	8	0	8	26
diver sp	0	2	8	30	2	7	22	2	0	0	9	28
Great crested grebe	0	0	2	0	4	0	0	0	0	2	0	2
Fulmar	0	0	0	2	3	5	13	12	8	17	13	20
Gannet	130	152	62	16	5	8	17	58	63	67	43	34
Cormorant	0	0	0	0	0	0	0	0	0	0	10	7
Lapwing	0	0	0	0	0	0	0	0	0	2	0	0
Curlew	0	0	0	0	0	0	0	2	0	0	0	0
Great Skua	10	7	0	0	0	2	0	0	0	0	0	0
skua sp	0	2	0	0	0	2	0	0	0	0	2	0
Common gull	0	111	72	58	93	143	315	93	74	110	98	143
Lesser black-backed gull	339	289	62	44	55	55	41	37	78	61	193	72
Herring gull	96	274	142	107	197	135	183	231	238	299	543	375
Great black-backed gull	2,417	178	70	24	27	58	68	45	62	40	64	54
black-backed gull sp	0	0	0	0	0	0	0	0	0	0	15	0

Species	6 and 7 Oct 2010	31 Oct and 1 Nov 2010	19 and 20 Nov 2010	28 Nov 2010	6 and 7 Dec 2010	12 and 13 Dec 2011	9 and 10 Jan 2011	9 and 10 Feb 2011	17 and 18 Feb 2011	22 and 23 Feb 2011	12 and 13 Mar 2011	18 and 19 Mar 2011
gull sp	0	0	0	0	0	13	0	0	0	0	7	0
large gull sp	56	153	60	95	40	95	92	8	224	90	557	125
Little gull	28	0	2	0	0	0	0	0	0	0	0	0
small gull sp	0	0	0	0	0	0	135	0	2	12	0	0
Black-headed gull	0	27	0	5	0	3	2	5	0	2	5	22
Kittiwake	2	84	246	123	38	7	570	318	192	337	21	20
Sandwich tern	5	0	0	0	0	0	0	0	0	0	0	0
Common tern	2	0	0	0	0	0	0	0	0	0	0	0
Guillemot	2	37	118	52	33	515	399	200	115	642	70	53
Razorbill	0	5	0	0	3	28	113	29	25	45	11	3
auk sp	0	4	34	20	0	475	378	117	106	489	45	0
Skylark	0	8	0	0	0	0	0	0	0	0	0	0
Meadow pipit	0	0	0	0	0	0	0	0	0	0	2	0
Robin	0	0	0	0	0	0	0	0	0	0	0	2
Black redstart	0	0	0	0	0	0	0	0	0	0	2	0
Blackbird	0	3	0	0	0	0	0	0	0	2	0	0
Starling	0	948	0	2	0	57	0	0	0	0	22	3
Chaffinch	0	93	0	0	0	0	0	7	0	0	0	2
Goldfinch	0	3	0	0	0	0	0	0	0	0	0	0
pigeon sp	0	2	0	0	0	0	0	0	0	0	0	0
finch sp	20	0	0	0	0	0	0	0	0	0	0	0
medium-sized passerine sp	0	3	0	0	0	0	0	0	0	0	0	0
pas sp	3	0	0	0	0	0	0	0	0	0	0	0
small passerine sp	0	0	0	0	0	0	0	0	0	0	3	30

The distribution of the birds in relation to the wind farm area has been summarised into 1km bands in Table 2. This Table gives the mean and peak counts recorded during 2010 - 2011 within the wind farm site, within a 1km buffer around the site, within the 1-

2km zone and in the control area (6-11km from the nearest wind turbine). These areas cover 35, 27, 33 and 38 km^2 respectively.

Table 2. Mean and peak population estimates for main species zones within and around the wind farm corrected for distance sampling and survey coverage in 2010-11.

	Mean estimate for each zone				Peak estimate for each zone			
Species	**Wind farm site**	**0-1km**	**1-2km**	**Control**	**Wind farm site**	**0-1km**	**1-2km**	**Control**
Red-throated diver	2	5	7	8	7	41	24	27
Black-throated diver	0	2	1	3	0	5	3.3	19
diver sp	1	4	2	2	3	23	5.5	21
Fulmar	0	1	1	5	2	3	5	13
Gannet	2	4	9	34	12	12	31	99
Common gull	40	20	26	17	150	55	71	58
Lesser black-backed gull	14	14	31	42	28	27	200	253
Herring gull	32	28	88	69	56	32	276	167
Great black-backed gull	14	71	24	141	72	716	111	1,508
Black-headed gull	1	1	1	2	3	5	8.3	18
Kittiwake	54	26	27	44	287	52	62	145
large gull sp	15	18	66	29	48	60	487	168
Guillemot	14	38	62	58	79	130	213	175
Razorbill	1	3	3	15	9	7	11	94
auk sp	6	13	26	64	36	76	103	267

The bird numbers recorded in each of these zones in the previous construction phase surveys (2009-10) are given in Table 3a and 3b for comparison (from Royal Haskoning 2010) of the mean and peak counts. Statistical analysis of these differences in bird numbers and a comparison with the pre-construction numbers are given in Section 8 of this report below.

Table 3a. Comparison of mean population estimates for main species zones within and around the wind farm based on 'in-transect' counts corrected for distance sampling and survey coverage in 2009-10 (construction phase) and 2010-11 (post-construction).

	2009-10 mean population estimate				2010-11 mean population estimate			
Species	**Wind farm site**	**0-1km**	**1-2km**	**Control**	**Wind farm site**	**0-1km**	**1-2km**	**Control**
Red-throated Diver	1	1	3	2	2	5	7	8
Gannet	2	4	7	21	2	4	9	34
Common Gull	119	68	56	41	40	20	26	17
Lesser Black-backed	25	13	23	16	14	14	31	42

	2009-10 mean population estimate				2010-11 mean population estimate			
Species	**Wind farm site**	**0-1km**	**1-2km**	**Control**	**Wind farm site**	**0-1km**	**1-2km**	**Control**
Gull								
Herring Gull	19	15	84	27	32	28	88	69
Great Black-blacked Gull	12	4	7	13	14	71	24	141
Kittiwake	29	15	44	10	54	26	27	44
Guillemot	10	20	28	22	14	38	62	58
Razorbill	1	3	6	8	1	3	3	15

Table 3b. Comparison of peak population estimates for main species zones within and around the wind farm based on 'in-transect' counts corrected for distance sampling and survey coverage in 2009-10 (construction phase) and 2010-11 (post-construction).

	2009-10 peak population estimate				2010-11 peak population estimate			
Species	**Wind farm site**	**0-1km**	**1-2km**	**Control**	**Wind farm site**	**0-1km**	**1-2km**	**Control**
Red-throated Diver	6	3	8	10	7	41	24	27
Gannet	22	16	32	95	12	12	31	99
Common Gull	716	430	222	342	150	55	71	58
Lesser Black-backed Gull	132	66	125	43	28	27	200	253
Herring Gull	52	36	663	116	56	32	276	167
Great Black-blacked Gull	56	13	22	53	72	716	111	1,508
Kittiwake	141	43	302	33	287	52	62	145
Guillemot	95	93	99	70	79	130	213	175
Razorbill	6	21	54	61	9	7	11	94

The bird densities recorded in each of these zones in 2010 - 2011 are compared in Table 4. This takes into account the differing extents of these zones (standardising for area by presenting the data as densities). Densities of divers and auks were clearly lower within the wind farm site than elsewhere but were similar across the buffers zones and in the control area, suggesting that the main displacement effect at this time was restricted to the wind farm site itself. Gull densities across these zones were variable, with some species found in highest densities within the wind farm site (common gull, kittiwake) but others (herring gull, lesser black-backed gull and great black-backed gull) found in higher densities further from the wind farm. Statistical analysis of the differences in bird numbers and a comparison with the pre-construction numbers are given in Section 8 of this report below.

Table 4. Mean and peak bird densities for zones within and around the wind farm based on counts corrected for distance sampling and survey coverage in 2010-11.

	Mean density for each zone				Peak density for each zone			
Species	**Wind farm site**	**0-1km**	**1-2km**	**Control**	**Wind farm site**	**0-1km**	**1-2km**	**Control**
Red-throated diver	0.06	0.20	0.20	0.22	0.19	1.50	0.72	0.72
Black-throated diver	0.00	0.06	0.03	0.08	0.00	0.19	0.10	0.50
diver sp	0.02	0.15	0.05	0.06	0.10	0.86	0.17	0.54
Fulmar	0.00	0.03	0.03	0.14	0.05	0.12	0.15	0.35
Gannet	0.05	0.16	0.28	0.89	0.33	0.43	0.93	2.62
Common gull	1.15	0.75	0.80	0.46	4.30	2.04	2.14	1.53
Lesser black-backed gull	0.40	0.53	0.93	1.11	0.81	0.99	6.06	6.67
Herring gull	0.90	1.03	2.67	1.81	1.60	1.18	8.36	4.39
Great black-backed gull	0.39	2.63	0.74	3.72	2.05	26.52	3.37	39.68
Black-headed gull	0.02	0.04	0.04	0.05	0.10	0.19	0.25	0.48
Kittiwake	1.55	0.97	0.81	1.17	8.19	1.93	1.88	3.82
large gull sp	0.43	0.68	2.00	0.77	1.37	2.22	14.77	4.43
Guillemot	0.39	1.43	1.89	1.52	2.25	4.80	6.46	4.60
Razorbill	0.03	0.11	0.08	0.38	0.25	0.25	0.32	2.47
auk sp	0.16	0.48	0.80	1.69	1.02	2.81	3.14	7.03

The bird densities recorded in each of these zones in 2009 -2010 are compared in Table 5. Densities of divers and auks were again lower within the wind farm site than elsewhere, though densities across the survey area were rather lower than the subsequent year when construction had been completed. The reduction in density of these species was greatest within the wind farm, but diver numbers were also lower within 1km (though the overall sample size was very low). Gull numbers did not appear to have been affected by the wind farm construction, with densities comparable to the control area found across the wind farm survey area.

Table 5. Mean and peak bird densities for zones within and around the wind farm based on 'in-transect' counts corrected for distance sampling and survey coverage in 2009-10

	Mean density for each zone				Peak density for each zone			
Species	**Wind farm site**	**0-1km**	**1-2km**	**Control**	**Wind farm site**	**0-1km**	**1-2km**	**Control**
Red-throated diver	0.03	0.01	0.08	0.05	0.17	0.11	0.24	0.26
Gannet	0.07	0.14	0.20	0.55	0.63	0.59	0.97	2.50

	Mean density for each zone				Peak density for each zone			
Species	**Wind farm site**	**0-1km**	**1-2km**	**Control**	**Wind farm site**	**0-1km**	**1-2km**	**Control**
Common gull	3.39	2.51	1.68	1.07	20.46	15.93	6.73	9.00
Lesser black-backed gull	0.71	0.50	0.70	0.41	3.77	2.44	3.79	1.13
Herring gull	0.55	0.57	2.53	0.72	1.49	1.33	20.09	3.05
Great black-blacked gull	0.33	0.15	0.21	0.33	1.60	0.48	0.67	1.39
Kittiwake	0.81	0.56	1.34	0.27	4.03	1.59	9.15	0.87
Guillemot	0.29	0.73	0.84	0.57	2.71	3.44	3.00	1.84
Razorbill	0.02	0.09	0.19	0.21	0.17	0.78	1.64	1.61

A comparison between the densities of the main species found during the pre-construction (ES) surveys in 2004 -2005, the construction phase (2009 -2010) and the first year's post-construction surveys (2010 - 2011) is shown in Table 6. Data from 1-2km buffer are not included as that zone was not surveyed in the ES surveys. Statistical analysis comparing the differences in bird numbers between the pre-construction, construction and post-construction periods are given in Section 8 of this report below.

Within the wind farm these data highlight declines in diver and auk densities during construction, though the 2010 – 2011 surveys provide evidence of an increase in densities since construction was completed. The densities of divers and auks was also higher in the zones outside the wind farm in 2010-11 than in the previous year, with the magnitude of that increase appearing to greater further from the wind farm.

For the gull species, there has been a major increase in great black-backed gull and kittiwake numbers post-construction, including within the wind farm (indeed the wind farm has held the highest densities of the latter species within the survey area in 2010 – 2011). Other gull species appear to have broadly maintained their pre-construction densities.

Table 6. Densities of the main seabird species present in the survey area during Oct-Mar in the pre-construction (ES), construction (2009-10) and post-construction (2010-11) surveys. Densities are given as mean numbers per km^2.

	Wind Farm			0-1km Buffer			Control		
	ES	**09-10**	**10-11**	**ES**	**09-10**	**10-11**	**ES**	**09-10**	**10-11**
All Divers	0.29	0.03	0.08	0.00	0.01	0.41	0.04	0.05	0.36
Gannet	0.05	0.07	0.05	0.00	0.14	0.16	0.06	0.55	0.89

	Wind Farm			0-1km Buffer			Control		
	ES	09-10	10-11	ES	09-10	10-11	ES	09-10	10-11
Common Gull	1.70	3.39	1.15	0.00	2.51	0.75	0.03	1.07	0.46
Lesser Black-backed Gull	0.33	0.71	0.41	1.44	0.50	0.53	0.76	0.41	1.11
Herring Gull	1.95	0.55	0.90	0.30	0.57	1.04	0.97	0.72	1.81
Great Black-blacked Gull	0.02	0.33	0.39	0.11	0.15	2.63	0.08	0.33	3.72
Kittiwake	0.20	0.81	1.56	0.15	0.56	0.98	0.14	0.27	1.17
All Gulls	4.32	5.79	4.83	2.81	4.29	6.59	1.98	2.80	9.02
Guillemot	0.69	0.29	0.39	0.65	0.73	1.43	1.32	0.57	1.53
Razorbill	0.22	0.02	0.03	0.22	0.09	0.11	0.14	0.21	0.39
All Auks	1.00	0.31	0.58	0.26	0	2.01	0.10	0	3.60

5.2 Seabird Distributions

The distributions of the main bird species observed during the 2010 – 2011 surveys are shown in **Figures 2 - 10**. These show all of the data obtained during the surveys, not just those that were used to derive the population estimates presented above. They also show the extent of the wind farm site, the 1km and 2km buffers and the study area as a whole. Each of the main species is discussed in turn.

Divers (Figure 2): divers were widely distributed at low density across most of the study area, including the control area to the south, though with fewer birds seen within the wind farm site itself.

Gannet: (Figure 3): gannets were more frequently recorded in the eastern part of the survey area, though with relatively few records within the wind farm itself.

Common Gull (Figure 4): common gulls were widely distributed over the whole study area, including within the wind farm.

Lesser Black-backed Gull (Figure 5): widely distributed gull species, found in all parts of the study area including the wind farm, largely at quite an even low density but with one particular aggregation to the south west of the wind farm on one survey.

Herring Gull (Figure 6): this gull species was also found across the whole of the study area, with greatest numbers found in the buffer zones around the wind farm.

Great Black-backed Gull (Figure 7): widely distributed gull species, found in all parts of the study area including the wind farm site. Numbers were highest in the control area.

Kittiwake (Figure 8): widely distributed gull species, found in all parts of the study area including the wind farm, which held most of the larger aggregations of this species.

Guillemot (Figure 9): guillemots were widely distributed across the survey area, though with relatively few records within the wind farm.

Razorbill (Figure 10): this species was most abundant in the control area, with no records at all within the central part of the wind farm.

As in previous surveys a small number of records of land-based species were also seen over-flying the study area, including brent goose, shelduck, wigeon, teal, mallard, lapwing, curlew, skylark, meadow pipit, robin, black redstart, blackbird, starling, chaffinch and goldfinch.

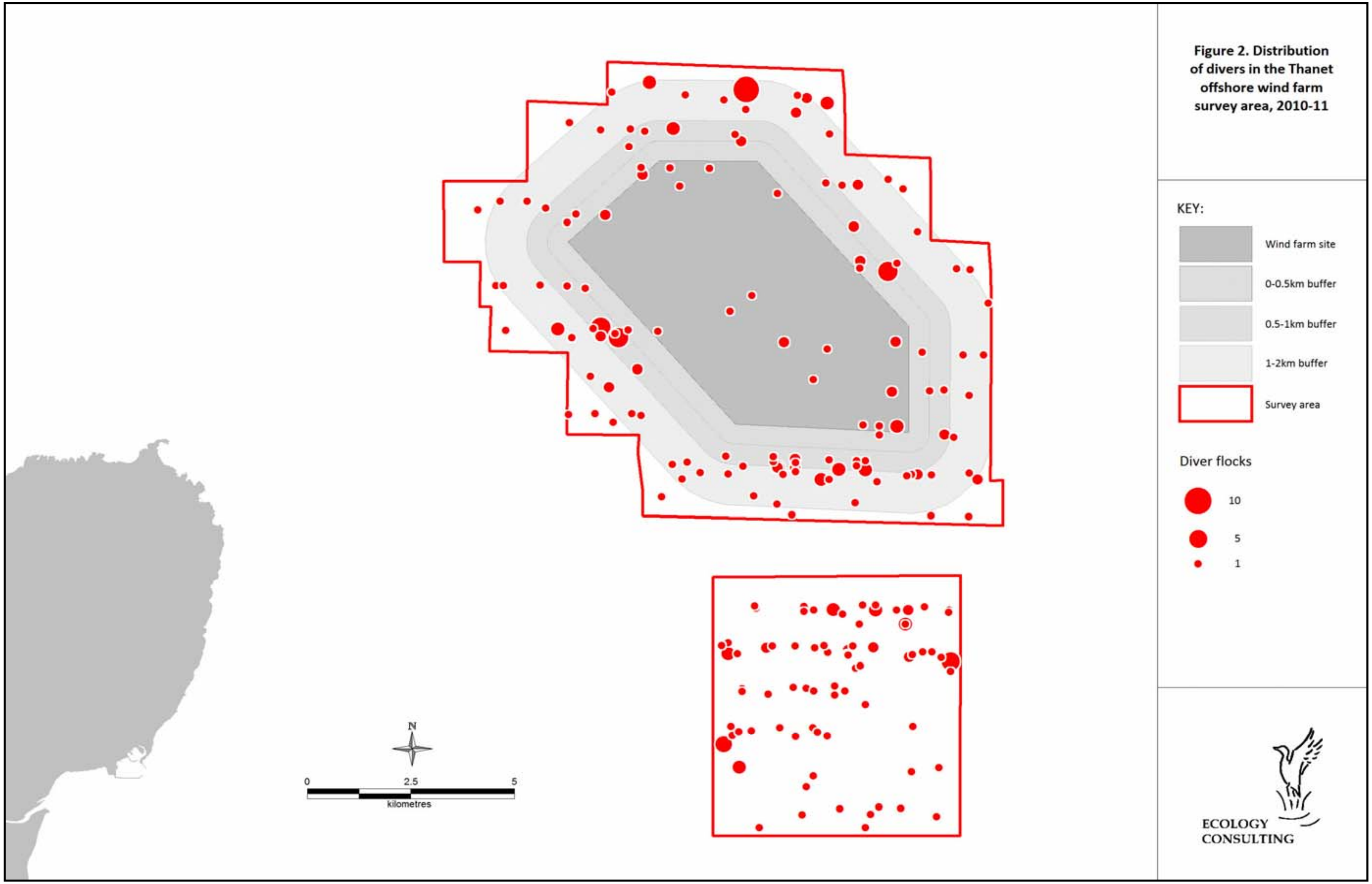
Figure 2. Distribution of divers in the Thanet offshore wind farm survey area, 2010-11
KEY:
Wind farm site
0-0.5km buffer
0.5-1km buffer
1-2km buffer
Survey area
Diver flocks
10
5
1
N
0
2.5
5
kilometres
ECOLOGY CONSULTING

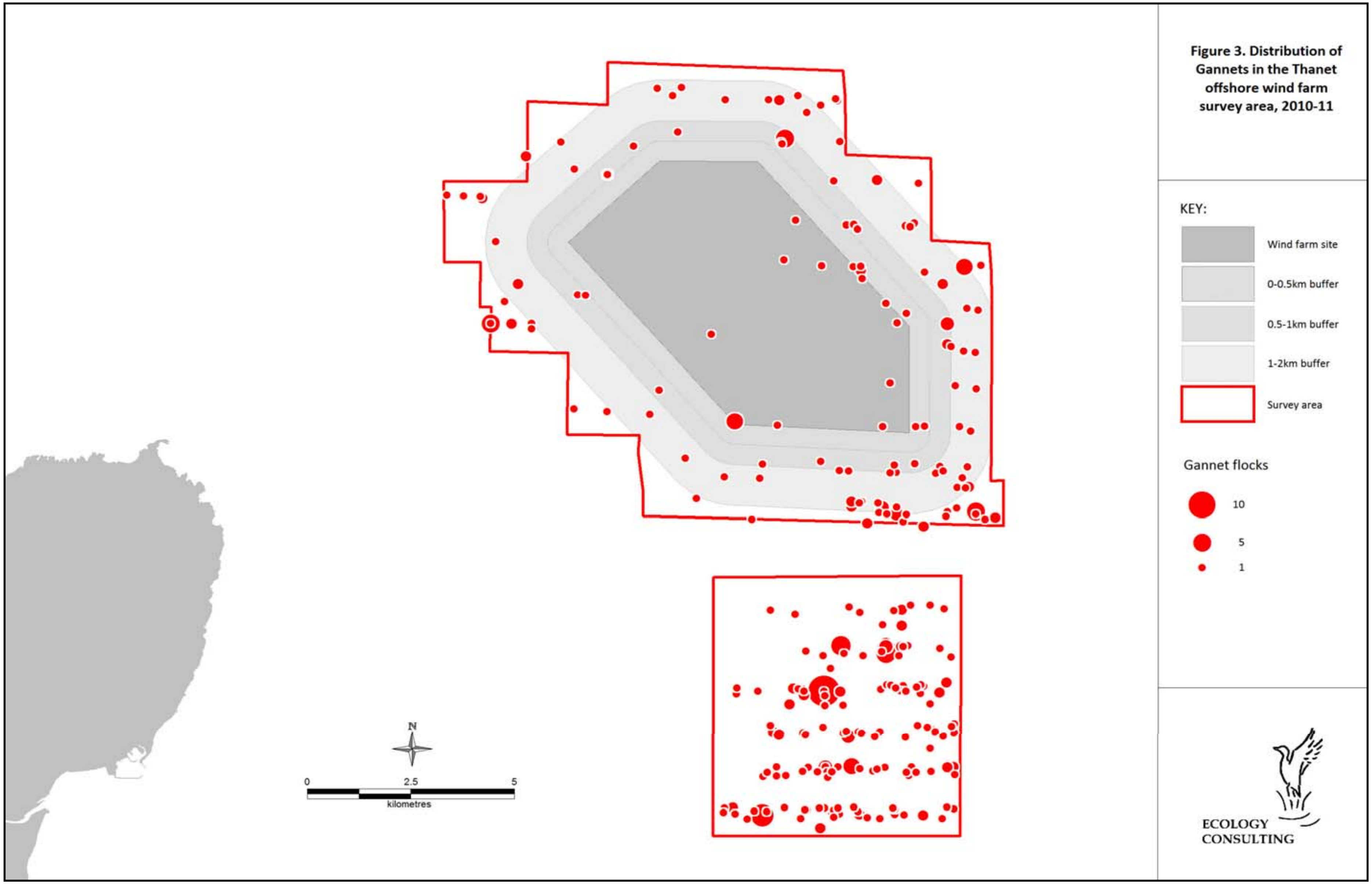

Figure 3. Distribution of Gannets in the Thanet offshore wind farm survey area, 2010-11
KEY:
Wind farm site
0-0.5km buffer
0.5-1km buffer
1-2km buffer
Survey area
Gannet flocks
10
5
1
N
0
2.5
5
kilometres
ECOLOGY CONSULTING

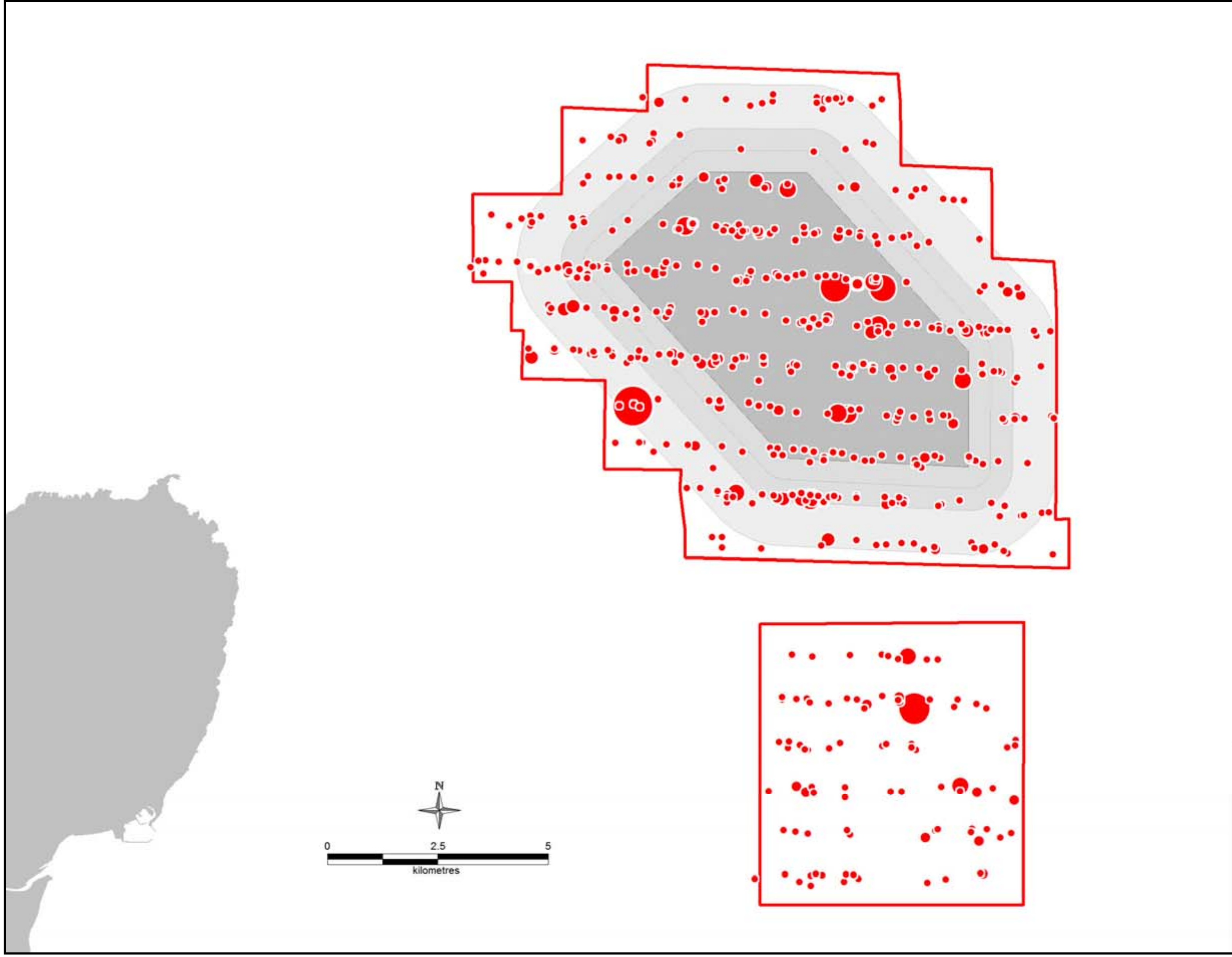

Figure 4. Distribution of Common Gulls in the Thanet offshore wind farm survey area, 2010-11

KEY:

Wind farm site

0-0.5km buffer

0.5-1km buffer

1-2km buffer

Survey area

Common Gull flocks

20

10

2

ECOLOGY CONSULTING

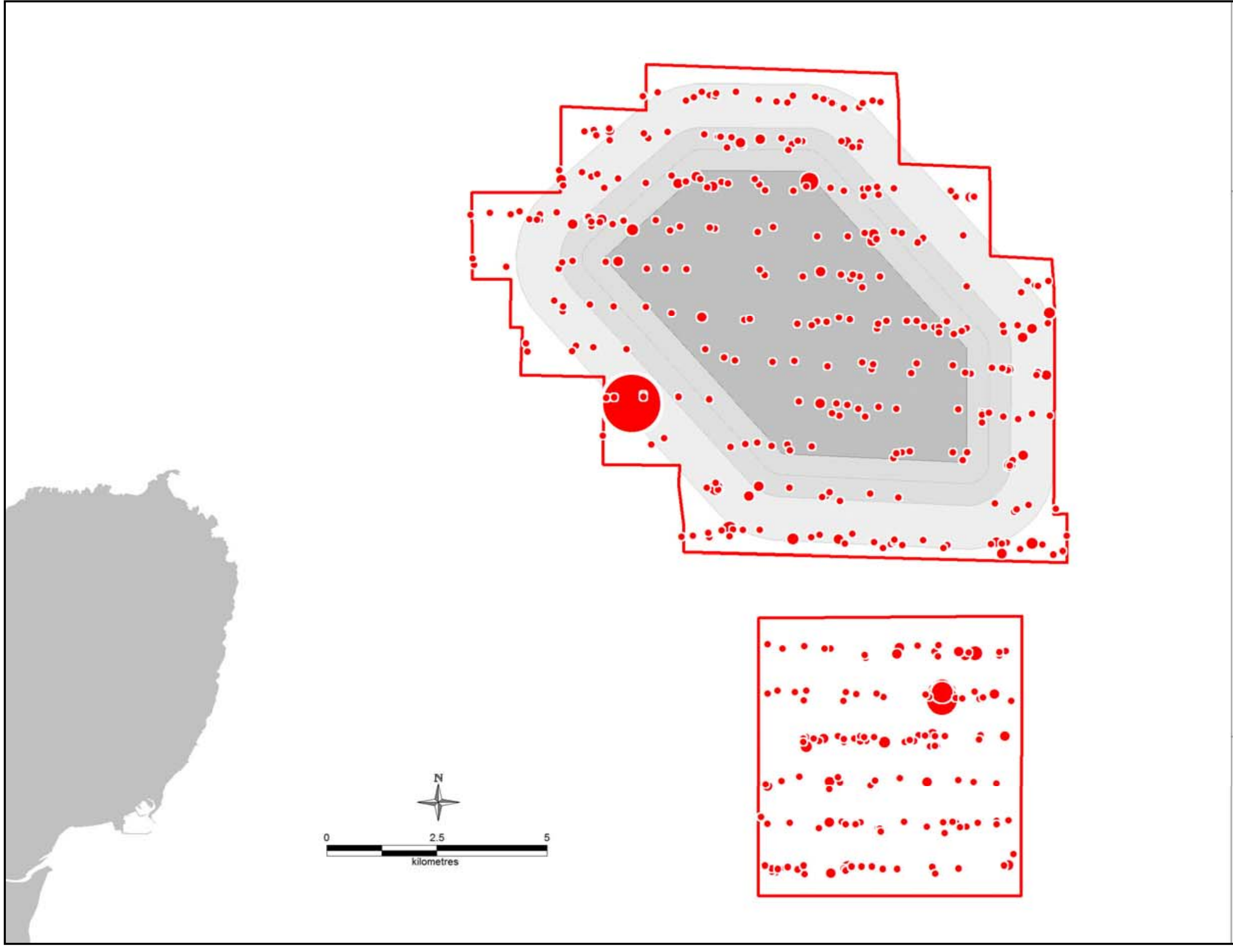

Figure 5. Distribution of Lesser Black-backed Gulls in the Thanet offshore wind farm survey area, 2010-11

KEY:

Wind farm site
0-0.5km buffer
0.5-1km buffer
1-2km buffer
Survey area

Lesser Black-backed Gull flocks

50
25
5

ECOLOGY CONSULTING

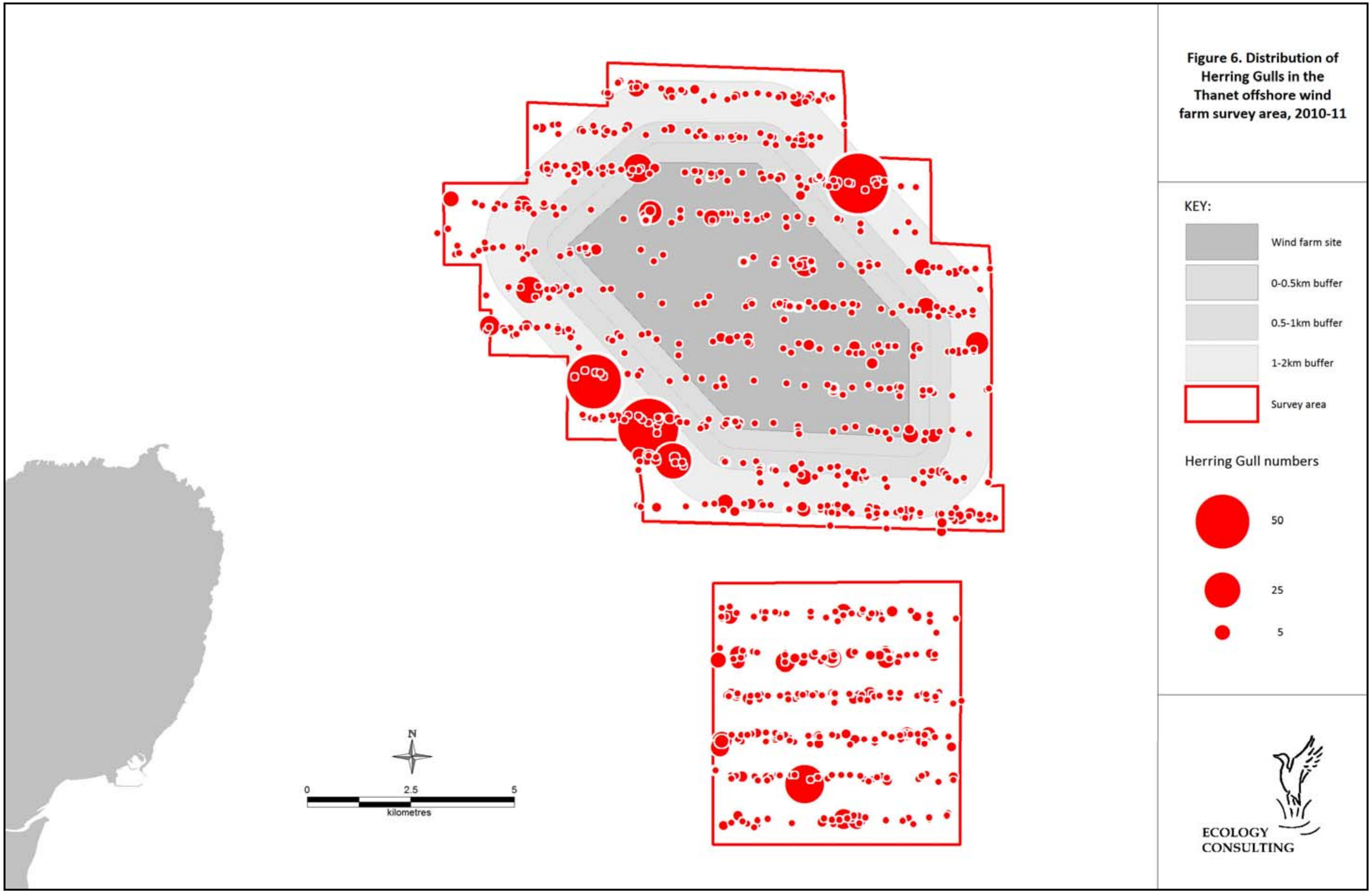

Figure 6. Distribution of Herring Gulls in the Thanet offshore wind farm survey area, 2010-11

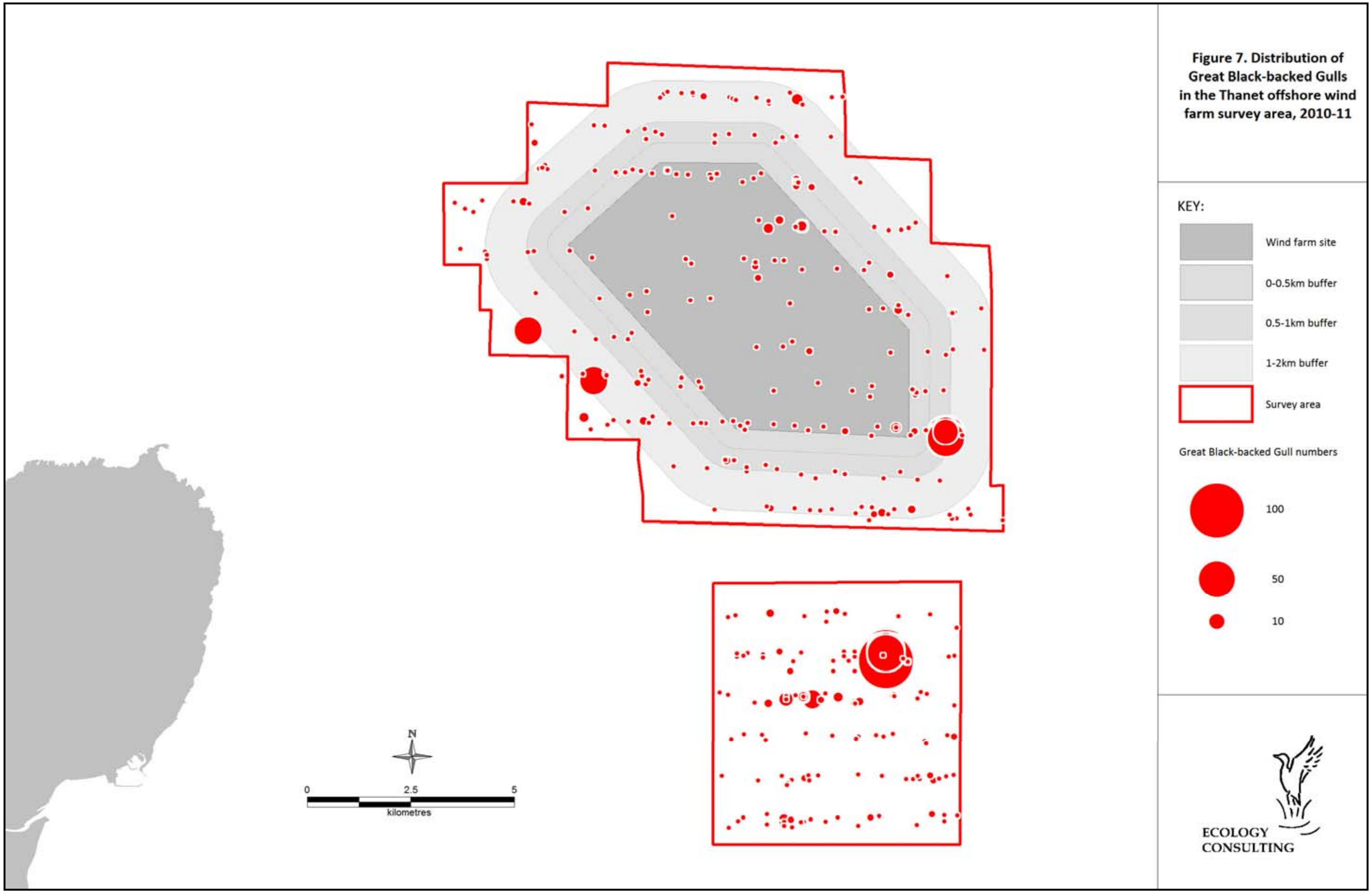
Figure 7. Distribution of Great Black-backed Gulls in the Thanet offshore wind farm survey area, 2010-11
KEY:
Wind farm site
0-0.5km buffer
0.5-1km buffer
1-2km buffer
Survey area
Great Black-backed Gull numbers
100
50
10
N
0
2.5
5
kilometres
ECOLOGY CONSULTING

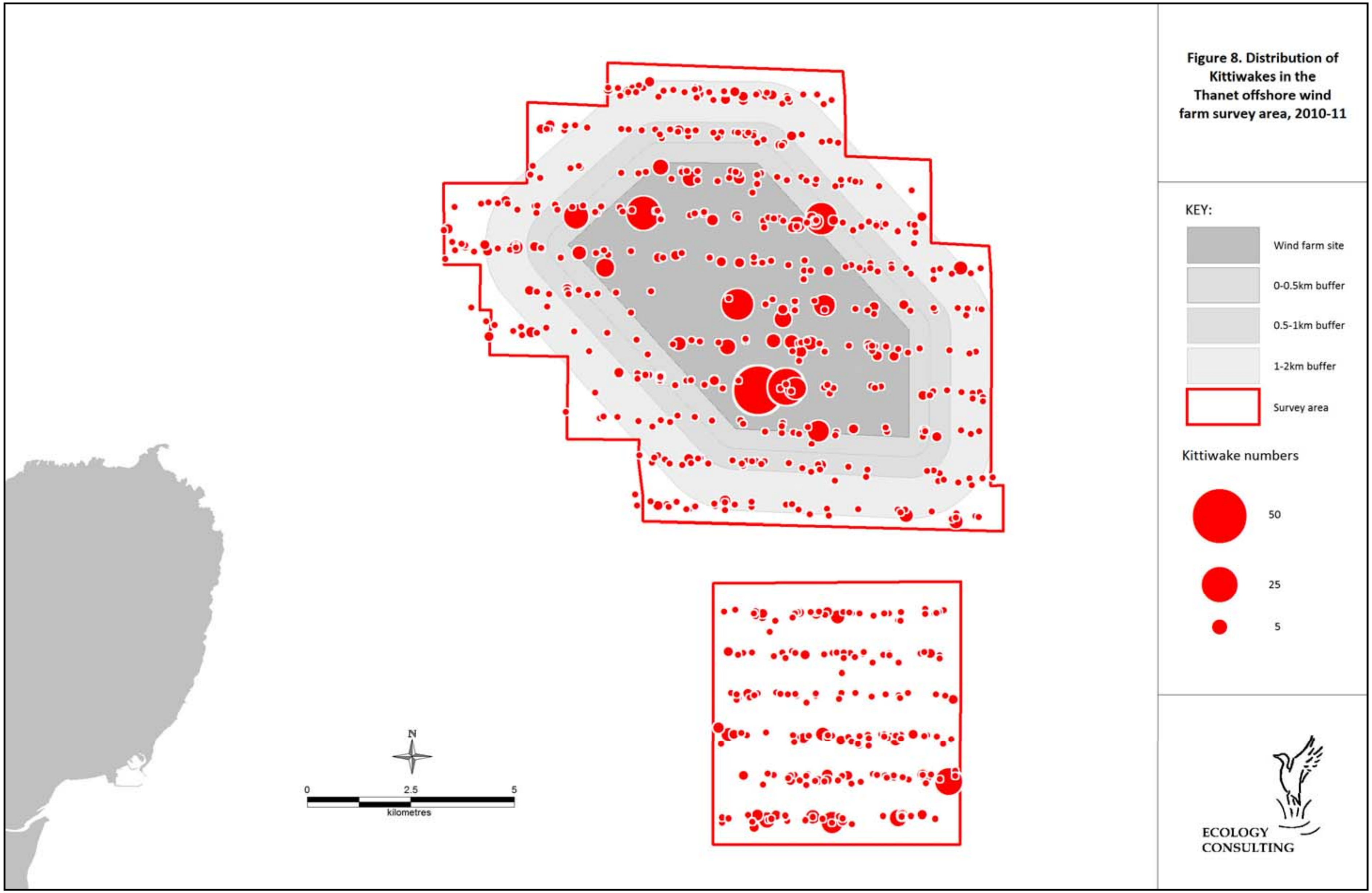
Figure 8. Distribution of Kittiwakes in the Thanet offshore wind farm survey area, 2010-11
KEY:
Wind farm site
0-0.5km buffer
0.5-1km buffer
1-2km buffer
Survey area
Kittiwake numbers
50
25
5
N
0
2.5
5
kilometres
ECOLOGY CONSULTING

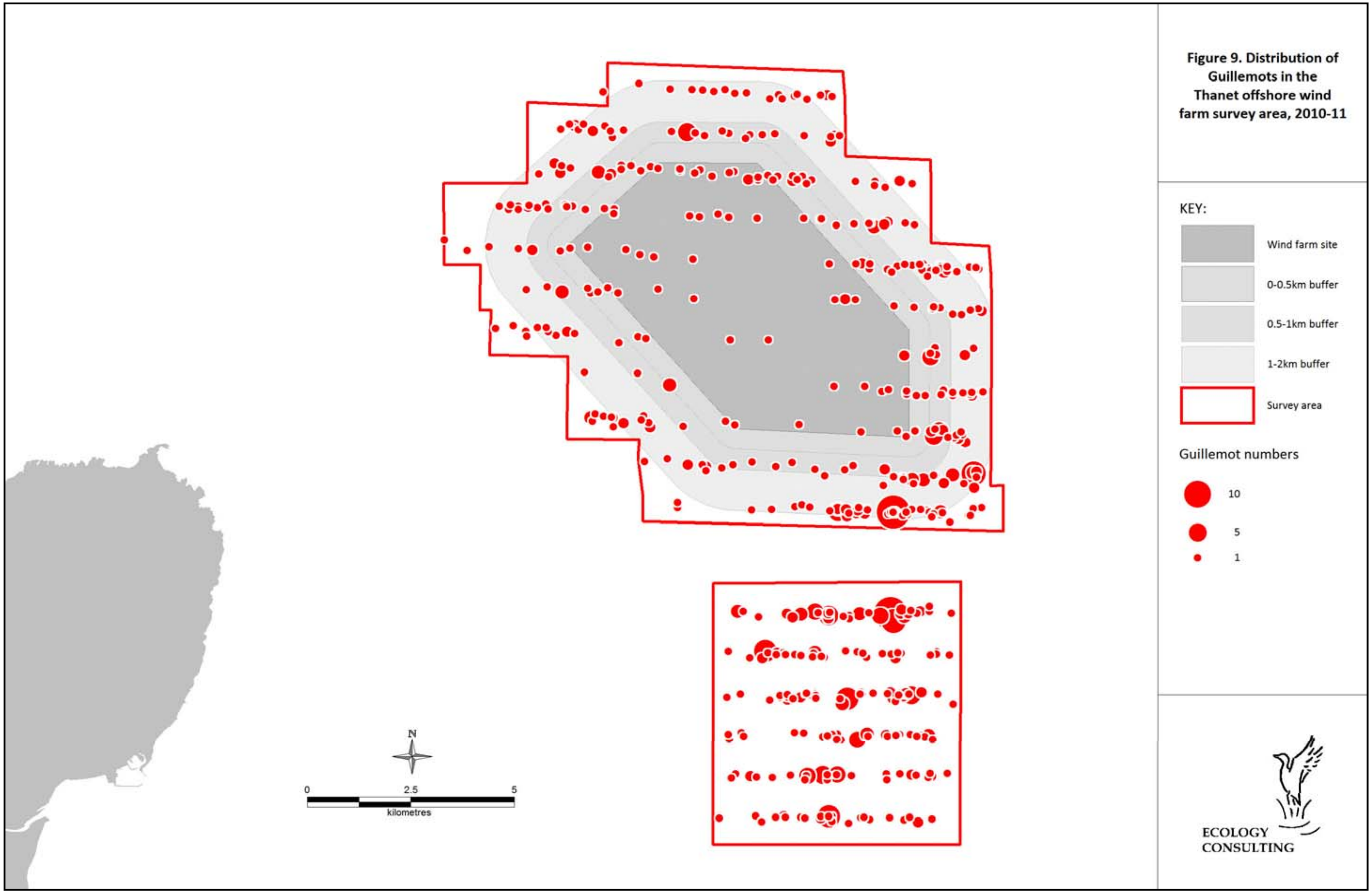

Figure 9. Distribution of Guillemots in the Thanet offshore wind farm survey area, 2010-11

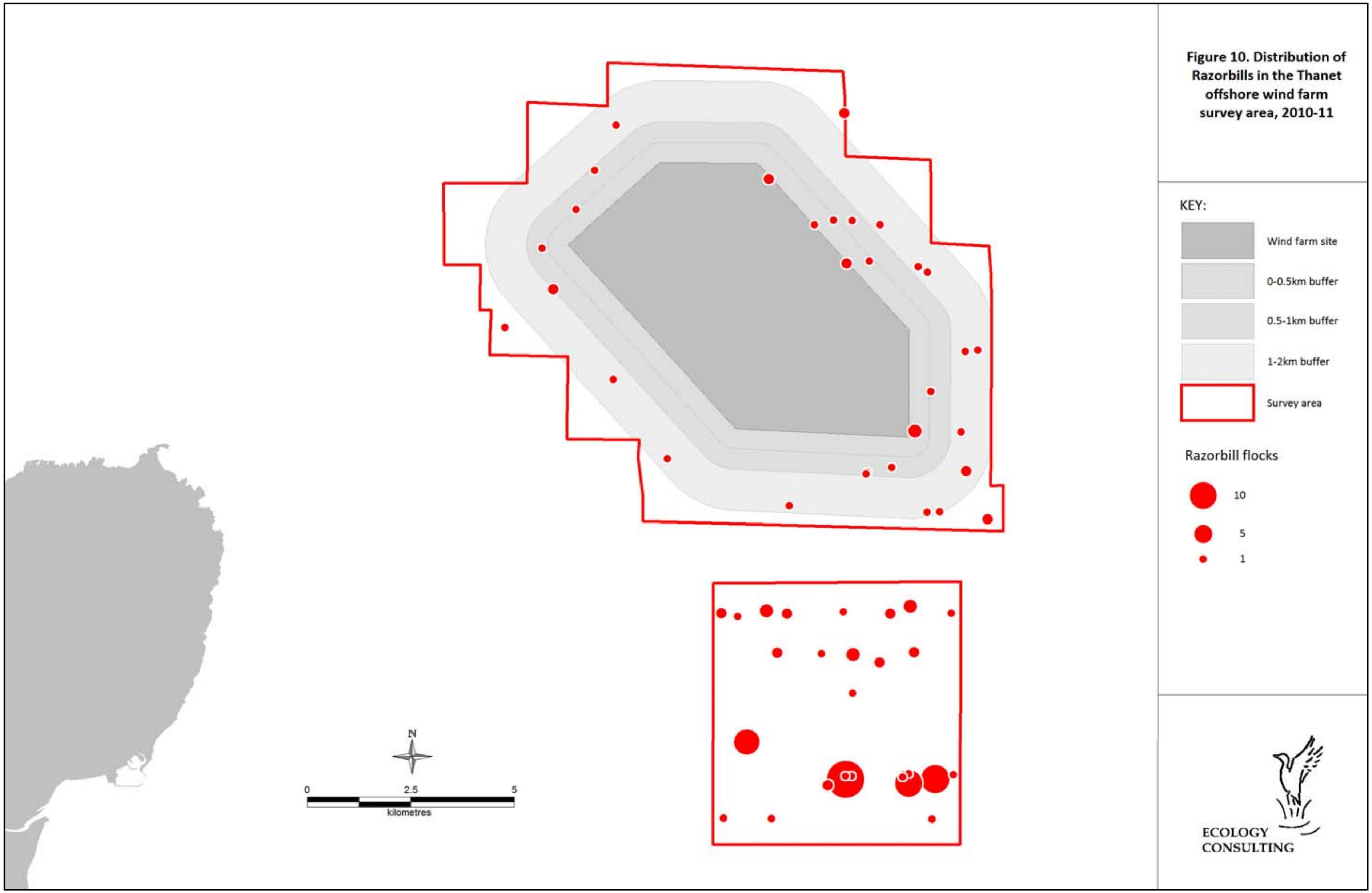

Figure 10. Distribution of Razorbills in the Thanet offshore wind farm survey area, 2010-11

6 FLIGHT HEIGHTS

The flight heights recorded during the 2010-11 surveys are summarised in Table 7. This Table gives the flight height distribution (by band) for each species seen over-flying, and the percentage of flights at rotor height (taken as all flights between20m and 120m). The sample unit was taken as the flock rather than the individual as individuals within a flock do not provide an independent sample.

Table 7. Flock flight height distribution observed in 2010-11. Values indicate the number of flocks in each category and the approximate percentage of flying flocks at rotor height.

	On sea	<20m	20-120m	>120m	% at rotor height
Brent goose	0	2	2	0	50
Shelduck	0	1	0	0	0
Wigeon	0	0	1	0	100
Mallard	0	2	0	0	0
Common scoter	1	1	0	0	0
Red-breasted merganser	0	0	1	0	100
Red-throated diver	28	86	11	0	11
Black-throated diver	14	20	2	0	9
Great crested grebe	2	2	0	0	0
Fulmar	2	53	0	0	0
Gannet	37	230	17	0	7
Cormorant	3	2	1	0	33
Lapwing	0	1	0	0	0
Curlew	0	1	0	0	0
Arctic skua	0	2	0	0	0
Great Skua	2	4	3	0	43
Common gull	38	339	191	1	36
Lesser black-backed gull	72	217	184	4	45
Herring gull	88	631	271	3	30
Great black-backed gull	130	177	84	0	32

	On sea	<20m	20-120m	>120m	% at rotor height
Little gull	0	6	1	0	14
Black-headed gull	0	21	1	0	5
Kittiwake	63	556	118	1	17
Sandwich tern	0	3	0	0	0
Teal	0	0	1	0	100
Common tern	0	1	0	0	0
Guillemot	401	127	0	0	0
Razorbill	40	18	0	0	0
Skylark	0	1	0	0	0
Meadow pipit	0	1	0	0	0
Black redstart	0	1	0	0	0
Blackbird	0	3	0	0	0
Starling	1	28	1	0	3
Chaffinch	1	7	0	0	0
Goldfinch	0	1	0	0	0
All divers	*51*	*141*	*15*	*0*	*10*
All auks	*513*	*310*	*0*	*0*	*0*

The specific flights within the wind farm at rotor height (i.e. those where the birds would be at risk of colliding with the turbine rotors) are summarised in Table 8, with allowance made for the survey area coverage to produce an estimate for the whole of the wind farm. Much of the greatest bird flight activity within this zone was of gulls, as previously noted in the ES and the subsequent survey reports, with a very low number of diver and gannet flights in this zone.

Table 8. Bird flight activity at rotor height within the Thanet offshore wind farm site, 2010-11 (population estimate for each survey).

Species	6 and 7 Oct 2010	31 Oct and 1 Nov	19 and 20 Nov 2010	28 Nov 2010	6 and 7 Dec 2010	12 and 13 Dec 2011	9 and 10 Jan 2011	9 and 10 Feb 2011	17 and 18 Feb 2011	22 and 23 Feb 2011	12 and 13 Mar 2011	18 and 19 Mar 2011	Mean	Peak
Red-throated diver	0	0	0	2	0	0	2	0	0	0	0	0	0.3	2
diver sp	0	0	0	0	0	3	0	0	0	0	0	0	0.3	3
Gannet	0	0	2	0	0	0	0	0	0	0	0	0	0.1	2
Common gull	0	5	2	3	5	7	40	20	3	10	15	7	9.7	40
Lesser black-backed gull	5	12	3	5	12	5	3	0	7	2	13	7	6.1	13
Herring gull	0	18	3	18	13	8	3	12	17	13	17	5	10.7	18
Great black-backed gull	7	7	2	0	2	2	3	2	2	2	0	3	2.5	7
Kittiwake	0	7	0	3	2	0	8	12	5	22	3	0	5.1	22
small gull sp	0	0	0	0	0	0	0	0	0	3	0	0	0.3	3
large gull sp	0	5	3	10	5	8	3	0	7	12	3	10	5.6	12
gull sp	0	0	0	0	0	0	0	0	0	0	2	0	0.1	2
Starling	0	37	0	0	0	0	0	0	0	0	0	0	3.1	37

One of the main objectives of the bird monitoring programme is to determine whether the collision risk has changed following construction of the wind farm. Table 9 compares the mean numbers within the wind farm over the pre-construction (ES – 2004 - 2005), construction (2009 - 2010) and post-construction (2010 - 2011) periods to make a relative comparison of the likely collision risk[2]. Diver and auk numbers in this zone declined during construction and post-construction. Gull numbers have been broadly similar during post-construction and construction as assessed in the pre-construction surveys carried out for the ES baseline, though with more Kittiwake activity in 2010-11 (an increase in which was seen generally within the Thames in that year, J. Ford pers. comm.; Percival et al. 2011). As a result whilst collision risk is likely to have increased for this species, for the others (and species of higher conservation interest, particularly divers) there has not been any notable increase in flight activity within the wind farm site since the ES assessment. There is no evidence to suggest that the conclusion reached in the ES (that there would not be any significant collision risk) would be changed by the recent post-construction data.

[2] The collision risk will be directly proportional to flight activity in the collision zone at rotor height, so this flight activity can be used to compare the change in risk from the ES to the post-construction phase.

Table 9. Mean count for each winter within the wind farm site, Oct-Mar

	ES (2004 – 2005)	Construction (2009 – 2010)	Post-construction yr 1 (2010 – 2011)
All divers	10	1	3
Gannet	2	2	2
Common gull	59	119	40
Lesser black-backed gull	11	25	14
Herring gull	68	19	32
Great black-blacked gull	1	12	14
Kittiwake	7	28	54
All gulls	151	203	169
Guillemot	24	10	14
Razorbill	8	1	1
All auks	35	11	21

7 CONSERVATION EVALUATION

The conservation importance of the bird populations recorded during these surveys has been assessed by reference to Table 10 (taken from Percival 2007) and by using the standard 1% criterion method (Holt et al., 2011); (>1% national population = nationally important, >1% international population = internationally important). The national baseline populations have been taken from Baker et al. (2006) and Musgrove et al. (2011). A further category of 'local importance' has been used for species that are not considered to be of regional importance, but were still of some ecological value. This included all species on the red or amber lists of the RSPB et al.'s (Eaton et al., 2009) 'Birds of Conservation Concern'.

Table 10. Sensitivity (Conservation Importance) of bird species

Sensitivity	Definitions
Very High	Species for which at site is designated (Special Protection Areas (SPAs) / Special Areas of Conservation (SACs)) or notified (Sites of Special Scientific Interest (SSSIs)). A local population of more than 1% of the international population of a species.
High	Other species that contribute to the integrity of an SPA or SSSI. A local population of more than 1% of the national population of a species. Any ecologically sensitive species, e.g. large birds of prey or rare birds (<300 breeding pairs in the UK). EU Birds Directive Annex 1, EU Habitats Directive priority habitat/species and/or Wildlife and Countryside Act 1981 (as amended) Schedule 1 species (if not covered above). Other specially protected species.
Medium	Regionally important population of a species, either because of population size or distributional context. UK Biodiversity Action Plan (BAP) priority species (if not covered above).
Low	Any other species of conservation interest, e.g. species listed on the Birds of Conservation Concern not covered above.

The evaluation of the conservation importance of the bird populations observed in the survey area during the 2010-11 surveys has been summarised in Table 11. This included:

- Eleven very high sensitivity species (SPA/SSSI qualifying/assemblage species; brent goose, shelduck, wigeon, teal, red-throated diver, great crested grebe, cormorant, lapwing, curlew, Sandwich tern and common tern);

- Three high sensitivity species (black-throated diver, great black-backed gull and little gull) that are EU Birds Directive Annex 1 species (black-throated diver and little gull) or present in the survey area in nationally important numbers (great black-backed gull);

- Ten medium sensitivity species (UK BAP priority species and/or present in regionally important numbers; common scoter, gannet, common gull, lesser black-backed gull, herring gull, kittiwake, guillemot, razorbill, skylark and starling); and

- Seven low sensitivity species (Birds of Conservation Concern amber-listed species and/or present in locally important numbers).

Table 11. Evaluation of the conservation importance of the bird populations using the Thanet Offshore Wind Farm site and its surrounds, 2010-11.

Species	SPA sp[3]	Population Importance[4]	EU Birds Directive Annex 1	Red [R]/ Amber [A] List	UK BAP Priority Species	Sensitivity
Brent goose	Q	Regional		A	✓	Very high
Shelduck	Q	Local		A		Very high
Wigeon	Q	Local		A		Very high
Teal	Q	Local		A		Very high
Mallard		Local		A		Low
Common scoter		Local		R	✓	Medium
Red-breasted merganser		Local				Low
Red-throated diver	Q	Regional	✓	A		Very high
Black-throated diver		Regional	✓	A	✓	High
Great crested grebe	A	Local				Very high
Fulmar		Local		A		Low
Gannet		Regional		A		Medium
Cormorant	A	Local				Very high
Lapwing	A	Local		R	✓	Very high
Curlew	Q	Local		A	✓	Very high
Great Skua		Local		A		Low
Common gull		Regional		A		Medium
Lesser black-backed gull		Regional		A		Medium
Herring gull		Regional		R	✓	Medium
Great black-backed gull		National		A		High
Little gull		Regional	✓	A		High
Black-headed gull		Local		A		Low
Kittiwake		Regional		A		Medium
Sandwich tern	Q	Local	✓	A		Very high
Common tern	Q	Local	✓	A		Very high
Guillemot		Regional		A		Medium

[3] Q = SPA qualifying species, A = SPA assemblage species

[4] On the basis of peak numbers in whole survey area and the 1% threshold (Baker et al. 2006, Holt *et al.*, 2009, Musgrove et al. 2011).

Species	SPA sp[3]	Population Importance[4]	EU Birds Directive Annex 1	Red [R]/ Amber [A] List	UK BAP Priority Species	Sensitivity
Razorbill		Regional		A		Medium
Skylark		Local		R	✓	Medium
Meadow pipit		Local		A		Low
Robin		Nil				Nil
Black redstart		Local		A		Low
Blackbird		Nil				Nil
Starling		Local		R	✓	Medium
Chaffinch		Nil				Nil
Goldfinch		Nil				Nil

8 COMPARISON OF BIRD NUMBERS BETWEEN THE PRE-CONSTRUCTION, CONSTRUCTION AND POST-CONSTRUCTION PHASE SURVEYS

8.1 Analysis Methods

This Section presents a statistical analysis comparing the differences in bird numbers between the pre-construction, construction and post-construction periods. As only a 1km buffer (plus a control area) was surveyed for the ES pre-construction baseline, any comparison involving the data for this analysis are necessarily limited to that spatial extent.

The species included in this analysis are all those present in sufficient numbers/frequency for a meaningful analysis to be undertaken: red-throated diver, gannet, common gull, lesser black-backed gull, herring gull, great black-backed gull, kittiwake, guillemot and razorbill.

The analysis was carried out on a grid square basis, overlaying a 500x500m grid onto survey area (aligned with the survey transects). A GIS (MapInfo) was used to extract bird numbers in each grid square from the main survey database, summed over each period (pre-construction, construction and post-construction) and standardised as the mean count per survey visit (to take into count different numbers of surveys in each period - there were 9 surveys during the pre-construction period during the Oct-Mar period, 10 during the construction phase in 2009-10 and 12 in 2010-11 in the first of the post-construction winters).

Three contrasts were then made for each grid square, calculating the change in bird numbers between the pre-construction and the construction phase, the pre-construction with the post-construction and construction with the post-construction phases.

The key null hypothesis tested was that there was no difference between bird numbers for each two-way comparison, i.e. the difference in bird numbers in the grid squares was not significantly different from zero.

The distance from each square to the nearest wind turbine was also calculated and used as a factor in the second part of the analysis. This enabled investigation of any changes in bird numbers in relation to distance from wind farm. These calculated distances were used to classify each grid square as (a) within wind farm (where there was a wind turbine within the grid square), (b) adjacent (turbine within 1km) or (c) more distant. The 1km distance was chosen as limited by the pre-construction survey data available.

8.2 Analysis Results

The grid square count difference data were normally distributed so parametric tests have been used through this section. There is additionally a potential issue with spatial auto-correlation as the sample units (grid squares) are located adjacent to each other, which will be further investigated when the full data set is available. Given this and that these results are only from the first of three years' post-construction monitoring they should be treated with caution at this stage.

The first tests undertaken were to determine whether there was a statistically significant difference in each species' numbers for each of the three comparisons being drawn (pre-construction versus construction, pre-construction versus post-construction and construction versus post-construction. The results (the mean differences for each of these comparisons) are summarised in Table 12, which also shows the statistical significance of the each t-test.

Table 12. Thanet Offshore wind farm mean grid square count differences for key bird species between wind farm periods.

Species		Mean change per grid square[5]	
	Pre-construction v. Construction	Pre-construction v. Post-construction	Construction v. Post-construction
Red-throated Diver	-0.034 *	0.012 ns	0.046 **
Gannet	0.115 ***	0.036 ns	-0.079 *
Common gull	0.632 ***	0.036 ns	-0.596 ***
Lesser black-backed gull	-0.022 ns	-0.138 **	-0.116 ns
Herring gull	-0.278 **	-0.329 ***	0.051 ns
Great black-backed gull	0.076***	0.331 ns	0.255 ns
Kittiwake	0.097 ns	0.026 ns	-0.071 ns
Guillemot	-0.145 ***	-0.125 ***	0.020 ns
Razorbill	-0.026 ns	-0.040 *	-0.014 ns

The second test was to determine whether any difference in abundance between comparison periods was related to distance of the grid squares from the wind farm. It

[5] ns = not significant P>0.05, * = P<0.05, ** = p<0.01, *** = p<0.001

was carried out as a one-way analysis of variance of each set of differences with the distance to turbine class as the factor in the analysis. The results are summarised in Table 13.

Table 13. Thanet Offshore wind farm mean grid square count differences for key bird species between wind farm periods in relation to distance from the wind farm.

Species	Comparison	Wind farm	0-1km buffer	>1km	p
Red-throated diver	Pre- v. Constr.	-0.077	-0.039	-0.011	0.21 ns
	Pre- v. Post-	-0.092	0.032	0.039	0.02 *
	Constr. V. Post-	-0.015	0.070	0.050	0.10 ns
Gannet	Pre- v. Constr.	-0.028	0.075	0.175	0.03 *
	Pre- v. Post-	-0.130	-0.001	0.093	0.02 *
	Constr. V. Post-	-0.075	-0.076	-0.082	0.99 ns
Common gull	Pre- v. Constr.	0.481	0.680	0.722	0.81 ns
	Pre- v. Post-	-0.056	0.100	0.038	0.32 ns
	Constr. V. Post-	-0.536	-0.580	-0.683	0.93 ns
Lesser black-backed gull	Pre- v. Constr.	0.013	-0.077	0.010	0.80 ns
	Pre- v. Post-	-0.153	-0.174	-0.091	0.69 ns
	Constr. V. Post-	-0.166	-0.096	-0.102	0.88 ns
Herring gull	Pre- v. Constr.	-0.338	-0.435	-0.064	0.13 ns
	Pre- v. Post-	-0.373	-0.439	-0.177	0.15 ns
	Constr. V. Post-	-0.036	-0.004	-0.113	0.71 ns
Great black-backed gull	Pre- v. Constr.	0.084	0.071	0.076	0.95 ns
	Pre- v. Post-	0.060	0.078	0.799	0.22 ns
	Constr. V. Post-	-0.024	0.007	0.723	0.19 ns
Kittiwake	Pre- v. Constr.	-0.026	0.143	0.139	0.40 ns
	Pre- v. Post-	0.079	0.071	-0.064	0.02 *
	Constr. V. Post-	0.105	-0.072	-0.203	0.12 ns
Guillemot	Pre- v. Constr.	-0.158	-0.096	-0.183	0.48 ns
	Pre- v. Post-	-0.199	-0.090	-0.118	0.49 ns
	Constr. V. Post-	-0.041	0.006	0.064	0.06 ns
Razorbill	Pre- v. Constr.	-0.167	-0.059	0.052	<0.001 ***
	Pre- v. Post-	-0.174	-0.043	0.015	0.001 **
	Constr. V. Post-	0.006	0.016	0.037	0.52 ns

The results of these tests for each species are examined and interpreted in turn below.

Red-throated diver: this species showed a significant drop in numbers within the survey area between the pre-construction and construction periods, but a significant increase after construction (Table 12). The trend was for the decrease to be higher but the increase lower within the wind farm site (Table 13) but this was only statistically significant for the pre- versus post-construction comparison (which gave a significant decrease within the wind farm but an increase outside it). It is though suggestive of partial diver displacement from the wind farm during construction, which will be investigated further when more post-construction data are available. Particular caution needs to be applied to these results however as the wind farm site has supported only low numbers of this species throughout the surveys, so the sample of birds exposed to potential displacement is only small.

Gannet: this species showed a significant increase in numbers across the survey area during construction and a decline post-construction (with no significant difference between the pre- and post-construction periods). Though there was no significant difference in the change in numbers in relation to distance from the wind farm between the construction and the post-construction phases, for both of the other comparisons gannets generally increased or remained stable outside the wind farm (and more so at greater distance from it) but declined within it. There is therefore some initial evidence of partial displacement from the wind farm for this species. As for the divers, caution needs to be applied to these results however as the wind farm site has supported only very low numbers of this species throughout the surveys, so the sample of birds exposed to potential displacement is only small.

Common Gull: common gull numbers across the whole survey area increased during the construction phase and decreased post-construction, with no significant difference between the pre- and post-construction periods. There was no significant difference between these changes within the wind farm, the 0-1km buffer or the grid squares more distant from the wind farm. This would suggest that this species has not been affected by the wind farm construction or operation.

Lesser Black-backed Gull: there was no significant difference in the numbers of this species in the survey area between either the pre-construction and the construction phases, or the construction and the post-construction periods, but there was a significant drop in numbers when comparing pre-construction with post-construction. There was no significant difference between these changes within the wind farm, the 0-1km buffer or the grid squares more distant from the wind farm. This would suggest that this species has not been affected by the wind farm construction or operation.

Herring Gull: this species showed a significant drop in numbers across the survey area during construction and that drop was maintained post-construction. However, there was no significant difference between these changes within the wind farm, the 0-1km buffer or the grid squares more distant from the wind farm. This would suggest that this species has not been affected by the wind farm construction or operation.

Great Black-backed Gull: there was a significant increase in numbers of this species in the survey area during construction, and no significant difference between either the pre-construction and the post-construction phases, or the construction and the post-construction periods. There was no significant difference between these changes within the wind farm, the 0-1km buffer or the grid squares more distant from the wind farm. This would suggest that this species has not been affected by the wind farm construction or operation.

Kittiwake: there was no significant difference in the numbers of this species in the survey area between any of the three comparison periods. The only statistically significant spatial comparison was for the pre- and post-construction comparison, where there was an increase within the wind farm site but a decrease in the control area. This would suggest that this species has not been affected by the wind farm construction or operation.

Guillemot: this species showed a significant drop in numbers across the survey area during construction and that drop was maintained post-construction. However, there was no significant difference between these changes within the wind farm, the 0-1km buffer or the grid squares more distant from the wind farm. The decrease was generally as great within the control area as it was within the wind farm. This would suggest that this species has not been affected by the wind farm construction or operation.

Razorbill: there was no significant difference in the numbers of this species in the survey area between either the pre-construction and the construction phases, or the construction and the post-construction periods, but there was a significant drop in numbers when comparing pre-construction with post-construction. Comparing both the pre-construction with the construction periods and the pre- with the post-construction periods, there were significant differences in the changes across the survey area, with declines within the wind farm but increases in the control area, suggesting that some partial displacement from the wind farm may have taken place.

9 MARINE MAMMALS

The numbers of marine mammals recorded during each survey are shown in Table 12. Only very low numbers (1-2) of seals and harbour porpoise were seen during October-January, but in February and March higher numbers of harbour porpoise were recorded (peak 21). A similar seasonal pattern of occurrence was observed during the construction phase surveys.

Table 12. Numbers of marine mammals observed during each of the boat surveys during 2010-11.

Species	6 and 7 Oct 2010	31 Oct and 1 Nov	19 and 20 Nov 2010	28 Nov 2010	6 and 7 Dec 2010	12 and 13 Dec 2011	9 and 10 Jan 2011	9 and 10 Feb 2011	17 and 18 Feb 2011	22 and 23 Feb 2011	12 and 13 Mar 2011	18 and 19 Mar 2011	TOTAL
Common seal	0	0	1	0	0	0	0	0	1	0	1	0	**3**
Seal sp.	0	0	1	0	0	0	0	0	0	2	0	0	**3**
Harbour porpoise	2	2	0	0	0	0	0	15	5	17	21	21	**83**

As during the construction phase numbers of porpoises were higher in the control area, though smaller numbers were seen within the wind farm (Figure 11).

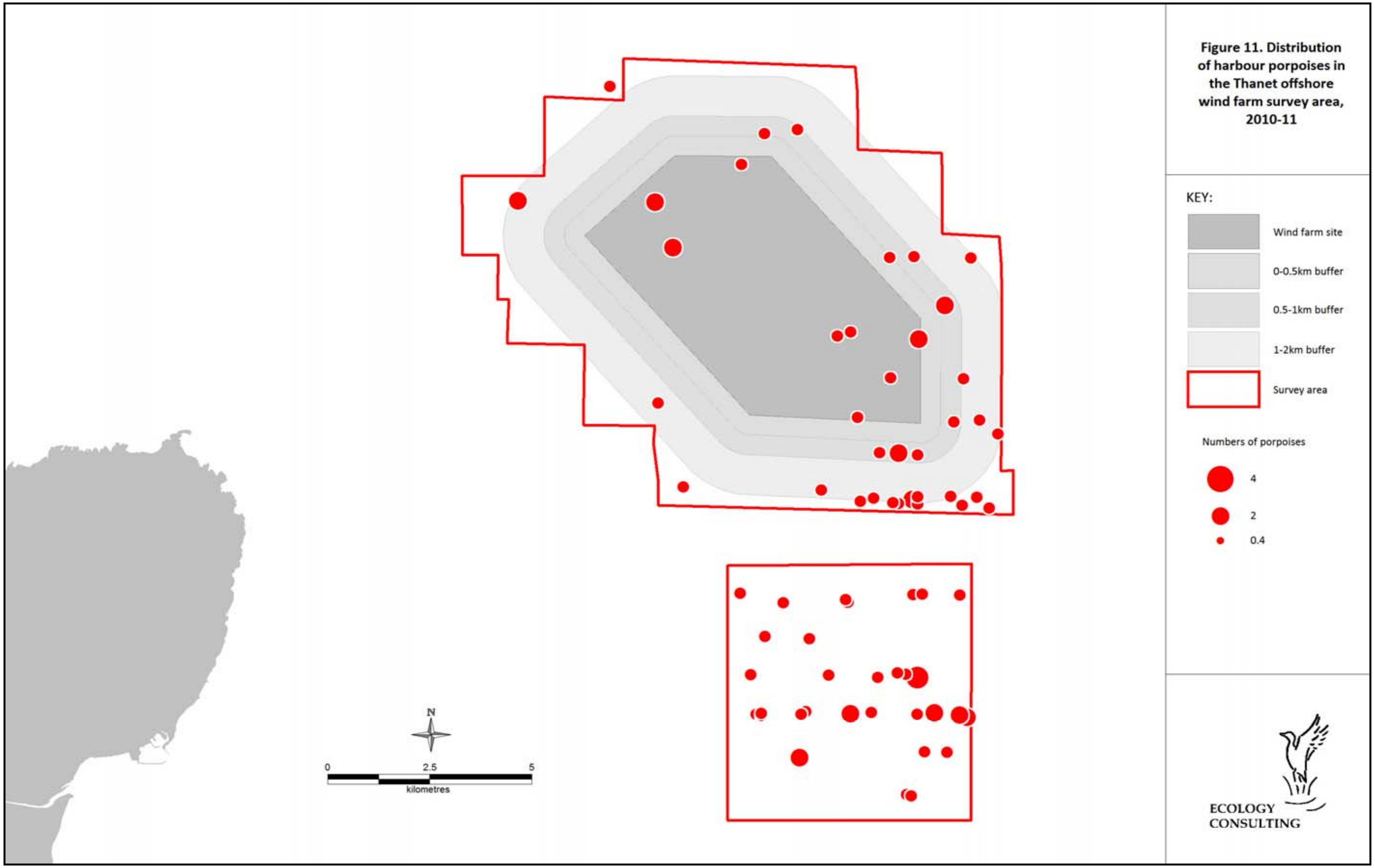
Figure 11. Distribution of harbour porpoises in the Thanet offshore wind farm survey area, 2010-11
KEY:
Wind farm site
0-0.5km buffer
0.5-1km buffer
1-2km buffer
Survey area
Numbers of porpoises
4
2
0.4
N
0
2.5
5
kilometres
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10 CONCLUSION

The results presented in this report give preliminary conclusions based on a single year's post-construction monitoring at Thanet, so should therefore be treated with caution. Clearer results should emerge as further post-construction surveys are completed.

The results indicate a decline during construction of divers and auks, though this is based on small sample sizes as the overall numbers observed were quite low through all of the surveys. There is some indication of a recovery to pre-construction levels within the wind farm in the first post-construction year. For the divers and razorbills, this decline was greater within the wind farm and it is likely that the presence of the wind farm did result in displacement. For guillemots these changes occurred across the survey area with no evidence of a greater effect within the wind farm, so the evidence for displacement of that this is more equivocal. There was some evidence too of displacement of gannets from the wind farm.

These small sample sizes mean that quantifying the magnitude of these changes should be treated with caution, but the results in relation to divers do contrast with those from the smaller Kentish Flats wind farm. At that site diver densities were reduced by 94% within the wind farm, 80% within 0-1km and 59% within 1-2km (Percival et al. 2011) after construction. At Thanet there have been regular sightings of small numbers of divers within the wind farm (albeit at a lower density than prior to construction) and densities have been maintained post-construction in the buffer zones around the wind farm (even in the 0-1km zone immediately adjacent to the wind farm). The comparative percentage change in density at Thanet was 45% within the wind farm comparing the pre-construction densities with those post-construction. It is not currently possible to generate comparative values for the buffer zones as no divers were recorded in the 0-1km buffer zone during the pre-construction surveys and the 1-2km zone was not surveyed during the pre-construction phase.

Gull numbers appear to have been largely unaffected by the construction or first winter of operation. Indeed several species have increased in number following construction of the wind farm, including within the wind farm, though this increase likely reflected wider population fluctuations rather than any site-specific effects given the wider increase in gull numbers seen in the Outer Thames in 2010-11 (J. Ford, pers. comm.; Percival et al. 2011) and the results of the spatial analysis of changes in gull numbers.

10.1 Comparison with ES Predictions

At this stage there is no evidence to suggest that the conclusion reached in the ES (that there would not be any significant collision risk) would be changed by the recent post-construction data.

In the ES it was predicted that disturbance to and displacement of feeding seabirds during construction would be short term and of minor adverse significance, as a result of overall low densities of birds observed throughout the year and availability of similar feeding areas close by.

The results of the construction phase monitoring supported this conclusion, with some minor displacement observed of some species including divers and auks.

Disturbance impacts during the operational phase of the wind farm were also predicted in the ES to result in only minor adverse effects, particularly on divers and auks. No disturbance effects were predicted on gulls This again appears from the results to date to be borne out by the results of the monitoring programme, with initial evidence of displacement of divers and some auks, and none for gulls.

In relation to collision risk, the data on bird flight activity collected as part of the post-construction monitoring has not found any evidence to suggest that the conclusion reached in the ES (that there would not be any significant collision risk) would be changed by the recent post-construction data (though no direct monitoring of collision risk has been undertaken).

10.2 Further Analysis

Two further years' post-construction data are being collected as part of the bird monitoring programme, and these will enable more robust conclusions to be drawn on the effects of the wind farm on birds. At the end of the 3-year post-construction monitoring period, data will be analysed in detail to show trends in abundance and distribution and fully assess the bird responses to the wind farm, and will include analysis of changes in bird numbers and distribution in relation to changes in fish distribution and results from benthic surveys (where the data from those fish and benthic surveys are of an appropriate spatial scale to allow such an analysis). Other available environmental data will also be included, including JNCC Sea Map data, water depth and shipping traffic, to better understand any changes in bird numbers and distribution that have occurred. This will include a full analysis of the raw pre-construction data as well as all of the construction and post-construction surveys.

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