Kentish Flats Offshore Wind Farm: Diver Surveys 2009-10

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Executive Summary

Surveys of the distribution and abundance of red-throated divers at the Kentish Flats wind farm during the pre-construction, construction and post-construction phases of the wind farm have been undertaken over 8 years prior to 2009-10. This report presents an analysis of new data sets from surveys completed at Kentish Flats during 2009-10.

The original statistical analysis carried out for the monitoring conducted under the FEPA licence of the effects of the Kentish Flats wind farm on bird populations utilised a BACI (before-after-control-impact) approach. However it was acknowledged in the monitoring reports that this was of relatively low power which meant that no statistically significant effect was identified although a qualitative assessment suggested an avoidance of the site by divers.

A previous review of the Kentish Flats monitoring programme data and re-analysis had shown that there has clearly been a notable decline in diver numbers within the wind farm/buffer zone following construction, at a time when the wider population (as determined from the aerial surveys) appeared to have been relatively stable, confirming the qualitative observations made in the previous Kentish Flats monitoring reports. There had been a statistically significant decrease in diver numbers within the wind farm site and its surrounds. There has not only been a decrease in numbers but also a shift in distribution away from the wind turbines, most markedly within 500m. This reduction in the wind farm site and 500m buffer was also apparent from the 2009-10 data. As noted in the previous report, the biological importance of such behaviour is not yet clear and needs to be addressed with reference to the context of the wider diver population within the Outer Thames Estuary.

There was some suggestion from the 2008-09 data in particular that the magnitude of the displacement may be decreasing through time; divers may be habituating to the presence of the wind turbines. The 2009-10 data did not suggest that the strength of any such habituation was increasing, though there were more diver records from within the wind farm site than there had been in 2008-09.

As noted previously, it is important to recognise that the results for this site may not be directly applicable to other wind farm sites given the Kentish Flats wind farm's relatively small number of turbines and footprint size, and its relatively low importance for divers. It is possible, for example, that divers using a site of greater importance/attractiveness to them may be less likely to be affected by disturbance than those at Kentish Flats.

Contents

1. Introduction

Background

Bird survey work for the Kentish Flats offshore wind farm was carried out between 2001 and 2007 using both boat based and aerial survey methods. Initially this provided baseline data for the project impact assessment and Environmental Statement [ES]. Subsequently a FEPA monitoring program through the pre-construction (2002 – 2003) and construction phase (August 2004 – August 2005) and for 3 years post-construction has been completed. The final ornithological monitoring report was produced by Environmentally Sustainable Systems Ltd [ESS], the project lead ornithological consultants, in July 2008 (Gill et al. 2008) which reported on the findings of the three year post-construction monitoring program.

The key ornithological issue identified at the Kentish Flats as a result of the FEPA monitoring is a possible effect on divers during the operational phase. The Thames Estuary as a whole has recently been shown to be of major international importance to this group, particularly red-throated divers, with a wintering population estimated at about 8,000 birds (O'Brien et al. 2008). The conclusion of the ESS monitoring report with respect to divers was that there was no evidence of any statistically significant effects of the wind farm on divers (when comparing the wind farm with the available data for the control site), although they did note an apparent displacement of divers from the operational turbine array based on a qualitative review and observations reported by the bird surveyors.

The bird monitoring required under the FEPA licence issued for the Kentish Flats wind farm site came to an end in 2008 and the final bird monitoring report has been accepted by Natural England and the Marine Fisheries Agency (MFA) so that no further statutory requirement for monitoring exists at the site. However, in recognition of the observations relating to the apparent avoidance of the turbine area by divers, Vattenfall (the owners and operators of the Kentish Flats site) have decided to undertake further, focused boat based surveys during the winter of 2008/2009 (Percival 2009) and 2009/10 on a voluntary basis to further investigate this issue. This report covers the second of those winter periods.

The original statistical analysis of the effects of the Kentish Flats wind farm on bird populations utilised a BACI (before-after-control-impact) approach. However it was acknowledged in the monitoring reports that this was of relatively low power which meant that no statistically significant effect was identified.

Objectives

The current study has allowed the application of a more powerful statistical approach using the specific recorded locations of each diver observation. Diver densities recorded in zones within and around the wind farm and their distances from wind turbine locations (before/during and after construction) have been analysed. Although limited by the extent of the survey area and the lower coverage of the control area, this approach has enabled a revised statistical analysis to be undertaken and updated conclusions to be reached that accord better with the observations made by field observers and reported in the previous monitoring reports – for a detailed account of the revised analysis of the FEPA data see Percival (2009).

The data re-analysis has shown that there has clearly been a notable decline in diver numbers within the wind farm/buffer zone following construction, at a time when the wider population (as determined from the aerial surveys) appears to have been relatively stable (as was that in the Control area, albeit with a limited data set). This confirms the qualitative observations made in the previous Kentish Flats monitoring reports. There has been a statistically significant decrease in diver numbers within the wind farm site and its surrounds. There has not only been a decrease in numbers but also a shift in distribution away from the wind turbines, most markedly within 500m. The current report provides additional field data from another winter period to test this result further, to examine the patterns of diver distribution and behaviour in relation to the operational wind farm.

There was some suggestion from previous analysis that the magnitude of the displacement may be decreasing through time; divers may be starting to habituate to the presence of the wind turbines. Another objective of the 2009-10 work was therefore to obtain further data to test this hypothesis.

2. Survey Methodology

The survey methodology for 2009-10 was the same as that followed in 2008-09, though gulls were again recorded (as in the year prior to 2008-09) and no vantage point survey were carried out (it had been concluded in the 2008-09 report that these would not be likely to add much to our knowledge of the interaction of the divers and the wind farm given the very low numbers observed flying through the wind farm; Percival 2009).

The same surveyors and survey vessel were used as previously, but the survey methodology was tailored to obtain better data on the key issue, behaviour of divers, whilst at the same time maintaining compatibility/comparability with the previous longer-term data set. This also allowed testing of some of the assumptions made previously and provided a better estimate of diver numbers in the study area.

The key differences in the survey method used in 2009-10 to those used prior to 2008-09 were as follows:

- The survey scan was extended from 90 to 180 degrees, recording on both sides of the boat. This effectively doubles the survey area.
- Divers more than 480m ahead of the boat were recorded and the distance at which they flushed estimated. This was to enable a correction to be applied to the previous data to account for this flushing effect.

All of these improvements maintain backwards-compatibility with previous surveys to allow for analysis of long-term changes.

For consistency the same survey transects were used as previously for the wind farm/buffer and control areas. These are approximately 1km apart, rather than the more usual 2km separation, which means that the potential for double-recording of mobile species such as divers is more likely. The absolute population estimates presented here should therefore be treated with caution as they may over-estimate the actual numbers. Particular care should be taken comparing these numbers with those from surveys using a wider transect separation. However, for the purposes of this analysis it has been assumed that this has not led to any systematic bias in the data set.

In addition the survey area was extended in 2009-10 to cover a wider area around the wind farm site, primarily to provide data for a possible extension to the wind farm. The extent of the current and previous survey areas and the current and previous survey transects are shown in Figure 1. The results for that additional area are shown in the bird distribution maps but are not included in any of the main population estimates, to maintain consistency and comparability with previous surveys. Population estimates for that area are presented separately.

A total of six surveys were carried out during November-February 2009-10. The survey dates and coverage were as follows:

- 30/11/09 – wind farm plus buffer and extension area.
- 16/12/09 - wind farm plus buffer, control and extension area.
- 11/1/10 - wind farm plus buffer, control and extension area.

- 19/1/10 - wind farm plus buffer, control and extension area.
- 3/2/10 - wind farm plus buffer, control and extension area.
- 19/2/10 - wind farm plus buffer, control and extension area.

3. Data Analysis

The additional analysis was carried out following the same analytical strategy as in 2008-09. This sought to address the specific questions of:

- How have diver numbers changed following construction of the wind farm?
- How has diver distribution changed and is this continuing to change through time?

One key principle in these analyses is to maximise the use of the information contained within the raw data, for example by using raw diver locations rather than just transect summaries.

5.1 Diver distribution and abundance 2009-10

The diver population estimates within the wind farm buffer and control areas based on the 2009-10 survey data are summarised in Figure 2. This Figure shows the estimated diver population for each survey for the wind farm buffer and control areas. Numbers in both these areas were highly variable through the winter period, as found in previous years. As previously these numbers have been calculated using correction to allow for survey coverage and for declining detectability of birds at increasing distance from the survey vessel (applying distance correction factors from the London Array wind farm baseline surveys – see Appendix 1).

Figure 2 also shows the population estimate for the new extension to the study area surveyed in 2009-10 for the first time. It held similar numbers to the control area (mean 22, peak 57).

As found previously, a very high proportion (98%) of all of the divers that were identified to species in 2009-10 were red-throated divers. The remainder were black-throated. Previously there had been an increase noted in the proportion of black-throated diver towards the end of the winter period, but in 2009-10 all records of this species were from the earlier part of the winter (with none after 10/1/10).

The diver distribution maps from the 2009-10 boat surveys are shown in Figure 3a. This map plots out all of the raw sightings, so when interpreting them it is important to consider that the control area was surveyed for one visit less than the rest of the study area. Diver distribution maps for the previous survey periods are given for comparison in Figures 3b-e.

5.2 Effects of the Wind Farm on Diver Distribution and Abundance

As in the previous report (Percival 2009) two key parameters have been used in the analysis of the effects of the wind farm on the divers; the diver populations in buffer zones around the wind farm and the distance of diver records from the wind turbine locations.

Diver Population Estimates

The mean and peak diver counts through the main diver period (Nov-Mar) are summarised in Table 1 for the wind farm/buffer area and for the control area. There has been a marked drop in diver numbers in the wind farm/buffer study area since the construction of the wind farm and this has continued into 2009-10. Data for the western Thames Estuary aerial survey area (TH1) are also given for comparison where these are available, to give a wider context of any population changes (though taking into account that a small part of the survey area - i.e. that in which the wind farm is located - was not surveyed). Some caution is required in directly comparing the population densities derived from the aerial and boat surveys: given experience from other surveys in the Outer Thames Estuary since it is likely that the aerial surveys under-estimate the actual numbers of divers (Percival et al. 2005).

Table 1.Mean and peak diver population estimates for the wind farm/buffer, control area and wider aerial survey area, 2002-2010.

Winter	Phase	Boat survey: Wind farm + buffer		Boat survey: Control		Aerial Survey TH1	
		Mean	Peak	Mean	Peak	Mean	Peak
2002-03	Pre	608	2,226	47	196	3,340	5,227
2003-04	Pre	552	1,313	5	19	1,214	1,644
2004-05	Construction	945	2,039	17	58	1,934	3,166
2005-06	Post	119	408	17	64	1,961	2,725
2006-07	Post	136	317	15	60	(2,009) *	(2,009) *
2008-09	Post	86	171	186	646	No data	No data
2009-10	Post	72	187	17	54	No data	No data

** In 2006-07 aerial surveys were only carried out during February 2007.*

There has clearly been a notable decline in diver numbers within the wind farm/buffer zone following construction (Kruskal-Wallis non-parametric ANOVA: H=8.4, p=0.015, 2df), at a time when the wider population (as determined from the aerial surveys) appears to have been relatively stable. This trend continued in 2009-10, adding further confirmation to the qualitative observations made in the Kentish Flats monitoring reports prior to the 2008-09 season and to the analysis presented in the 2008-09 report (Percival 2009). The higher numbers recorded in the Control area in 2008-09 were not observed in 2009-10 (when numbers returned to their more usual lower level).

Diver Distribution in relation to the Wind Farm

Looking in more detail at the spatial pattern of those changes, the following zones were used: wind farm footprint and buffers of 500m, 1km, 2km and 3km. Figure 4 shows the population estimates in each of these zones during the pre-construction, construction and post-construction periods, updated to include the 2009-10 results. Figure 5 shows the equivalent analysis for population densities (i.e. standardised for the area of each zone).

Figures 4 and 5 both show that the diver populations dropped markedly in the wind farm footprint and the 500m buffer around that in the construction year, with an increase in numbers in the 2-3km buffer, suggesting that there had been some displacement from the wind farm. The post-construction data showed a marked decline, and that decline extended over all of the study area, including in 2009-10. The diver numbers in the whole study area have clearly been lower during the post-construction surveys. That decline has been apparent across the study area but have been most marked in the zone within 500m of the wind turbines.

Table 2 gives the diver densities (population estimates standardised for the area in each buffer zone to give a mean density per km^2) observed in each of the buffer zones and the proportionate change in diver density observed in each during the pre-construction, construction and post-construction periods. Densities during the construction phase declined only in the zones within 500m of the wind turbines, with higher numbers recorded in the 2-3km zone. Densities recorded during the post-construction surveys have been rather lower across the whole survey area, though with the magnitude of that decline higher in closer proximity to the wind farm.

Table 2. Diver densities (number per km^2) in each of the wind farm buffer zones during the pre-construction, construction and post-construction periods, and the percentage change from the pre-construction baseline.

Period	Wind farm	0-0.5km	0.5-1km	1-2km	2-3km
Pre-construction	3.5	5.1	8.4	7.7	9.8
Construction	1.1	0.8	9.2	3.3	48.0
Post-construction	0.2	0.7	2.0	3.0	3.6
% change from pre-construction baseline:					
Construction	-69%	-84%	+10%	-57%	+488%
Post-construction	-95%	-87%	-76%	-61%	-63%

Diver Proportionate Distribution in relation to the Wind Farm

An alternative way to explore the effects of the wind farm is to look at the proportionate distribution of birds across these zones. This takes into account differences in overall numbers between years by analysing the proportion of divers records from each of the buffer zones rather than the counts/densities. For each zone the population estimates are expressed as a proportion of all of the records from within the study area. Figure 4 shows the proportion of diver records in each of these zones during the pre-construction, construction and post-construction periods. This highlights the decline in diver activity within 500m of the wind farm, which has continued in 2009-10. The ‘expected’ proportion in each zone is also shown on the Figure (as a dashed red line) if the distribution were uniform across the whole study area (i.e. if the number of diver records in each zone was proportional to the area of that zone surveyed). The proportionate distribution of the divers in relation to the wind farm was similar to that recorded in the previous post-construction surveys, with only 2% of records observed within the wind farm. The wind farm site and the 500m buffer around it were both under-utilised throughout the surveys, including those carried out prior to construction,. There was a small increase in use of the wind farm site in 2009-10 over 2008-09, when there was only a single record of a diver from within the wind farm – 5 were seen there in 2009-10 (three singles and a flock of 2). This may be an indication that the divers are becoming more tolerant of the wind turbines. Overall the diver distribution remains significantly different from both a uniform and the pre-construction baseline (X^2 = 22.7 and 22.2 for the uniform and pre-construction comparisons, $p <0.001$ in both cases).

Table 3 summarises the diver proportionate distributions observed in each of the buffer zones and the percentage change in those proportions observed in each during the pre-construction, construction and post-construction periods. The percentage of diver records from within the wind farm has declined from 9% pre-construction to only 2% during construction and post-construction. This represents a reduction by 79% from the pre-construction value during construction and by 81% from the pre-construction value during the post-construction period. Substantial percentage declines were also recorded in the 0-0.5km buffer zone around the wind farm (10% of records prior to construction, 1% and 4% during construction and post-construction respectively). This represents a reduction by 89% of the pre-construction value during construction and by 59% from the pre-construction value during the post-construction period. The changes more than 500m from the wind farm are much lower, though the results do suggest a smaller-scale reduction up to 1km from the wind farm (where the percentage of diver records has dropped by 24% of the pre-construction baseline during construction and by 21% post-construction). Beyond 1km no decline in the proportionate distribution was noted during the post-construction period.

These changes in the proportionate distribution are considered here to be more robust than the changes in density (Table 2) as they are less sensitive to changes in the overall diver numbers in the region. However the limited spatial scale of the boat survey area at Kentish Flats means that caution needs to be applied in interpreting these values and in applying them elsewhere.

Table 3. The proportions of diver records in each of the wind farm buffer zones during the pre-construction, construction and post-construction periods, and the percentage change in those proportions from the pre-construction baseline.

Period	Wind farm	0-0.5km	0.5-1km	1-2km	2-3km
Pre-construction	9%	10%	21%	41%	18%
Construction	2%	1%	16%	12%	69%
Post-construction	2%	4%	17%	54%	24%
% change from pre-construction baseline:					
Construction	-79%%	-89%	-24%	-70%	+372%
Post-construction	-81%	-59%	-21%	+30%	+29%

Clearly there has been a statistically significant decrease in diver numbers within the wind farm site and its surrounds, and this has continued in 2009-10. There has not only been a decrease in numbers but also a shift in distribution away from the wind turbines, most markedly within 500m.

Spatial Distribution of Divers in relation to Distance from Wind Turbines

Additional analysis was also undertaken of the spatial distribution of diver records in relation to distance from the wind turbines. If the birds were displaced then one would expect that distance to increase after the turbines had been constructed. For this analysis the control area data have been excluded due to the reduced coverage of the surveys in that area and so that the analysis focussed more closely on the area in proximity to the wind farm. The results summarised in Table 4 show that divers were found significantly further from the turbines during the construction and post-construction surveys (ANOVA $F=14.9$, $p_{4,1219}<0.001$). Pairwise comparisons showed that the post-construction diver distances from turbines were significantly greater than pre-construction for all of the years compared. Comparing the construction and post-construction years, the lowest distances were recorded in the construction year but those in the most recent survey year, 2009-10, were not significantly different from the construction year. In the intervening post-construction years divers were recorded at significantly greater distances from the turbines than in either the construction year or 2009-10. The mean distance to a series of random points is also given for comparison. These results add further support to the conclusion that displacement of red-throated divers has occurred from the wind farm site to a distance of about 500m.

Table 4. Distances between diver records and the wind turbine locations during the pre-construction, construction and post-construction phases.

Period	Mean distance from turbines (km)	Standard error	95% confidence limits
Pre-construction	1.18	0.03	1.12-1.24
Construction	1.38	0.06	1.27-1.49
Post-construction (2005-07)	1.53	0.05	1.43-1.62
Post-construction (2008-09)	1.63	0.07	1.49-1.77
Post-construction (2009-10)	1.44	0.06	1.33-1.55
Random points	1.09	0.04	1.01-1.17

The mean distances from the turbines recorded in each winter are shown in Figure 5 to illustrate the between-year differences. The mean distance was significantly smaller small in both of the pre-construction years in comparison with the construction and post-construction years. The 2009-10 data showed a reduction in the mean distance between the divers in comparison with the previous year, a possible indication of increasing tolerance of the turbinesbut were still statistically significantly greater than the pre-construction years.

4. Conclusions

The analysis of the 2009-10 data collected at Kentish Flats has shown that the decrease in diver numbers within the wind farm site and its surrounds (particularly within 500m of the turbines) has continued into the fifth winter since construction.

There have been some indications of an increased use of the area in proximity to the wind turbines compared with previous post-construction years (particularly in 2008-09) and this may indicate that the divers are starting to habituate to the presence of the wind turbines. However use of the wind farm site by divers continues to be very low, though even in the pre-construction baseline years use of the wind farm site was still relatively low. As noted in the previous report, the biological importance of such behaviour is not yet clear and needs to be addressed with reference to the context of the wider diver population within the Outer Thames Estuary (particularly the Special Protection Area).

An important question with regard to the local effect of the Kentish Flats wind farm on divers (displacing divers from the wind farm site and its surrounds) is its context in the wider Outer Thames Estuary SPA diver population. The area affected is very small as a proportion of the area used by divers (the wind farm plus a 500m buffer occupies only 0.004% of the Outer Thames SPA), and the aerial survey results suggest that Kentish Flats is not particularly important for divers (with a raw observed density of 1.5 divers per km^2 in that area, compared with densities in excess of 10-fold this amount in more preferred parts of the aerial survey area). This displacement effect is therefore probably negligible in the context of the Outer Thames diver population as a whole but further investigation would be needed to test this hypothesis. Further monitoring data from other offshore wind farms should also provide useful data to address this question, though methods for that monitoring should be tailored to obtain the best possible data on divers.

Whilst these results continue to show a clear reduction in diver numbers within the Kentish Flats wind farm, it was apparent that the magnitude of that reduction appeared to be reduced from the 2008-09 surveys. This effect was less clear from the 2009-10 data but may continue through time as has been observed at some onshore wind farms (e.g. for pink-footed geese, Madsen and Boertmann 2008). Studies of divers at existing offshore wind farms have also reported displacement from the wind farms. At Horns Rev none were found within the wind farm after construction, during a three-year monitoring programme (Petersen et al. 2006) and a reduction in density was reported up to 2km from the wind farm. The same publication also reported a reduced diver utilisation of areas within 2km of the Nysted wind farm after construction. Post-construction monitoring at the Nordzee wind farm project (Leopold et al. 2010) has not found any significant effects on divers, though those wind farms are located outside the divers' main preferred areas.

As noted in the previous report, it is also important to recognise that the results for this site may not be directly applicable to other wind farm sites given the Kentish Flats wind farm's relatively small number of turbines and footprint size, and its relatively low importance for divers. Divers using a site of greater importance/attractiveness to them may be less likely to be affected by disturbance than those at Kentish Flats. Differences in susceptibility to disturbance in relation to resource availability have been noted in other bird-wind farm interactions. For example, foraging barnacle geese have been reported as being displaced from as far as 600m from wind turbines on farmland habitat in winter (Kowallik and Borbach-Jaene 2001) yet birds from the same population feed as close as 25m to turbines during spring staging on Gotland (Percival 1998), where the birds are feeding on a much scarcer and more nutritionally valuable saltmarsh habitat in proximity to wind turbines. Displacement from less preferred feeding sites may more readily occur than from more important foraging areas (where birds may be more tolerant of the presence of the wind turbines).

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APPENDIX ONE – Distance correction factors and calculations.
[Originally produced as Appendix 5 to the London Array Wind Farm ES]

As noted in the main ES, the raw count data from both the boat-based and the aerial surveys need to be adjusted to take into account the fact that the likelihood of a bird being seen declines with distance from the observer (i.e. detectability is a function of distance from the transect line). Put simply, the chance of seeing a bird close to the observer would be higher than if it were at greater distance. The relationship between detectability and distance can be modelled using software packages such as Distance (Buckland *et al*. 2001), but for the purposes of this assessment a simpler approach was adopted (mainly because the limited number of distance bands makes modelling of the distance function difficult for many of the species encountered in this study). The approach used here is similar to that used by JNCC in their Seabirds at Sea surveys (e.g. Stone et al. 1995), but correction factors have been calculated for each major species group (divers, seaduck, gannet, gulls, terns and auks) specifically using the data collected from each of the two survey methods (boat and aerial). Species were assigned to these groups on their similarly of likely detectability and pooled to give a robust sample size for each group. Group compositions are given in Table A3.1. The same process was used to correct both the aerial and the boat data, though as detectability differed between these methods separate correction factors were calculated for each.

Table A3.1. Species groups used in calculation of distance correction factors

Species Group	Species
Divers	Divers, cormorants.
Gannet	Gannet
Gulls	Gulls, skuas, terns, shearwaters
Seaduck	All wildfowl

The process in calculating those correction factors was as follows:

- The total numbers of birds of each species group were calculated for each distance band over all of the surveys.
- Differences in the width of the distance bands were taken into account by dividing the total number by the band width, to give a standardised total (density index).
- It was assumed that bird detectability in the closest transect to the observer was 100% (a standard assumption of the Distance sampling methodology).
- As detectability of birds on the sea and flying were different from the boat survey data separate correction factors were used for each of these. In fact detectability of flying birds was so high that no correction factors were necessary for these birds – effectively all of these birds were detected within the main transect.
- For each of the other bands, the percentage difference between that band's standardised total and the closest band to the observer were calculated.

- These differences were then applied as the correction factors, dividing each count by the appropriate factor. For example, auks in band C were divided by 41%. Hence a count of 100 in that band would be corrected to 244 (=100/0.41).

Table A3.2. Distance correction factors used for the boat survey data

Species group	A [0-50m]	B [50-100m]	C [100-200m]	D [200-300m]	E [>300m] – out of transect
Auks	100%	100%	41%	21%	3%
Divers	100%	100%	90%	90%	60%
Gannet	100%	100%	100%	100%	100%
Gulls	100%	100%	76%	76%	74%
Seaduck	100%	100%	85%	85%	85%

Note: values are given in the Table for band E but these were not used in the density calculations or population estimates.

Table A3.3. Distance correction factors used for the aerial survey data

Species group	A [49-174m]	B [175-459m]	C [>460m]
Auks	100%	29%	2%
Divers	100%	42%	7%
Gannet	100%	62%	15%
Gulls	100%	40%	10%
Seaduck	100%	90%	21%

Note: values are given in the Table for band C but these were not used in the density calculations or population estimates.

ECOLOGY CONSULTING

APPENDIX TWO – 2009-10 BOAT SURVEY DIVER DATA.

Date	Transect	Time	Species	Flock	Distance Band	Direction	Fly	On Sea	Feed	Height	In Transect	Notes	Side	Latitude	Longitude
30/11/2009	Transect 0	09:02	BV	1	C			1				Flushed but struggled to get airbourne - full of fish?	S	51.45645	1.017273
30/11/2009	Transect 0	09:03	RH	1	D	SE	1			1			P	51.45653	1.024002
30/11/2009	Transect 1	09:41	RH	1	B			1				Flushed.	S	51.44415	1.053775
30/11/2009	Transect 2	10:25	RH	1	C	SW	1			35			P	51.45008	1.065
30/11/2009	Transect 3	11:14	RH	1	A	W	1			10			S	51.46692	1.059796
30/11/2009	Transect 6	12:55	RH	1	C	W	1			5			S	51.4856	1.081757
30/11/2009	Transect 6	13:23	RH	1	B	E	1			2			P	51.43585	1.155349
30/11/2009	Transect 7	14:05	RH	1	A			1				Flushed	S	51.48548	1.107185
30/11/2009	Transect 8	14:19	RH	1	E	W	1			15			S	51.47192	1.127991
30/11/2009	Transect 8	14:25	RH	1	C	N	1			2			P	51.46353	1.149498
16/12/2009	Transect 0	13:33	RH	1	B			1					S	51.43278	1.048981
16/12/2009	Transect 0	13:34	RH	3	A	W	1			2			S	51.43404	1.04644
16/12/2009	Transect 0	13:35	RH	1	D	SW	1			8			S	51.43687	1.046985
16/12/2009	Transect 0	13:47	RH	8	A	W	1			5			S	51.45417	1.021621
16/12/2009	Transect 0	13:47	RH	2	A	NE	1			2			S	51.45417	1.021621
16/12/2009	Transect 0	13:51	RH	3	A	W	1			3			P	51.46002	1.013248
16/12/2009	Transect 0	13:52	RH	7	A	W	1			2			S	51.46181	1.012036
16/12/2009	Transect 0	13:52	RH	3	D	N	1			10			S	51.46297	1.014698
16/12/2009	Transect 0	13:54	RH	1	A	W	1			2			S	51.46492	1.008609
16/12/2009	Transect 1	14:01	RH	1	A	E	1			15			S	51.47539	1.011949
16/12/2009	Transect 1	14:09	RH	1	C	E	1			5	1		P	51.46158	1.031865
16/12/2009	Transect 1	14:16	RH	2	A	E	1			10			S	51.44812	1.047112
16/12/2009	Transect 2	14:43	RH	2	D	W	1			1			S	51.43825	1.083474
16/12/2009	Transect 2	14:54	RH	1	D			1				flushed	S	51.45449	
16/12/2009	Transect 2	14:58	RH	1	C			1				flushed	S	51.46042	1.051185
16/12/2009	Transect 2	15:07	RH	2	D	W	1			3			P	51.4724	1.028885
16/12/2009	Transect 2	15:09	RH	2	A	W	1			2			P	51.47673	1.027642
16/12/2009	Transect 2	15:11	RH	2	D	W	1			10			S	51.48146	1.026897
16/12/2009	Transect 3	12:35	RH	1	C			1				flushed	P	51.4799	1.045428
16/12/2009	Transect 3	12:50	RH	1	C			1				flying along edge of array	S	51.45279	1.075731
16/12/2009	Transect 3	13:05	RH	1	D	E	1			5			S	51.42668	1.107717
16/12/2009	Transect 4	11:56	RH	1	A	E	1			10			P	51.43117	1.125574
16/12/2009	Transect 4	12:22	RH	1	D	SW	1			3			P	51.4742	1.063054
16/12/2009	Transect 4	12:23	RH	6	C	W	1			5			S	51.47823	1.065076
16/12/2009	Transect 4	12:23	RH	1	A	NW	1			10			S	51.47749	1.063713
16/12/2009	Transect 4	12:26	RH	2	C	S	1			12			P	51.48121	1.054871
16/12/2009	Transect 4	12:27	RH	1	B			1					S	51.48415	1.05487
16/12/2009	Transect 5	11:17	RH	1	B			1				flushed	S	51.47821	1.077582
16/12/2009	Transect 5	11:25	RH	1	B	E	1			2	1	flying through array	P	51.4674	1.095632

Date	Transect	Time	Species	Flock	Distance Band	Direction	Fly	On Sea	Feed	Height	In Transect	Notes	Side	Latitude	Longitude
16/12/2009	Transect 6	10:37	RH	1	A	E	1			10	1		P	51.44507	1.140426
16/12/2009	Transect 6	10:54	RH	1	C	SE	1			15	1		P	51.47616	1.095149
16/12/2009	Transect 6	10:54	RH	2	C			1				flushed	S	51.47796	1.098371
16/12/2009	Transect 6	10:57	RH	1	C			1				flushed	P	51.48203	1.087734
16/12/2009	Transect 6	10:57	RH	2	C			1				flushed	S	51.48357	1.091286
16/12/2009	Transect 6	10:58	RH	3	C			1				flushed	P	51.48404	1.085483
16/12/2009	Transect 7	09:57	RH	1	B	NE	1			8			S	51.48096	1.111054
16/12/2009	Transect 7	09:58	RH	1	E	SE	1			5			P	51.48259	1.11952
16/12/2009	Transect 7	09:58	RH	3	A	E	1			10			S	51.47974	1.113461
16/12/2009	Transect 7	10:00	RH	2	E	SE	1			10			P	51.47964	1.12322
16/12/2009	Transect 7	10:01	RH	1	D	SE	1			5	1		P	51.47685	1.122096
16/12/2009	Transect 7	10:01	RH	5	A	E	1			10			S	51.47532	1.118965
16/12/2009	Transect 7	10:07	RH	1	D			1				flushed	P	51.46822	1.133986
16/12/2009	Transect 7	10:07	RH	1	C			1				flushed	S	51.466	1.129433
16/12/2009	Transect 7	10:08	RH	1	C			1				flushed	P	51.46617	1.134727
16/12/2009	Transect 7	10:09	RH	1	E	N	1			5			P	51.46661	1.140562
16/12/2009	Transect 7	10:12	RH	2	D	S	1			2			P	51.4609	1.142916
16/12/2009	Transect 7	10:12	RH	1	D	NW	1			1			S	51.458	1.137384
16/12/2009	Transect 7	10:21	RH	1	A	E	1			10			S	51.44646	1.157239
16/12/2009	Transect 7	10:23	RH	1	E	NE	1			5			P	51.44658	1.166861
16/12/2009	Transect 8	09:43	RH	1	E	S	1			5			P	51.48064	1.121622
16/12/2009	Transect 8	09:43	RH	1	A	E	1			15			P	51.48309	1.127244
16/12/2009	Transect 8	09:30	RH	1	D	E	1			15			S	51.45893	1.161848
16/12/2009	Transect C1	09:16	BV	1	B			1				flushed	S	51.43222	1.194243
16/12/2009	Transect C2	08:59	RH	1	E	NW	1			2			P	51.44079	1.206188
16/12/2009	Transect C2	09:00	RH	1	D	SE	1			20			S	51.43488	1.200055
16/12/2009	Transect C2	09:01	RH	1	D	S	1			20			S	51.43332	1.202156
16/12/2009	Transect C2	09:06	BV	1	D			1				flushed	P	51.42847	1.218364
16/12/2009	Transect C3	08:49	RH	1	C			1				flushed	S	51.44885	1.206075
16/12/2009	Transect C4	08:28	RH	1	C			1				flushed	S	51.43799	1.231521
16/12/2009	Transect C4	08:31	RH	1	C			1				flushed	P	51.43508	1.241414
16/12/2009	Transect C4	08:31	RH	1	A	E	1			5			S	51.43401	1.239566
16/12/2009	Transect C4	08:33	RH	1	C			1				flushed	S	51.43039	1.242481
11/01/2010	Transect 0	09:23	RH	1	A	W	1			2			P	51.45717	1.016932
11/01/2010	Transect 0	09:27	RH	1	D			1		0	1	Flushed.	S	51.44855	1.022457
11/01/2010	Transect 0	09:30	RH	1	B	SE	1			30	1		P	51.44558	1.033015
11/01/2010	Transect 0	09:31	BV	1	C			1		0	1	Flushed.	S	51.44261	1.032961
11/01/2010	Transect 1	09:51	BV	1	D	W	1			30			S	51.42651	1.080414
11/01/2010	Transect 1	10:05	RH	1	B	W	1			3			S	51.44874	1.048593
11/01/2010	Transect 1	10:08	RH	1	C	SW	1			1			S	51.45404	1.043105
11/01/2010	Transect 1	10:10	RH	1	C	W	1			5			S	51.45702	1.03884
11/01/2010	Transect 1	10:10	RH	1	D			1		0	1		S	51.45756	1.039994
11/01/2010	Transect 1	10:12	RH	1	B	SE	1			10			S	51.45982	1.034017

Date	Transect	Time	Species	Flock	Distance Band	Direction	Fly	On Sea	Feed	Height	In Transect	Notes	Side	Latitude	Longitude
11/01/2010	Transect 1	10:12	RH	5	A	W	1			10			S	51.45956	1.033426
11/01/2010	Transect 1	10:12	RH	3	C			1		0	1		S	51.4602	1.034905
11/01/2010	Transect 1	10:12	RH	3	D			1		0	1	Flushed.	P	51.45814	1.030172
11/01/2010	Transect 1	10:13	RH	1	B			1		0	1		S	51.45982	1.034017
11/01/2010	Transect 1	10:13	RH	5	C	W	1			10			S	51.4602	1.034905
11/01/2010	Transect 1	10:13	RH	1	A			1		0	1		S	51.46126	1.031525
11/01/2010	Transect 1	10:14	RH	1	A			1		0	1		S	51.46289	1.029463
11/01/2010	Transect 1	10:14	RH	1	C	NE	1			10			S	51.46363	1.030825
11/01/2010	Transect 1	10:16	RH	1	D			1		0	1		S	51.46734	1.027747
11/01/2010	Transect 1	10:16	RH	1	A	E	1			10			S	51.46606	1.025221
11/01/2010	Transect 1	10:17	RH	1	B			1		0	1		S	51.46634	1.025782
11/01/2010	Transect 1	10:17	RH	1	D			1		0	1	Flushed.	S	51.46734	1.027747
11/01/2010	Transect 2	10:35	RH	1	A			1		0	1		S	51.46799	1.038622
11/01/2010	Transect 2	10:39	RH	1	B			1		0	1		P	51.46312	1.046234
11/01/2010	Transect 2	10:39	RH	1	A			1		0	1	Flushed.	S	51.4608	1.047313
11/01/2010	Transect 2	10:39	RH	1	D			1		0	1	Flushed.	P	51.46239	1.050356
11/01/2010	Transect 2	10:41	BV	1	A	NW	1			5			S	51.45729	1.052003
11/01/2010	Transect 2	10:42	RH	1	D	NW	1			5			S	51.45422	1.051884
11/01/2010	Transect 2	10:42	RH	1	C			1		0	1		S	51.4548	1.052991
11/01/2010	Transect 2	10:42	RH	11	A	W	1			10			S	51.45553	1.054373
11/01/2010	Transect 2	10:42	RH	1	D	W	1			3	1		P	51.45712	1.057416
11/01/2010	Transect 2	10:44	RH	2	C	SW	1			3			P	51.45475	1.058684
11/01/2010	Transect 2	10:44	RH	18	A	W	1			10			S	51.45201	1.059033
11/01/2010	Transect 2	10:44	RH	2	D	S	1			5			P	51.4536	1.062076
11/01/2010	Transect 2	10:45	RH	7	A	W	1			10			S	51.45027	1.061348
11/01/2010	Transect 2	10:52	RH	3	D	W	1			25			S	51.43689	1.075626
11/01/2010	Transect 2	10:54	RH	1	A	W	1			15	1		P	51.43493	1.0835
11/01/2010	Transect 2	10:58	RH	2	C	N	1			25			P	51.42858	1.094349
11/01/2010	Transect 3	11:27	RH	1	D			1		0	1	On sea between turbines KF20 & KF26 then flushed then low W out of turbine array.	S	51.46098	1.073018
11/01/2010	Transect 3	11:27	RH	1	C			1		0	1	Flushed.	P	51.45892	1.068285
11/01/2010	Transect 3	11:35	RH	1	A			1		0	1		S	51.47196	1.052964
11/01/2010	Transect 3	11:35	RH	4	A	W	1			5			S	51.47196	1.052964
11/01/2010	Transect 3	11:35	RH	2	C			1		0	1		S	51.47273	1.054285
11/01/2010	Transect 3	11:39	RH	2	E	SW	1			2			P	51.47533	1.038522
11/01/2010	Transect 3	11:41	RH	1	C	NE	1			5			P	51.47999	1.039368
11/01/2010	Transect 4	11:53	RH	2	D			1		0	1	Flushed.	P	51.47858	1.066686
11/01/2010	Transect 4	11:53	RH	1	A	W	1			6			P	51.47725	1.064233
11/01/2010	Transect 4	11:56	RH	1	A	SW	1			20			S	51.47176	1.070797
11/01/2010	Transect 5	12:35	RH	1	A			1		0	1		S	51.44413	1.124904

Date	Transect	Time	Species	Flock	Distance Band	Direction	Fly	On Sea	Feed	Height	In Transect	Notes	Side	Latitude	Longitude
11/01/2010	Transect 5	12:56	RH	2	D	W	1			10			S	51.47829	1.083847
11/01/2010	Transect 5	12:57	RH	1	D	N	1			10			S	51.47987	1.081757
11/01/2010	Transect 5	12:57	RH	2	D	W	1			10			S	51.47987	1.081757
11/01/2010	Transect 5	12:57	RH	4	A	W	1			10			S	51.47859	1.079231
11/01/2010	Transect 5	13:00	RH	2	C			1		0	1		P	51.48239	1.071249
11/01/2010	Transect 5	13:01	RH	1	B			1		0	1		S	51.48524	1.071476
11/01/2010	Transect 7	14:11	RH	1	A	W	1			3			P	51.48104	1.111583
11/01/2010	Transect 8	14:26	div	1	E			1		0			P	51.47286	1.148208
11/01/2010	Transect 8	14:32	RH	1	C			1		0	1	Flushed.	S	51.46155	1.152216
11/01/2010	Transect 8	14:34	RH	9	E			1		0		Flushed.	P	51.46356	1.161663
11/01/2010	Transect 8	14:34	RH	3	D	W	1			3			P	51.46046	1.161163
11/01/2010	Transect 8	14:35	RH	1	C			1		0	1	Flushed.	S	51.45638	1.159245
11/01/2010	Transect 8	14:39	RH	4	E	N	1			2			P	51.45317	1.17566
11/01/2010	Transect C1	14:44	RH	1	A	W	1			10			S	51.44149	1.180702
11/01/2010	Transect C1	14:46	RH	1	A	NE	1			5			S	51.43799	1.18502
11/01/2010	Transect C1	14:48	RH	1	D	W	1			30			P	51.43615	1.192425
11/01/2010	Transect C1	14:52	RH	5	D	W	1			20			S	51.42658	1.196171
11/01/2010	Transect C3	15:20	RH	1	C	N	1			5			P	51.44505	1.210561
11/01/2010	Transect C3	15:23	BV	1	D	W	1			5		Appeared to have just flushed.	S	51.43776	1.21377
11/01/2010	Transect C3	15:30	RH	1	D	W	1			1			S	51.42807	1.227967
11/01/2010	Transect C4	15:35	RH	1	D	N	1			1			S	51.43169	1.247554
11/01/2010	Transect C4	15:37	RH	3	A			1		0	1	Flushed.	S	51.43392	1.240658
11/01/2010	Transect C4	15:39	RH	1	E	N	1			2			P	51.43433	1.230373
11/01/2010	Transect C4	15:40	RH	7	E			1		0			P	51.4359	1.228211
11/01/2010	Transect C4	15:41	RH	1	C	W	1			1			S	51.44152	1.232624
19/01/2010	Transect 0	15:59	RH	1	A			1		0	1		S	51.45688	1.016742
19/01/2010	Transect 0	16:00	RH	3	A	W	1			2			S	51.45507	1.018939
19/01/2010	Transect 1	15:40	RH	1	D	W	1			5			P	51.46481	1.021554
19/01/2010	Transect 1	15:41	RH	1	A	SW	1			1			S	51.46798	1.022493
19/01/2010	Transect 4	13:41	RH	1	C			1		0	1		S	51.43497	1.118061
19/01/2010	Transect 4	13:44	RH	1	C	E	1			1			S	51.43097	1.123844
19/01/2010	Transect 5	12:35	RH	1	A	E	1			1			S	51.43427	1.137551
19/01/2010	Transect 6	12:15	RH	1	D	E	1			1	1		S	51.44757	1.131687
19/01/2010	Transect 6	12:16	RH	2	A	NE	1			12			S	51.44765	1.135986
19/01/2010	Transect 6	12:20	RH	1	A	NE	1			1			S	51.44211	1.143472
19/01/2010	Transect 6	12:24	RH	1	A	NE	1			10			S	51.43688	1.151084
19/01/2010	Transect 8	09:40	RH	1	D	N	1			2			P	51.46539	1.151933
03/02/2010	Transect 0	15:38	RH	2	C			1		0	1	Flushed.	S	51.46302	1.00694
03/02/2010	Transect 0	15:39	RH	3	C			1		0	1	Flushed.	S	51.46133	1.008987
03/02/2010	Transect 0	15:41	RH	1	A			1		0	1	Flushed.	S	51.45868	1.014549
03/02/2010	Transect 2	14:25	RH	1	A	E	1			25			P	51.46565	1.043038
03/02/2010	Transect 5	12:34	RH	2	C			1		0	1	Between turbines KF23 and	S	51.46303	1.1024

Date	Transect	Time	Species	Flock	Distance Band	Direction	Fly	On Sea	Feed	Height	In Transect	Notes	Side	Latitude	Longitude
												KF17.			
03/02/2010	Transect 5	12:45	RH	1	D			1		0	1	Flushed.	S	51.48453	1.075704
03/02/2010	Transect 6	11:54	RH	2	D			1		0	1		P	51.45932	1.125055
03/02/2010	Transect 6	12:00	RH	2	A	E	1			10	1		S	51.44927	1.133482
03/02/2010	Transect 6	12:07	RH	1	A			1		0	1	Flushed.	S	51.44097	1.144478
03/02/2010	Transect 6	12:12	RH	1	A	E	1			1			P	51.43313	1.155918
03/02/2010	Transect 7	11:13	RH	1	D	S	1			5			P	51.46045	1.134059
03/02/2010	Transect 7	11:14	RH	1	A			1		0	1	Flushed.	S	51.46381	1.135011
03/02/2010	Transect 8	09:20	RH	2	A	W	1			10			S	51.48055	1.130323
03/02/2010	Transect 8	09:20	RH	1	D	NE	1			8			P	51.48214	1.133367
03/02/2010	Transect 8	09:20	RH	1	A	N	1			15			S	51.48055	1.130323
03/02/2010	Transect 8	09:20	RH	1	E	NE	1			8			P	51.48358	1.136135
03/02/2010	Transect 8	09:22	div	6	E	W	1			10			P	51.48	1.141025
03/02/2010	Transect 8	09:23	RH	2	A	E	1			15			P	51.47725	1.135767
03/02/2010	Transect 8	09:23	RH	6	A	W	1			10	1		P	51.47539	1.138212
03/02/2010	Transect 8	09:24	RH	7	A	S	1			10			S	51.47332	1.138903
03/02/2010	Transect 8	09:24	RH	3	C			1		0	1	Flushed.	P	51.47307	1.1414
03/02/2010	Transect 8	09:26	RH	1	D	N	1			1			S	51.46874	1.134323
03/02/2010	Transect 8	09:30	RH	1	A			1		0	1		S	51.4627	1.147371
03/02/2010	Transect 8	09:31	RH	1	A			1		0	1		P	51.46227	1.151125
03/02/2010	Transect 8	09:35	RH	1	D	N	1			25	1		P	51.45767	1.164866
03/02/2010	Transect 8	09:36	RH	6	C			1		0	1		S	51.45366	1.162637
03/02/2010	Transect 8	09:36	RH	6	A	W	1			5			S	51.45437	1.164039
03/02/2010	Transect 8	09:37	RH	9	C			1		0	1	Flushed.	P	51.45361	1.168267
03/02/2010	Transect 8	09:38	RH	3	A	W	1			5			S	51.4509	1.168466
03/02/2010	Transect C1	09:46	RH	4	B			1		0	1	Flushed.	S	51.43675	1.185533
03/02/2010	Transect C1	09:51	RH	3	C			1		0	1		P	51.42963	1.199163
03/02/2010	Transect C1	09:52	RH	1	C	E	1			10			P	51.42794	1.201339
03/02/2010	Transect C1	09:53	RH	1	D	S	1			10			P	51.42681	1.204714
03/02/2010	Transect C1	09:55	RH	1	E			1		0			P	51.42767	1.207468
03/02/2010	Transect C2	10:06	RH	5	D			1		0	1	Flushed.	S	51.43703	1.207005
03/02/2010	Transect C4	10:42	RH	12	D			1		0	1		P	51.4397	1.227263
03/02/2010	Transect C4	10:42	RH	4	A			1		0	1	Flushed.	P	51.44263	1.227918
03/02/2010	Transect C4	10:45	RH	17	E			1		0		Flushed.	P	51.44574	1.215929
19/02/2010	Transect 0	09:30	RH	12	D	NE	1			15		2km ahead	P	51.468	1.008484
19/02/2010	Transect 0	09:32	RH	1	C	N	1			12			S	51.46234	1.007583
19/02/2010	Transect 0	09:37	RH	3	C	NE	1			5			S	51.45406	1.018725
19/02/2010	Transect 0	09:38	RH	1	A	W	1			2		1km ahead	P	51.45345	1.022912
19/02/2010	Transect 0	09:40	RH	1	D	SE	1			10		break in survey while deviating from line	S	51.44914	1.026947
19/02/2010	Transect 1	10:46	RH	1	A	W	1			1			S	51.4604	1.032908
19/02/2010	Transect 2	11:07	RH	1	C	NE	1			10	1		S	51.47137	1.030956
19/02/2010	Transect 2	11:37	RH	1	C			1		0	1	flushed	P	51.42557	1.097391

Date	Transect	Time	Species	Flock	Distance Band	Direction	Fly	On Sea	Feed	Height	In Transect	Notes	Side	Latitude	Longitude
19/02/2010	Transect 2	11:37	RH	1	A			1		0	1		S	51.42411	1.096445
19/02/2010	Transect 4	12:58	RH	1	D	N	1			1			S	51.43719	1.112766
19/02/2010	Transect 4	13:02	RH	2	B			1				flushed	P	51.4331	1.123606
19/02/2010	Transect 4	13:03	RH	1	D			1		0	1	flushed	S	51.43138	1.119811
19/02/2010	Transect 4	13:05	RH	1	E	E	1			5			P	51.43139	1.133707

1

Note: RH = red-throated diver, div = diver species, BV = black-throated diver.

Figure 1. Boat survey area used in 2009-10, showing the main transects and the additional transect extensions

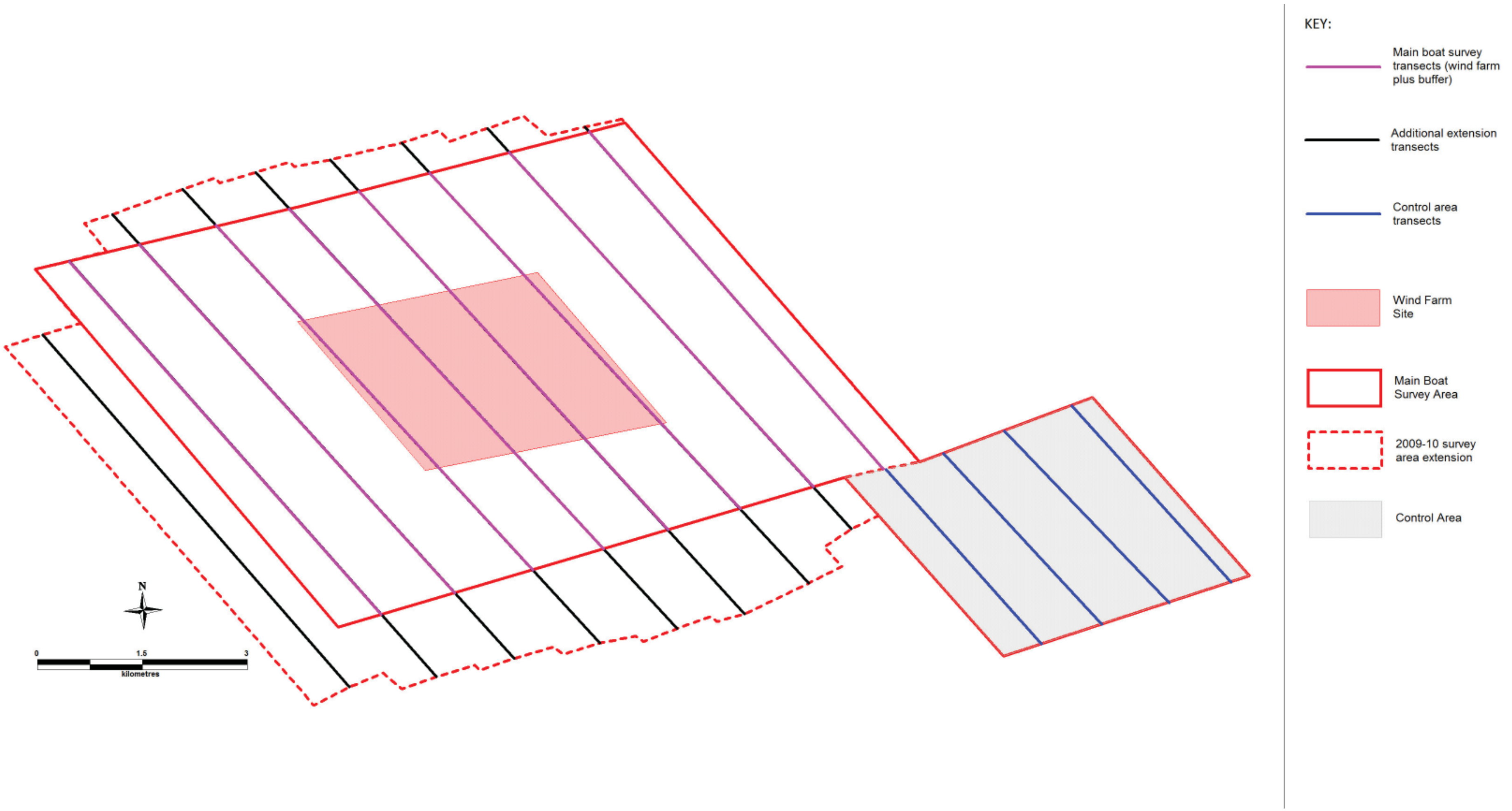

Figure 2. Diver population estimates for each survey of the wind farm plus buffer, control and new extension zones in 2009-10.

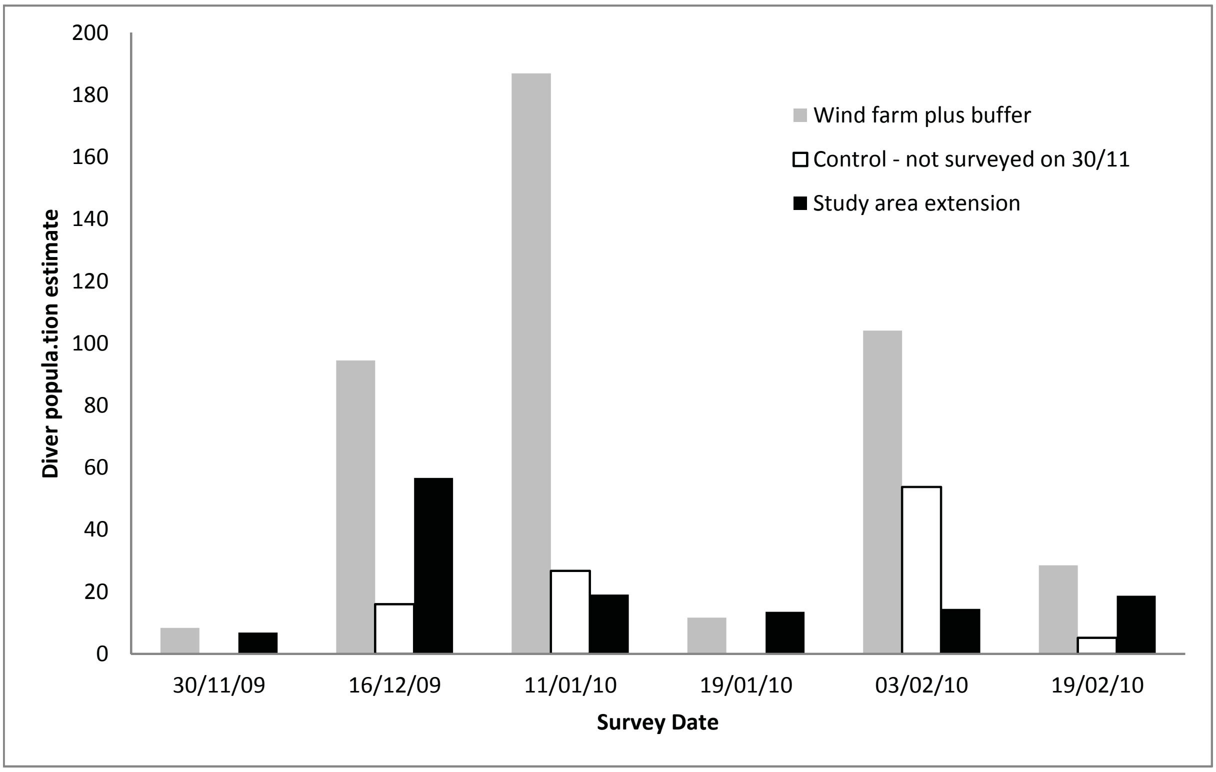

Figure 3a. Distribution of divers recorded during the 2009-10 post-construction boat surveys

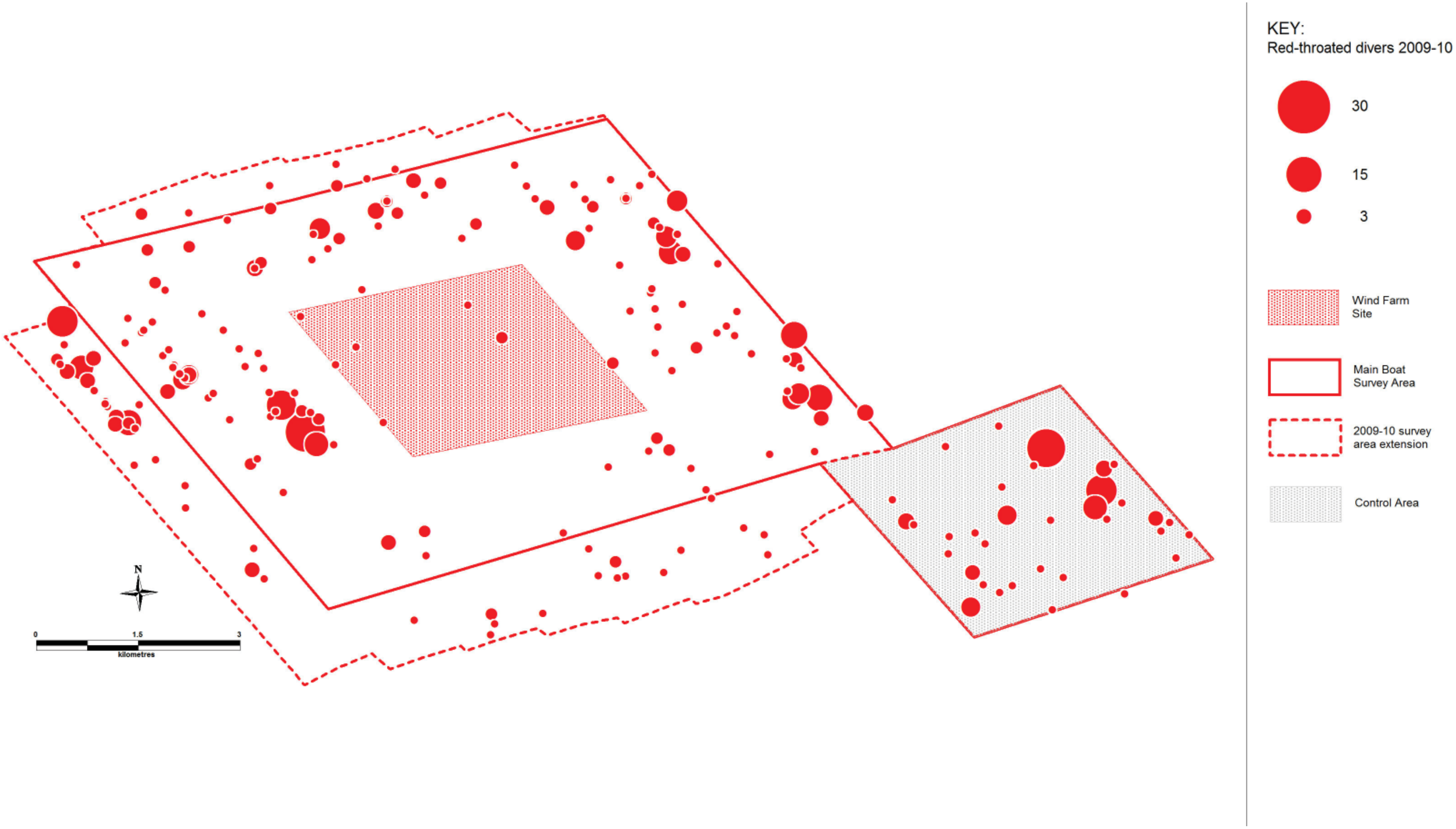

Figure 3b. Distribution of divers recorded during the pre-construction boat surveys

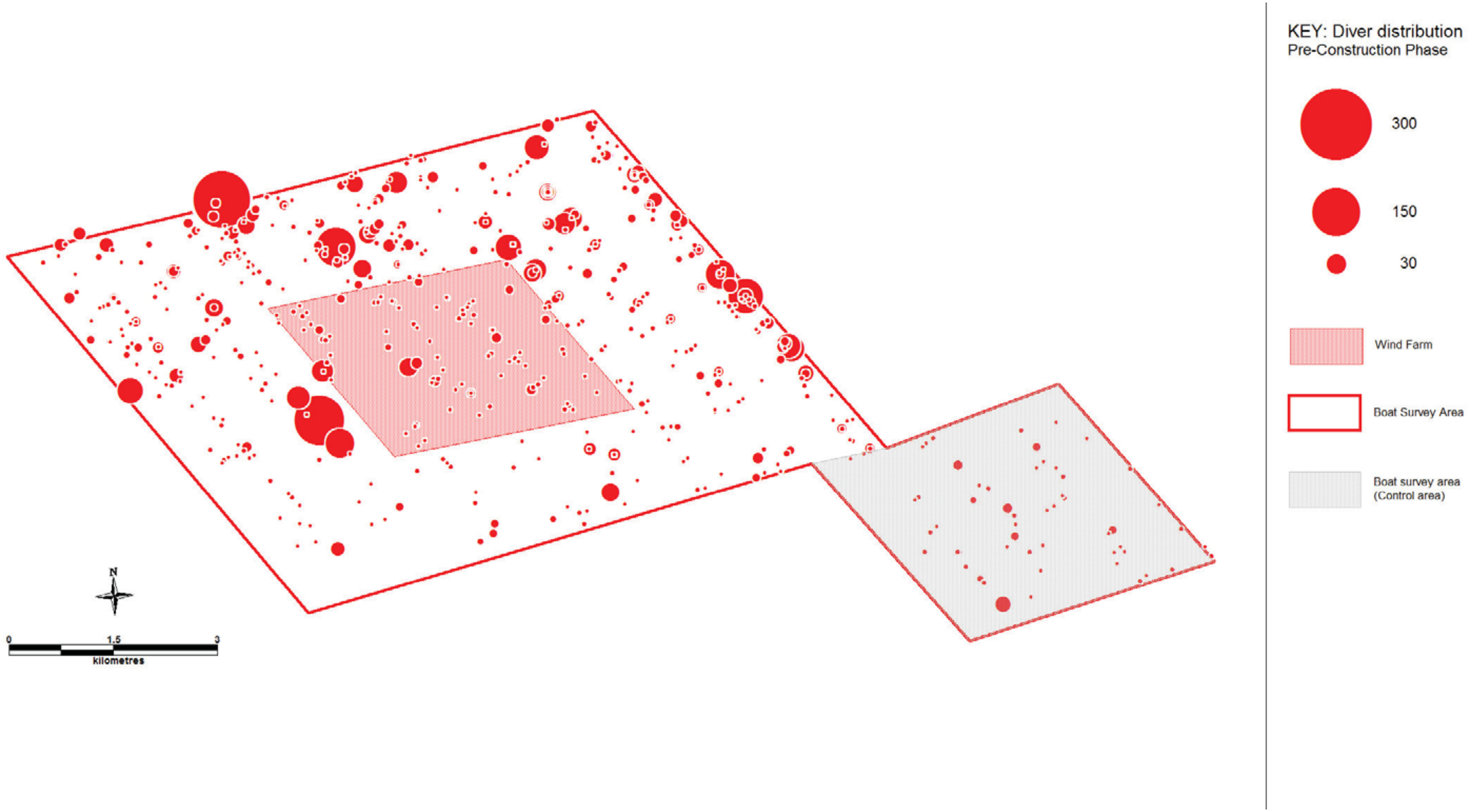

Figure 3c. Distribution of divers recorded during the construction phase boat surveys

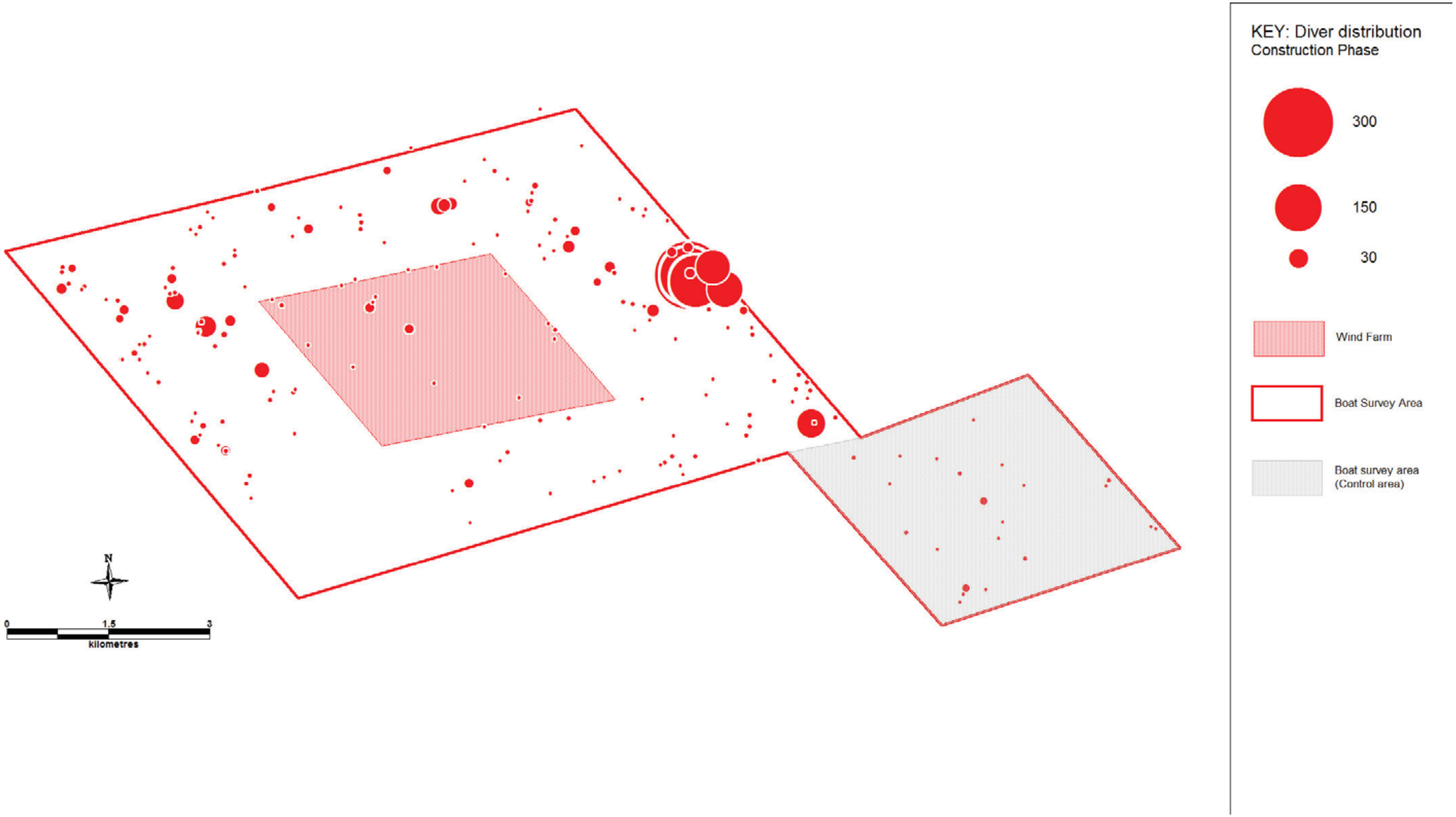

Figure 3d. Distribution of divers recorded during the post-construction boat surveys

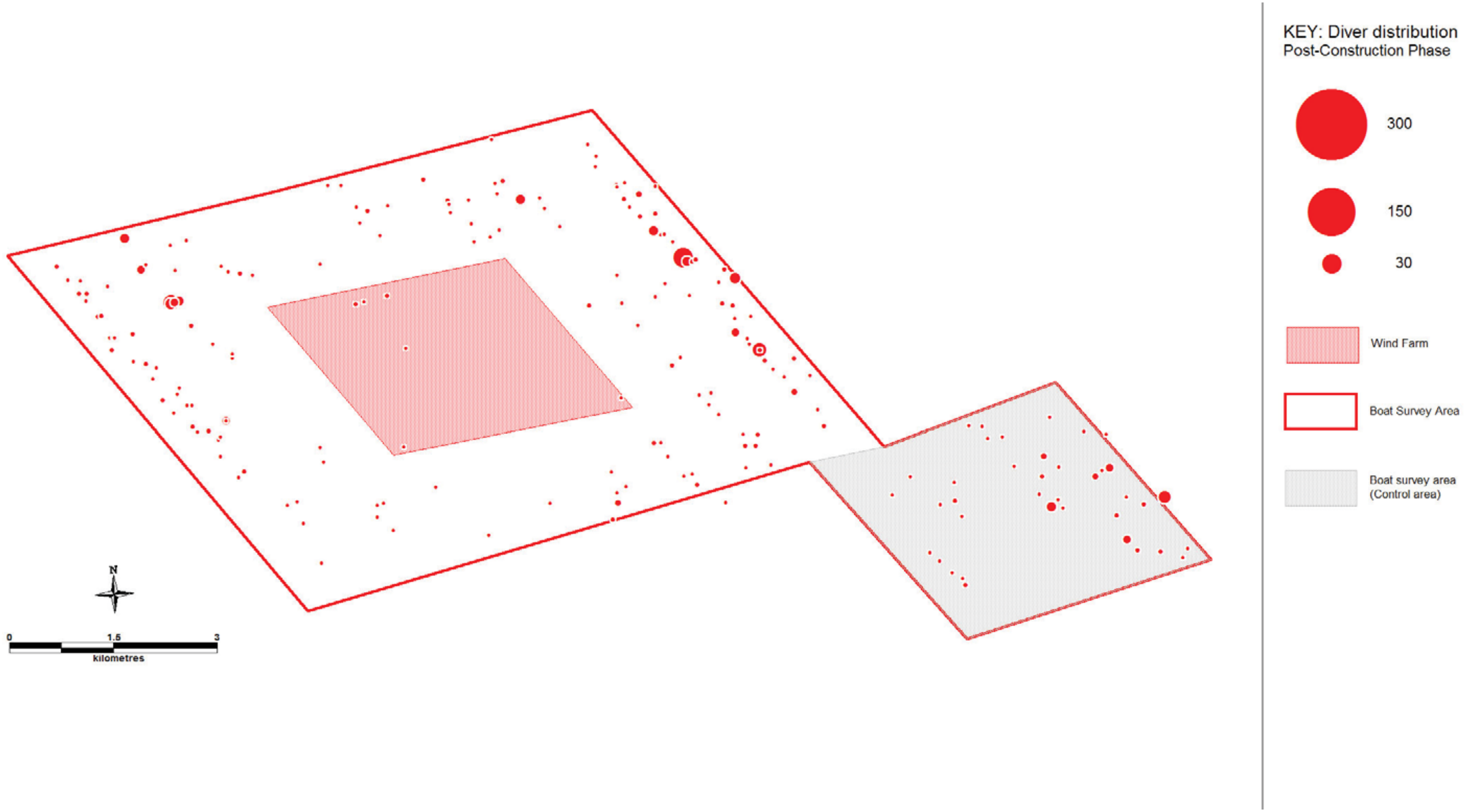

Figure 3e. Distribution of divers recorded during the 2008-09 post-construction boat surveys

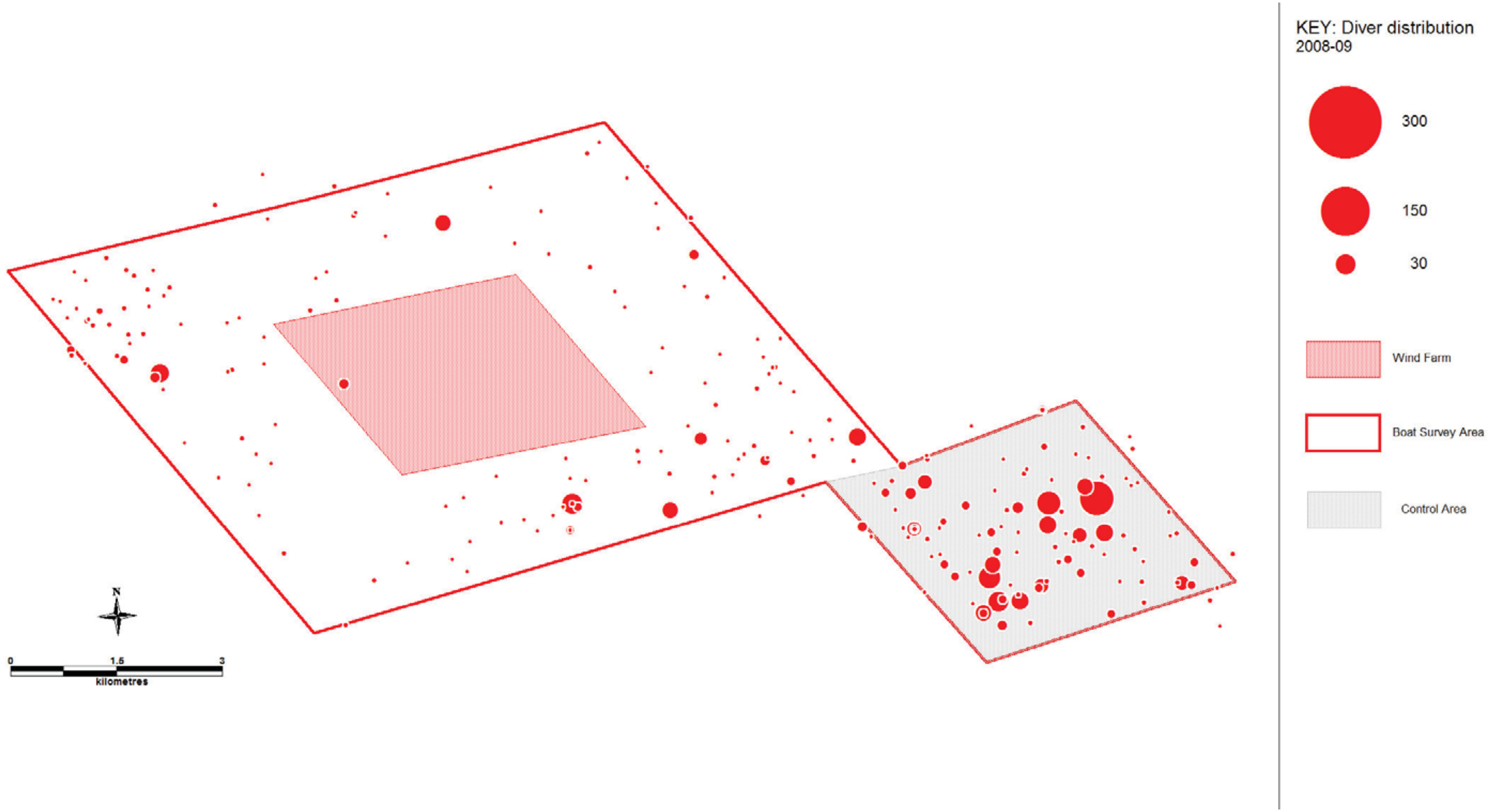

Figure 4. Diver population estimates for the wind farm footprint and surrounding buffer zones for each survey year (grey = pre-construction - 2002-03 and 2003-04, white = construction year - 2004-05 and black = post-construction - 2005-06, 2006-07, 2008-09 and 2009-10)

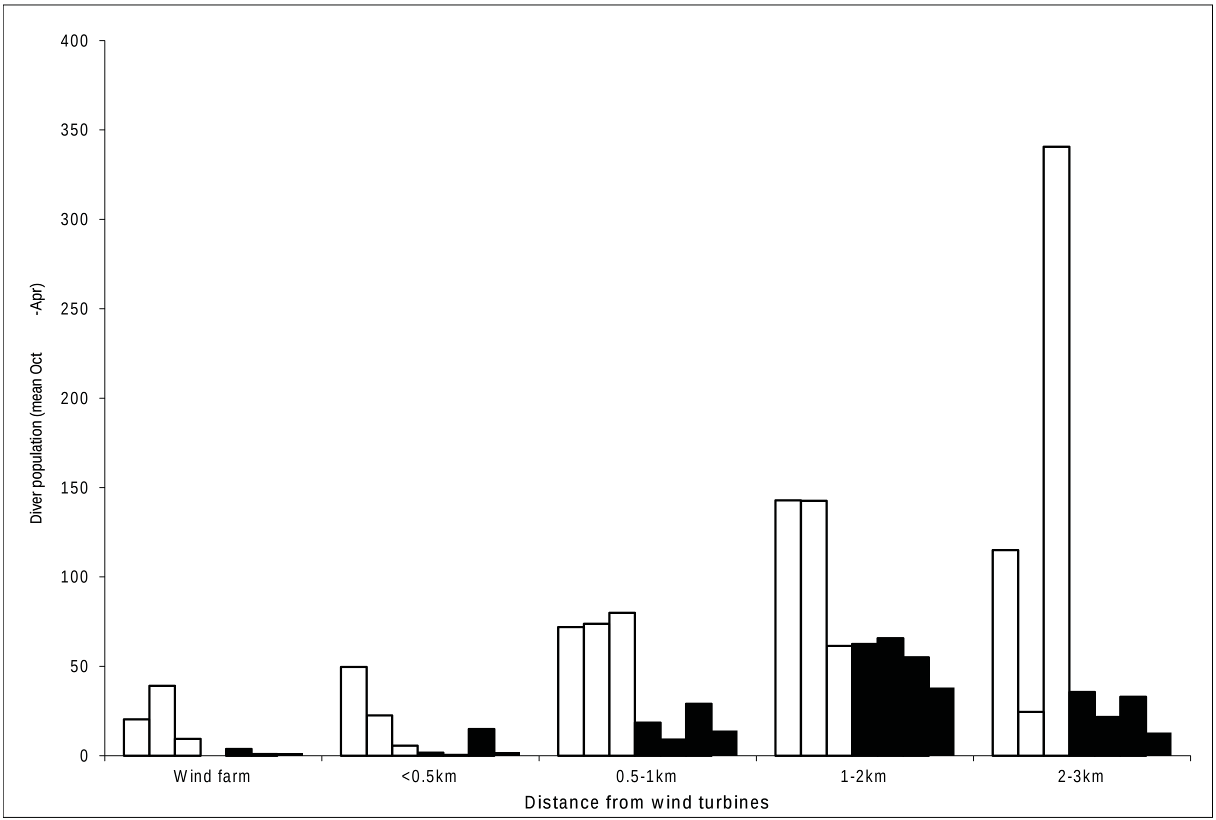

Figure 5 Diver population densities for the wind farm footprint and surrounding buffer zones for each survey year (grey = pre-construction - 2002-03 and 2003-04, white = construction year - 2004-05 and black = post-construction - 2005-06, 2006-07, 2008-09 and 2009-10)

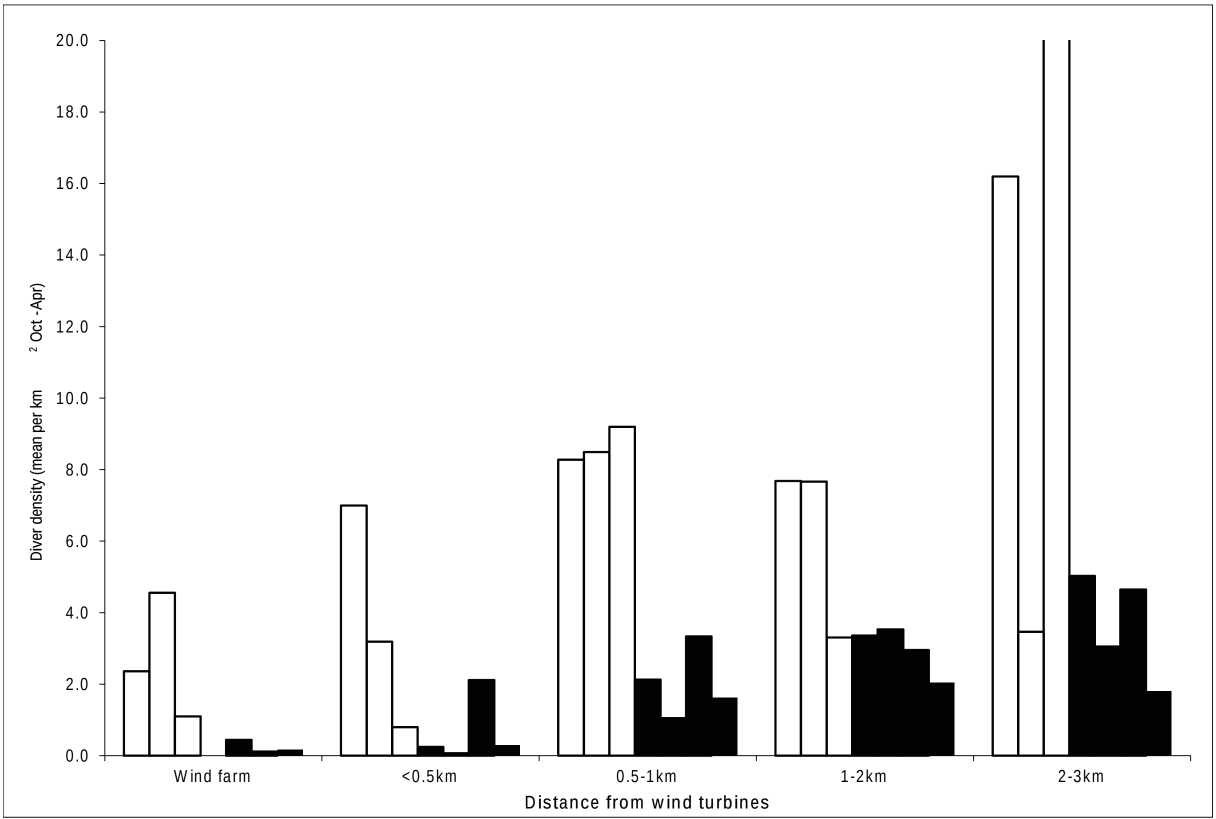

Figure 6. Diver proportionate distribution for the wind farm footprint and surrounding buffer zones for each survey year (grey = pre-construction - 2002-03 and 2003-04, white = construction year - 2004-05 and black = post-construction - 2005-06, 2006-07, 20008-09 and 2009-10). Red dashed lines indicate expected proportion if distribution uniform.

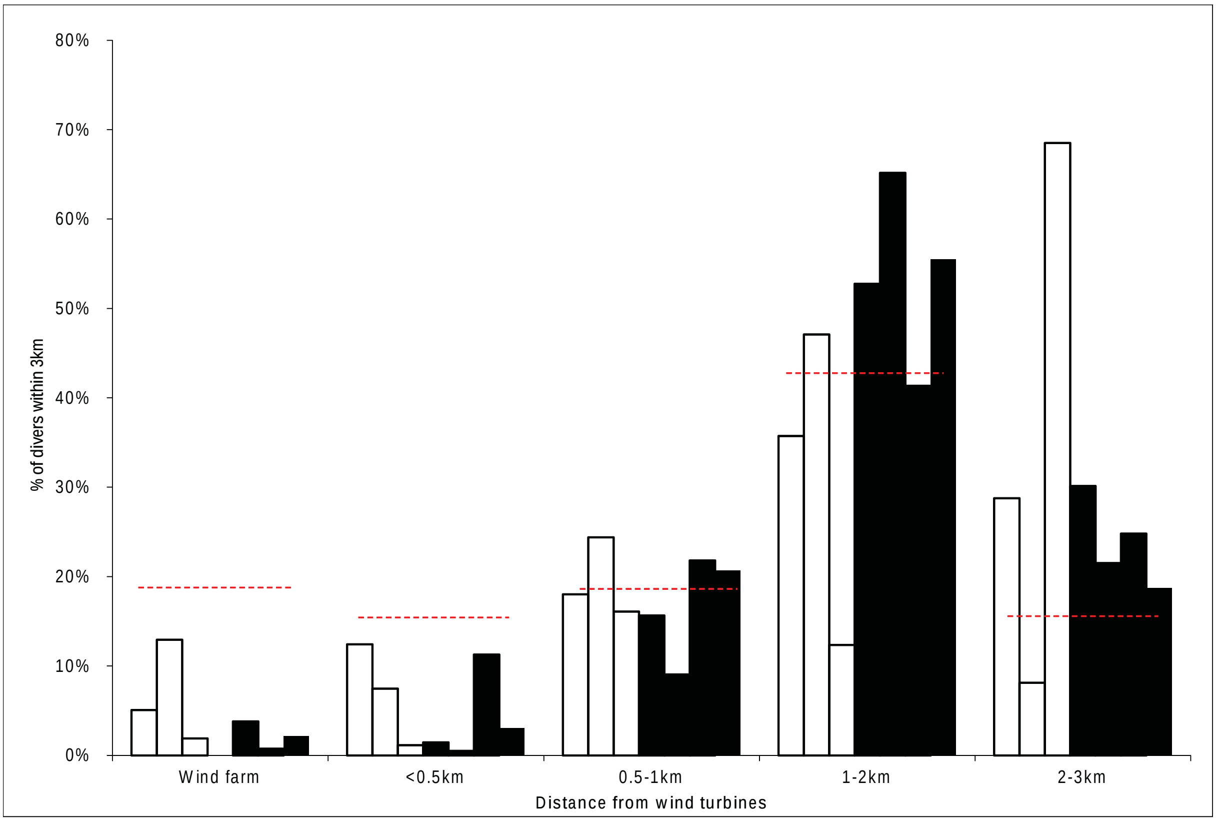

Figure 7. Distances between diver records and the wind turbine locations during each winter of the pre-construction (grey bars), construction (white) and post-construction (black) phases. Mean values are shown + upper 95% confidence limit