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An assessment of the numbers and distributions of little gull *Hydrocoloeus minutus* and great cormorant *Phalacrocorax carbo* over winter in the Outer Thames Estuary

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Data collected between October 2002 and March 2005 were commissioned jointly by a consortium of companies. These were London Array Limited (E.ON UK Renewables Developments Limited), Elsam A/S, Vestas Wind Systems A/S, GE Gunfleet Limited, Greater Gabbard Offshore Winds Limited (Airtricity and Fluor Corporation), Thanet Offshore Wind Limited (Warwick Energy Limited) and npower renewables. In addition, the Department of Trande and Industry (DTI) and the Department for Environment, Food and Rural Affairs provided funding for surveys carried out in the winter of 2004/05. These surveys were co-ordinated initially by Peter Cranswick of WWT, then latterly by Phil Bloor of the Department of Trade and Industry.

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Surveys carried out by the Natural Environmental Research Institute, Denmark were co-ordinated by Ib Krag Petersen and Tony Fox, and carried out by Jens Peter Hounisen, Ib Krag Petersen, Jesper Kyed Larsen, Rasmus Bisschop Larsen, Lucy Smith, Thomas Eske Holm. Aircraft were provided by Ravenair and by Sterling Aviation and flown and co-ordinated by Howard Fenby, Christopher Mace and David Maclean.

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Summary

Directive 2009/147/EC of the European Parliament and the Council of 30 November 2009 on the conservation of wild birds (this is the codified version of Directive 79/409/EEC as amended) requires EU member states to identify as Special Protection Areas (SPAs) the most suitable territories on land and at sea for species listed on Annex I of the Directive and regularly occurring migratory species. To identify inshore areas that might be suitable for SPA classification, 45 areas of search were selected where potentially important numbers of waterbirds congregate outside the breeding season. The Outer Thames Estuary was one of these, as it is known that seabirds and waterbirds use the area during winter. In 2010 part of the Outer Thames Estuary area of search was classified as an SPA to protect wintering red-throated diver (O'Brien *et al* 2012). Additional intertidal SPAs fringing the Outer Thames Estuary area provide protection for a variety of bird features above mean low water.

Webb *et al* (2009) provide population estimates for waterbird and seabird species recorded on aerial surveys of the Outer Thames Estuary over eight winter seasons 1988/89 – 2006/07. Red-throated diver occurred in numbers that exceeded the Stage 1.1 threshold and were subsequently protected within the Outer Thames Estuary SPA. Little gull *Hydrocoloeus minutus* numbers were assessed but it was suggested that further survey would be required in order to determine if important numbers of little gull were regularly present. Other waterbird and seabird species individually or as an assemblage were not present in numbers that exceeded the thresholds under the UK SPA selection guidelines.

Incorporating an additional year of data (2007/08), this report reassesses the number and distribution of little gull within the Outer Thames Estuary over winter and investigates the number and distribution of great cormorant *Phalacrocorax carbo*, as this species had not been assessed previously.

Five winter seasons of aerial survey data (2003/04, 2004/05, 2005/06, 2006/07, 2007/08) were analysed using distance sampling methods. The means of the highest counts from each winter (mean of peak) were used to define the size of the population of each species in the Outer Thames Estuary, as is standard practice deriving from the Ramsar convention. The numbers of little gull and great cormorant were assessed against the UK SPA selection guideline thresholds (Stroud *et al* 2001).

Little gull had a mean of peak population estimate of 258 individuals, taken over two seasons within the Outer Thames Estuary area of search. The numbers of little gull recorded in the Outer Thames Estuary were the third highest of the inshore areas of search around the UK. There is no GB population estimate for little gull currently available, accordingly the aggregation of this species in the Outer Thames was considered under Stage 1.4 of the UK SPA selection guidelines. The highest densities of little gull were concentrated offshore along the 12nm limit and in the northern part of the area of search, though usage was dispersed within the area rather that in regularly occurring hotspots.

The distribution of great cormorant was concentrated in the inshore waters of the Thames Estuary, particularly along the north Kent coastline. The mean of peak population estimate for great cormorant within the area of search was 1,077 individuals, based on five winter seasons (2003/04 - 2007/08). This is just below the 1% biogeographic threshold of 1,200 individuals. One of the surveys that contributed to this mean of peak calculation had an exceptionally high estimate for great cormorant. The numbers recorded on all other surveys were considerably less.

Contents

1 Introduction

In 1979, the European Commission adopted the European Council (EC) Directive on the conservation of wild birds, commonly known as the Birds Directive (EC 2009; codified version). It requires Member States to classify the “most suitable territories” in number and size as Special Protection Areas (SPAs) for species listed on Annex I of the Directive and regularly occurring migratory species.

The UK SPA selection guidelines for the identification of SPAs advise that sites should be identified in two stages (Stroud *et al* 2001). While Stage 1 identifies areas that are likely to qualify for SPA status, Stage 2 further considers these areas to select the most suitable areas in number and size for SPA classification.

Stage 1 of the Guidelines identifies areas as follows:

1. Stage 1.1: an area is used regularly by 1% or more of the Great Britain (GB) population of a species listed in Annex I of the EC Birds Directive;
2. Stage 1.2: an area is used regularly by 1% or more of the biogeographic population of a regularly occurring migratory species, other than those listed in Annex I of the EC Birds Directive;
3. Stage 1.3: an area is used regularly by an assemblage of more than 20,000 waterbirds comprising at least two species;
4. Stage 1.4: where the application of stages 1.1-1.3 does not identify an adequate suite of areas, additional sites may be selected if they meet one or more of the Stage 2 guidelines.

Stage 1's fourth guideline gives consideration, using the Stage 2 judgements, to cases where a species' population status, ecology or movement patterns may mean that an adequate number of areas cannot be identified from Stage 1's first three guidelines alone.

Stage 2 of the Guidelines considers the following:

1. Population size and density: Areas holding or supporting more birds than others and/or holding or supporting birds at higher concentrations are favoured for selection.
2. Species range: Areas selected for a given species provide as wide a geographic coverage across the species' range as possible.
3. Breeding success: Areas of higher breeding success than others are favoured for selection.
4. History of occupancy: Areas known to have a longer history of occupation or use by the relevant species are favoured for selection.
5. Multi-species areas: Areas holding or supporting the larger number of qualifying species under Article 4 of the Directive are favoured for selection.
6. Naturalness: Areas comprising natural or semi-natural habitats are favoured for selection over those which do not.
7. Severe weather refuges: Areas used at least once a decade by significant proportions of the biogeographical population of a species in periods of severe weather in any season, and which are vital to the survival of a viable population, are favoured for selection.

Natural England advises the UK Government of the most suitable areas for classification as SPAs in UK territorial waters adjacent to England (within 12nm). The aim of this report is to provide Natural England with the evidence necessary to support its advice to the UK Government on the relative importance of the Outer Thames Estuary area in a UK context for little gull *Hydrocoloeus minutus* and great cormorant *Phalacrocorax carbo* over winter.

Population estimates for little gull and great cormorant in the Outer Thames Estuary during winter are provided. Other waterbird and seabird species, individually or as an assemblage, did not occur in numbers that exceeded the thresholds under the UK SPA Guidelines (Webb *et al* 2009).

As an Annex 1 species, little gull would normally be assessed against 1% of the GB population estimate under Stage 1.1 of the SPA Guidelines, however there is no GB population estimate currently available for little gull (Musgrove *et al* 2013). The Birds Directive requires that the most suitable territories for Annex 1 species are classified as special protection areas. If no GB population estimate is available, the application of Stage 1.4 of the SPA Guidelines is a possibility to identify the most suitable sites with help of Stage 2 judgements.

2 Methods

2.1 Outer Thames Estuary area of search

The Outer Thames Estuary area of search, as defined herein, extends from Great Yarmouth in the north, to Dover in the south and extends to just beyond 12nm offshore (Figure 1). It adjoins the Greater Wash area of search to the north. The survey coverage shows some gaps along the inshore boundary of the area of search as data were collected in a series of survey blocks and were not originally designed for the purpose of SPA identification (Figure 3).

The coastline in this area is characterised by shallow creeks, drowned estuaries, mudflats and broad tracts of tidal salt-marsh with sand and shingle beaches along the coast edge. Most of the marine area is shallow water (<20m) over a sandy, muddy and gravel substrate (McBreen *et al* 2011).

Several Special Areas of Conservation (SACs) and SPAs have been designated within the Outer Thames Estuary area (Stroud *et al* 2001). The SACs in this area protect Annex I habitat types under the Habitats Directive (EC 2007; consolidated version 1.1), such as sandbanks which are slightly covered by sea water all the time, mudflats and sandflats, reefs, estuaries and coastal lagoons (Figure 2).

There are seventeen SPAs in or adjacent to the Outer Thames Estuary area of search (Figure 1). Of these, twelve provide protection for some waterbirds or seabird species extending to mean low water. The species protected within these existing SPAs include: little tern (*Sterna albifrons),* common tern *(Sterna hirundo),* sandwich tern (*Sterna sandvicensis),* and Mediterranean Gull (*Larus melanocephalus),* under Article 4.1; and lesser black-backed gull (*Larus fuscus)* under Article 4.2. Great cormorant, herring gull (*Larus argentatus),* black-headed gull (*Larus ridibundus),* common goldeneye (*Bucephala clangula),* great crested grebe *(Podiceps cristatus),* red-breasted merganser (*Mergus serrator*), and little grebe (*Tachybaptus ruficollis)* are protected as part of an assemblage.

The Outer Thames Estuary is the only fully marine SPA in the area. It was classified in 2010 under Article 4.1 of the Birds Directive for the protection of wintering red-throated diver.

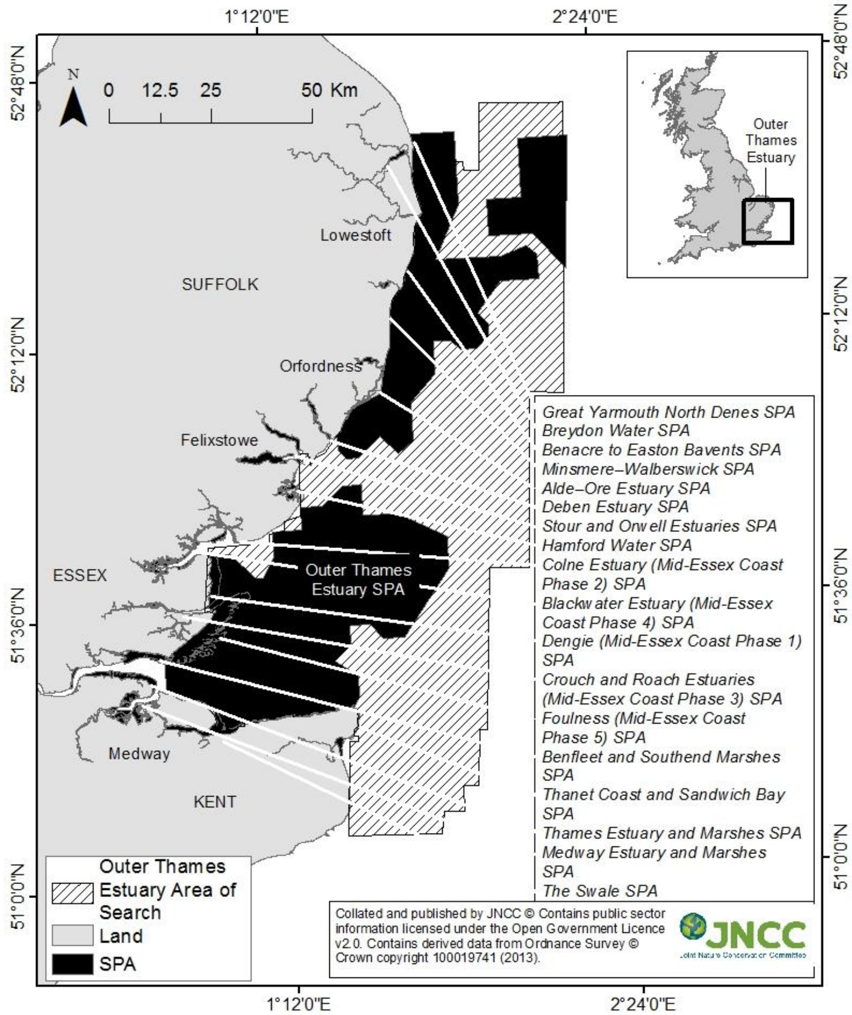


Figure 1. Map indicating the location of existing SPAs in relation to the Outer Thames Estuary area of search.

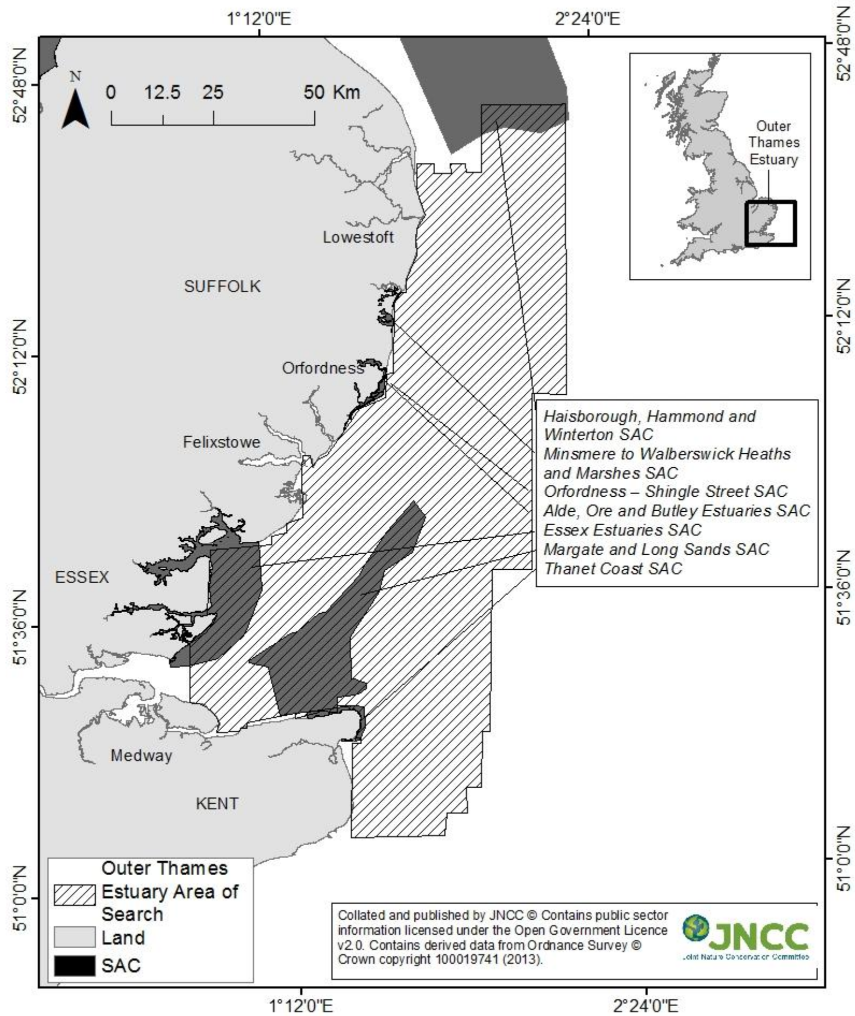


Figure 2. Map indicating the location of existing SACs in relation to the Outer Thames Estuary area of search.

2.2 Survey design

The Outer Thames Estuary area of search was one of 45 inshore sites across the UK that were identified in 2000 as supporting potentially important numbers of inshore waterbirds (mostly seaducks, divers and grebes) outside the breeding season. These areas of search were initially identified by reviewing existing data and literature; for the Outer Thames Estuary it indicated that large numbers of red-throated diver occurred there annually outside the breeding season (O'Brien *et al* 2008). The seaward limits of the areas of search were defined by water depth, based on expert knowledge of the ecology of the target species. Where feasible, the areas of search extended to cover inshore waters up to 30-50m depth.

Aerial survey was the preferred method for data collection to inform marine SPA classification for aggregations of inshore wintering waterbirds (Webb & Reid 2004; Camphuysen *et al* 2004). Aerial survey allowed large areas of water to be surveyed in a relatively short time period, thereby enabling repeat surveys to be undertaken. They generally provide more robust estimates of the numbers of wintering divers and seaduck than boat-based surveys, particularly for species prone to disturbance by boats (Schwemmer *et al* 2011). However, species that aggregate very close to the coast are often missed by visual aerial surveys as the aircraft has to climb or turn as it approaches land.

Aerial surveys of the Outer Thames Estuary, conducted by the Nature Conservancy Council (NCC), Wildfowl & Wetlands Trust and the Natural Environmental Research Institute, Denmark, were carried out over nine winter seasons (1988/89, 1989/90, 2001/02, 2002/03, 2003/04, 2004/05, 2005/06, 2006/07, and 2007/08). Aerial surveys in the first two seasons (1988/89, 1989/90) were conducted using strip-transect methods, which provide total counts of birds using the area. The strip transect method cannot be corrected using distance analysis as the number of birds that were missed due to being further from the observer cannot be estimated and corrected for. The counts from the strip transect method underestimate the true numbers of birds in a survey area. The 1988/89 and 1989/90 surveys were therefore excluded from this analysis as more recent and better quality survey data were available. The other subsequent surveys deployed line-transect sampling techniques, with which distance analysis can be used to provide an estimate of the total numbers of birds in the area corrected for the individuals likely to have been missed by the observer. Distance analysis was conducted using the software Distance 6.0 (Thomas *et al* 2010). The most recent five years of suitable data were used in these analyses, as is standard practice deriving from the Ramsar convention (Austin *et al* 2014; Musgrove *et al* 2013).

A number of repeat surveys (two to five) of the Outer Thames Estuary area of search were undertaken during each winter season. In some cases, one survey took a number of days to complete and, although the dates were not always consecutive, they were as close as possible given weather conditions and logistical constraints. This is not ideal as there is the potential for double-counting birds that have moved and changed their distribution within a single survey. Conversely, birds could have moved such that they were missed on either survey, so there was no systematic bias towards under- or overestimating numbers.

The spatial coverage of surveys within the area of search was not consistent. Figure 3 shows the varying survey effort across the area of search and Figure B1, in Appendix 2, shows the survey transect lines for each of the surveys within the study area. The data and survey coverage were carefully assessed prior to analysis to ensure that only representative surveys were included. A survey was considered representative if it covered the main distribution of the bird population both spatially and temporally, i.e. the survey should have sufficient spatial coverage of the area of search, considering individual species distributions, and temporal coverage should include the periods when the species was present in peak abundances to avoid underestimating the number of birds that the area supports. The distribution of observations of each species is shown in Figure 6 and Figure 9 and these can be used with Figure B1 a-r (showing survey transects) to make comparisons and assess how representative each survey was in relation to the distribution of species.

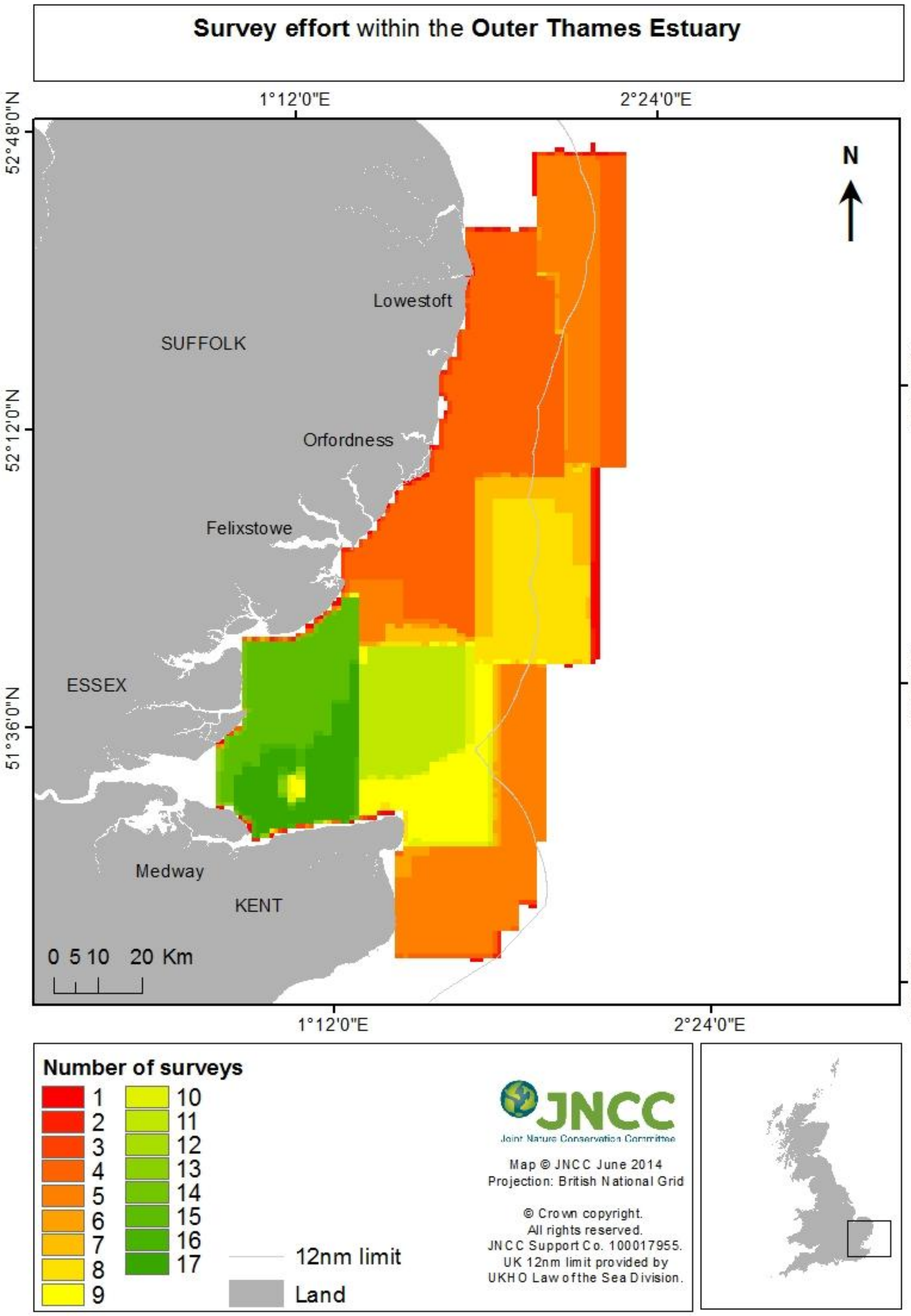


Figure 3. Aerial survey effort within the Outer Thames Estuary area of search 2003-2008.

2.3 Data Collection

A summary of data collection methods is presented here, but see Kahlert *et al* (2000) and Camphuysen *et al* (2004) for more detail on general survey methods.

Surveys were carried out from a Partenavia PN68 aircraft flying at an altitude of 76m (250ft) and a speed of approximately 185kmh-1 (100 knots). The aircraft flew in a systematic pattern of line-transects, designed to repeatedly cross environmental gradients such as sea depth. In 2003, line transects were spaced 4km apart, but in subsequent surveys transects were spaced 2km apart to ensure better coverage. Following Kahlert *et al* (2000), this distance was chosen to maximise the detection of birds, or flocks of birds, located between transects, while minimising the risk of double counting birds on neighbouring transects.

Two observers recorded numbers of birds (identified to species level where possible) and time of observation from either side of the aircraft. A Global Positioning System (GPS) recorded the location of the aircraft. All bird observations were allocated to one of four distance bands (A = 44-162m, B = 163-282m, C = 283-426m and D = 427-1,000m), based on the perpendicular distance of the bird(s) from the aircraft track line. Data were collected to the nearest second, though an error margin of up to 5 seconds (which equates to a distance of approximately 250m) is possible between the exact location of the bird and the time at which it was recorded. Observers were unable to see birds directly below the aircraft, so the closest distance band started 44m from the aircraft. Observers determined these distances using fixed angles of declination from the visual horizon, measured using a clinometer. For each bird, or flock of birds, the time at which it was perpendicular to the flight path of the aircraft was recorded. When it was not always possible to identify birds to species level during aerial surveys, birds were assigned to the lowest taxonomic level possible. The survey data analysed in this report were collected over five winter seasons from 2003/04 to 2007/08 between the months of October to March, inclusive. Observers were not specifically requested to record little gull until 2004, therefore the surveys in November 2003 and December 2003 were not included in the little gull analysis. No little gull were recorded on these surveys.

2.4 Number of birds in the Outer Thames Estuary area of search

The UK SPA selection guideline thresholds are provided as a percentage (1%) of the national or biogeographic populations of a given species (Stroud *et al* 2001). The biogeographic population estimates used to assess regularly occurring migratory species, under Stage 1.2 of the UK SPA selection guidelines, are published in *Waterbird Population Estimates* WPE5 (Wetlands International, 2015). The Great Britain population estimates used to assess Annex 1 species, under Stage 1.1 of the UK SPA selection guidelines, are published in (Musgrove *et al* 2013).

To estimate the number of individuals within the Outer Thames Estuary area of search, a population estimate was determined for each species and survey with the help of Distance sampling. A peak count was then identified from these individual survey estimates within a winter season and an average of the peak counts from the five most recent winter seasons was calculated to produce the mean of peak population estimate for the area of search. The mean was taken over five seasons where the data were available. The mean of peak was assessed to determine if the numbers present exceeded the thresholds on a regular basis under the UK SPA Selection Guidelines (Stroud *et al* 2001).

Little gull is considered under stage 1.4 of the Guidelines as there is no GB population estimate currently available against which to assess it. It is nonetheless relevant to establish the numbers of little gull that regularly occur to determine the relative importance of this area, and thereby identify the most suitable site/s for this Annex 1 species as required under the Birds Directive.

2.4.1 Distance sampling

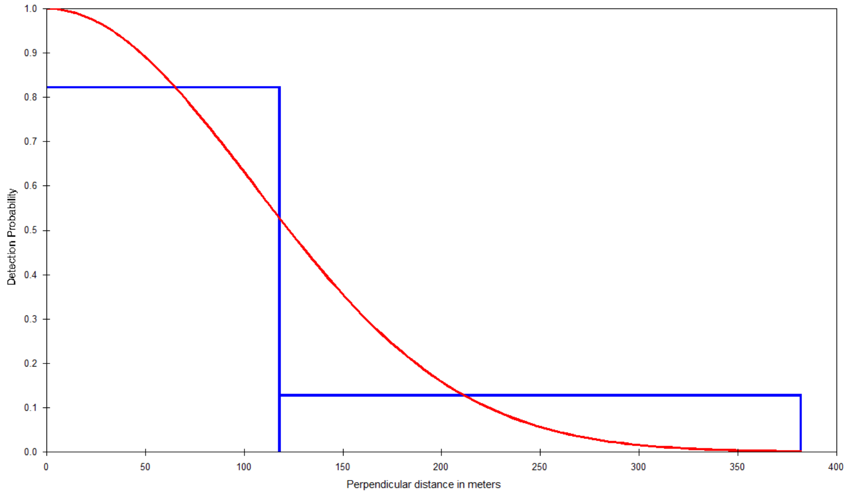
Distance sampling uses a detection function to model the decline in the probability of detecting an individual with increasing distance from the transect line. By assuming that the observer has seen all birds on the transect line, the numbers of undetected individuals can be estimated with the help of the detection function, and the total number of individuals in the survey area - including missed individuals - can be estimated for each survey.

Distance sampling is widely used in ecology to estimate the numbers of animals in an area when it is not feasible to make a complete count (Buckland *et al* 2001). It has also been used in other parts of JNCC's marine SPA work (e.g. O'Brien *et al* 2012; O'Brien 2014). The software Distance 6.0 was used to undertake this analysis. See Thomas *et al* (2010) for more information on distance sampling methods.

Great cormorant were recorded in sufficient numbers to apply conventional Distance sampling methods. A detection function was chosen that provided the best fit to the data on the basis of minimising the Akaike Information Criterion (AIC) and variance around the estimate. A half-normal model provided the best fit for most surveys. But on some surveys, when only few observations of great cormorant were recorded (<15 observations), a reliable detection function could not be produced. In these cases the survey was instead treated as a strip transect and population estimates were generated using a uniform model. To produce 95% confidence limits for the abundance estimates, non-parametric bootstrapping was used, re-sampling transects as samples with replacements (Buckland *et al* 2001).

Little gull were not recorded in sufficient numbers to generate a reliable detection function using conventional distance sampling methods on most surveys of the Outer Thames Estuary area of search. To overcome this problem, data on little gulls from all surveys of the Outer Thames Estuary and Liverpool Bay were pooled and a single global detection function was created. The global detection function was then used to estimate the number of little gulls that were present on each individual survey. Pooling data helps to overcome problems of small sample sizes, so long as the detection functions of individual surveys are similar (pers. comm. Eric Rexstad, CREEM, St Andrews), which was the case with these surveys (Figure 4). It improves the model for the detection function, and does not bias the estimates for individual surveys.

The distance sampling software produced a population estimate for each survey, even if the number of observations on which the population estimate was based was very low, e.g. just one little gull seen in February 2004. The number of little gulls recorded on each survey was plotted against the respective coefficient of variation (CV) of the distance-corrected population estimates to identify the point when CV became very high and population estimates were likely to be unreliable (Figure 5). When the number of raw observations of little gull recorded on a survey was low, the coefficient of variation became very high (Figure 5), implying there was considerable uncertainty associated with the population estimate. The percentage CV did not change as the number of raw observations increased above five, suggesting that surveys on which five or more individuals were recorded were reliable (Figure 5). Surveys with a high CV (>70%) were not used to find a mean of peaks population estimate.



Detection Probability
1.0
0.9
0.8
0.7
0.6
0.5
0.4
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0.1
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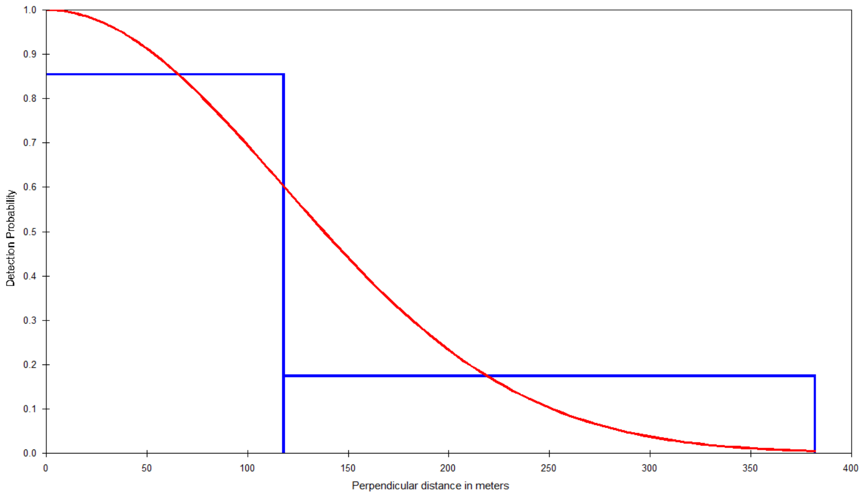
0
50
100
150
200
250
300
350
400
Perpendicular distance in meters

a)



Detection Probability
1.0
0.9
0.8
0.7
0.6
0.5
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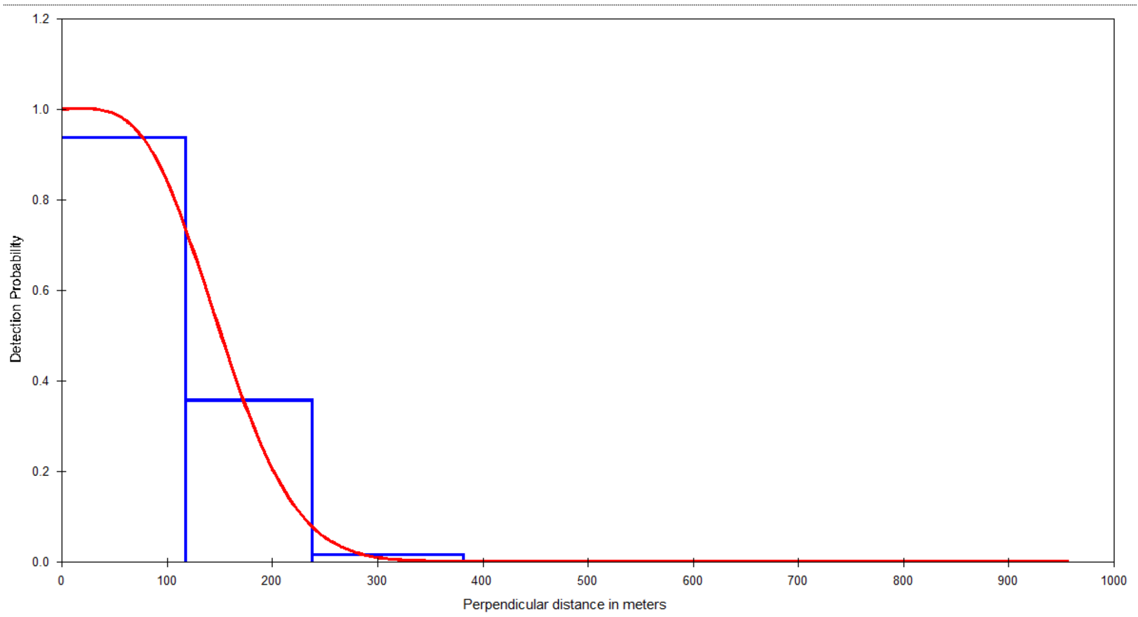
Perpendicular distance in meters

b)



c)

Figure 4. Detection function (red line) fitted to little gull observations (blue histogram) from distance Bands A, B and C; figure (a) is Liverpool Bay, (b) Outer Thames and (c) the global detection function using data from both of these area of search. These histograms show the decline in probability of detecting a little gull with perpendicular distance from the aircraft was similar in the two areas. No little gulls were recorded in Band D so this was excluded from the analysis. The histograms for Liverpool Bay (a) and the Outer Thames (b) present the data from Bands B and C presented together.

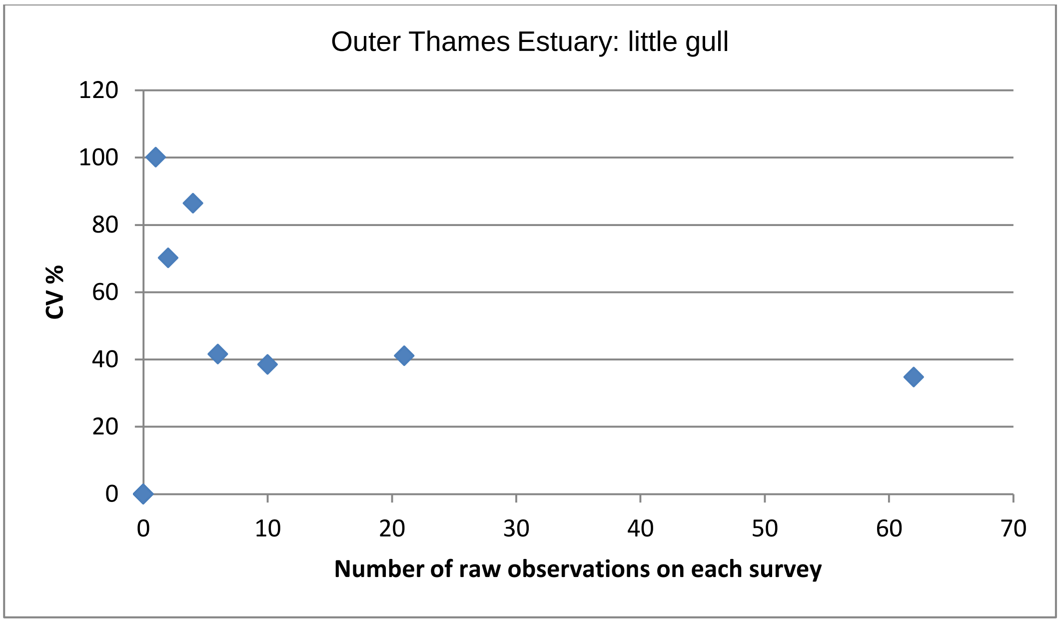


Figure 5. Plot of %CV (percentage coefficient of variation) against number of raw observations of little gulls for each survey. This shows that when the number of raw observations on a survey was low the %CV was high (>70%).

2.4.2 Regularity

An assessment was made of the regularity with which numbers of birds in excess of their 1% population thresholds occurred within the Outer Thames Estuary area of search. The UK SPA Selection Guidelines define regular occurrence as:

- the requisite number of birds is known to have occurred in two thirds of the seasons for which adequate data are available, the total number of seasons being not less than three; or
- the mean of the maxima of those seasons in which the site is internationally important, taken over at least five years, amounts to the required level.

Webb and Reid (2004) considered the most appropriate definition to use for inshore waterbird aggregations is two thirds of the seasons for which adequate data are available, the total number of seasons being not less than three. Using the mean of peak method for assessing regularity "...may be inappropriate in the marine environment, where transient aggregations of prey might lead to irregular occurrences of very large numbers of some inshore birds at a site."

However, there are circumstances in which the mean of peaks method would be more appropriate. For example where there is evidence that a site provides a severe weather refuge resulting in unusually high counts in one year.

2.5 Identifying important aggregations within the area of search

It was assumed that the areas supporting the highest densities of birds represented the most suitable areas to protect those species. Where population estimates of species exceeded the relevant UK SPA Selection Guidelines thresholds, a modelled density surface was produced which could be used to identify areas with the highest estimated densities.

2.5.1 Modelling bird densities

For each species and survey, density surfaces were generated using Kernel Density Estimation (KDE) applied to the raw bird observations. Raw count data were converted to density at 5 second intervals along each transect line. The chosen resolution or bandwidth, in this case 3km, ensures the density estimate is produced from data collected on at least one and usually two transects. This retains sufficient detail in the bird distribution patterns to allow identification of areas of higher density without excessively smoothing and flattening out high density areas (O'Brien *et al* 2012). KDE smoothed the point density estimates into a surface of relative densities (Silverman 1998), displayed on a grid of 1km x 1km cells.

The density surface was restricted to the area where data were collected, defined as the area within 1km of any line transects, to ensure it was not predicting densities over areas without survey data. In order to obtain density estimates from the KDE surfaces that accorded with the robust estimates derived from distance analysis, the density values in all cells were rescaled to match the population estimate obtained from Distance sampling for each survey.

Finally, a single mean modelled density surface for the area of search was created for each species by overlaying the KDE surfaces from all surveys and calculating the mean density in each 1km x 1km cell. All surveys were given equal weight, irrespective of survey month and year. The resulting mean density surface might be described as representing an average or typical indication of where birds regularly occur in higher numbers.

3 Results

3.1 Distribution and densities of birds in the Outer Thames Estuary area of search

3.1.1 Little gull

Low counts of little gull were distributed throughout the area of search, with two clusters of observations evident along the 12nm limit (Figure 6). The mean density surface (Figure 7) reflects this pattern, though the difference in the areas covered by each survey causes some problems in assessing the consistency of higher density areas.

Figure **3** and Figure B1 present the survey effort within the area of search for the five seasons that were analysed (2003/04 to 2007/08). Data on little gull were not collected during the surveys November 2003 and December 2003 and these surveys were excluded from the analysis. The area off Felixstowe around the 12nm line was surveyed in three seasons (2003/04, 2004/05, 2005/06) and this higher density area for little gull was present in two of these seasons (2004/05, 2005/06). The inshore area off Lowestoft was surveyed in one season (2004/05) and the aggregation observed here was present in two of the five surveys undertaken in this winter season. The area further offshore from Lowestoft to Orfordness was surveyed in two seasons (2005/06 and 2006/07) higher density areas of little gull were present here in three of the six surveys undertaken in these seasons.

A few of the small aggregations lie within the Outer Thames Estuary SPA boundary but the higher density aggregations are almost entirely outside the existing SPA boundary.

The data available for little gull indicate variability in the areas that they use, or their distribution may be more widely dispersed, with many small aggregations throughout the area of search. Aggregations of little gull are shown in the mean density surface (Figure 7), but the consistency of these aggregations or hotspots through time is not readily apparent. To assess the consistency of these aggregations, the density threshold (0.0129 birds per km^2) determined by maximum curvature analysis was applied to each survey-specific density surface such that each cell on the surface with a density equal to or greater than the density threshold was given a score of 1 (hotspot present) and cells with a density less than the threshold were given a score of 0 (hotspot absent). The survey-specific density surfaces were then overlaid and summed to create a hotspot assessment surface, such that each cell on this surface had a count of the number of times a hotspot was present in that cell.

The result of this hotspot analysis is presented in

Figure **8** and show that little gull were not consistently present in a well defined location but that their usage of the Outer Thames Estuary area of search was variable and spread throughout the site. The area off Felixstowe around the 12nm line was the most consistent location with an aggregation (≥0.0129 birds per km^2) of little gulls recorded on three surveys. Twelve surveys were assessed in the hotspot analysis from the seasons (2003/04 – 2006/07), though the area covered varied between surveys.

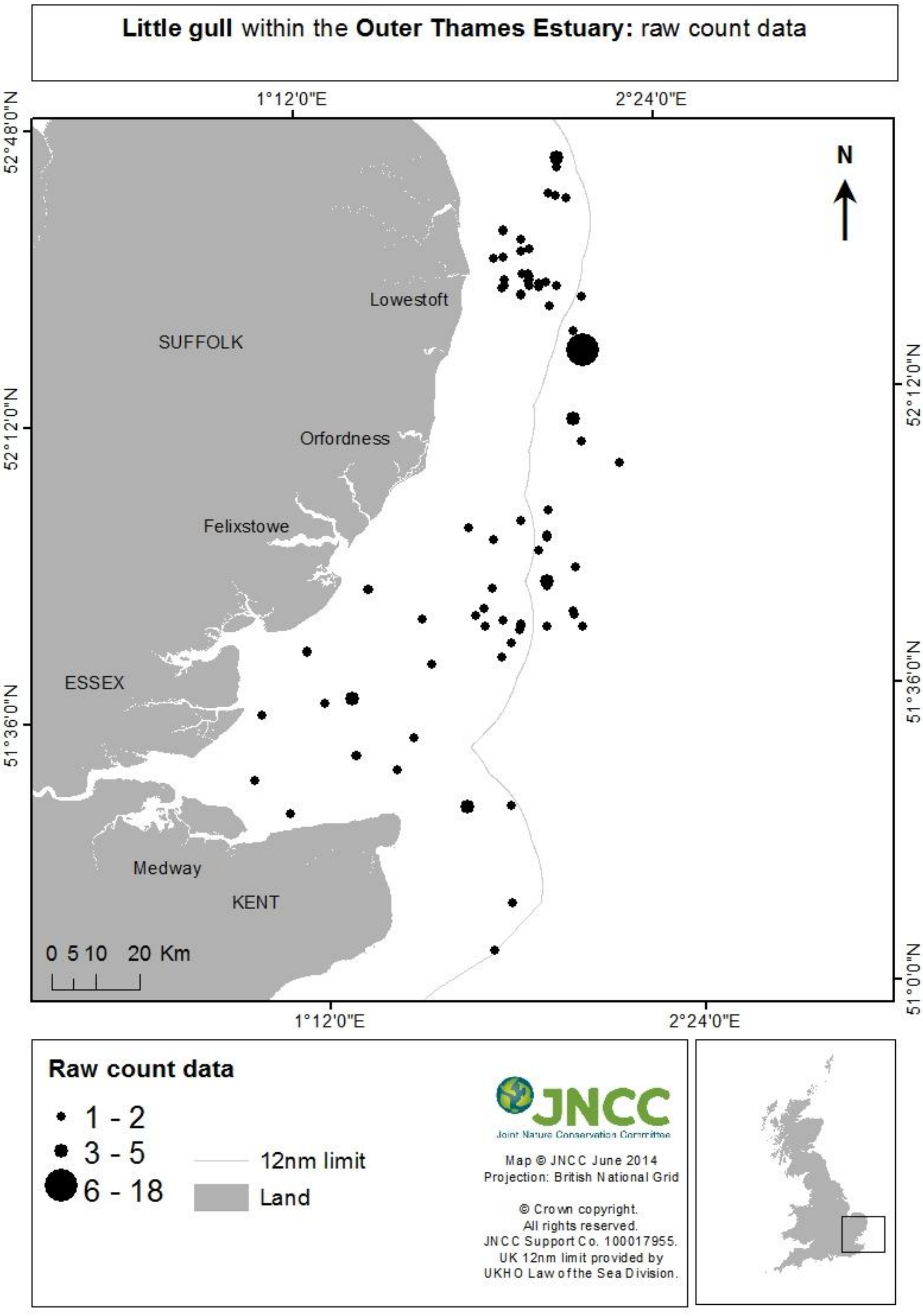


Figure 6. Raw count data of little gull recorded during WWT consulting aerial surveys within the Outer Thames Estuary area of search (2003/04, 2004/05, 2005/06, 2006/07, 2007/08).

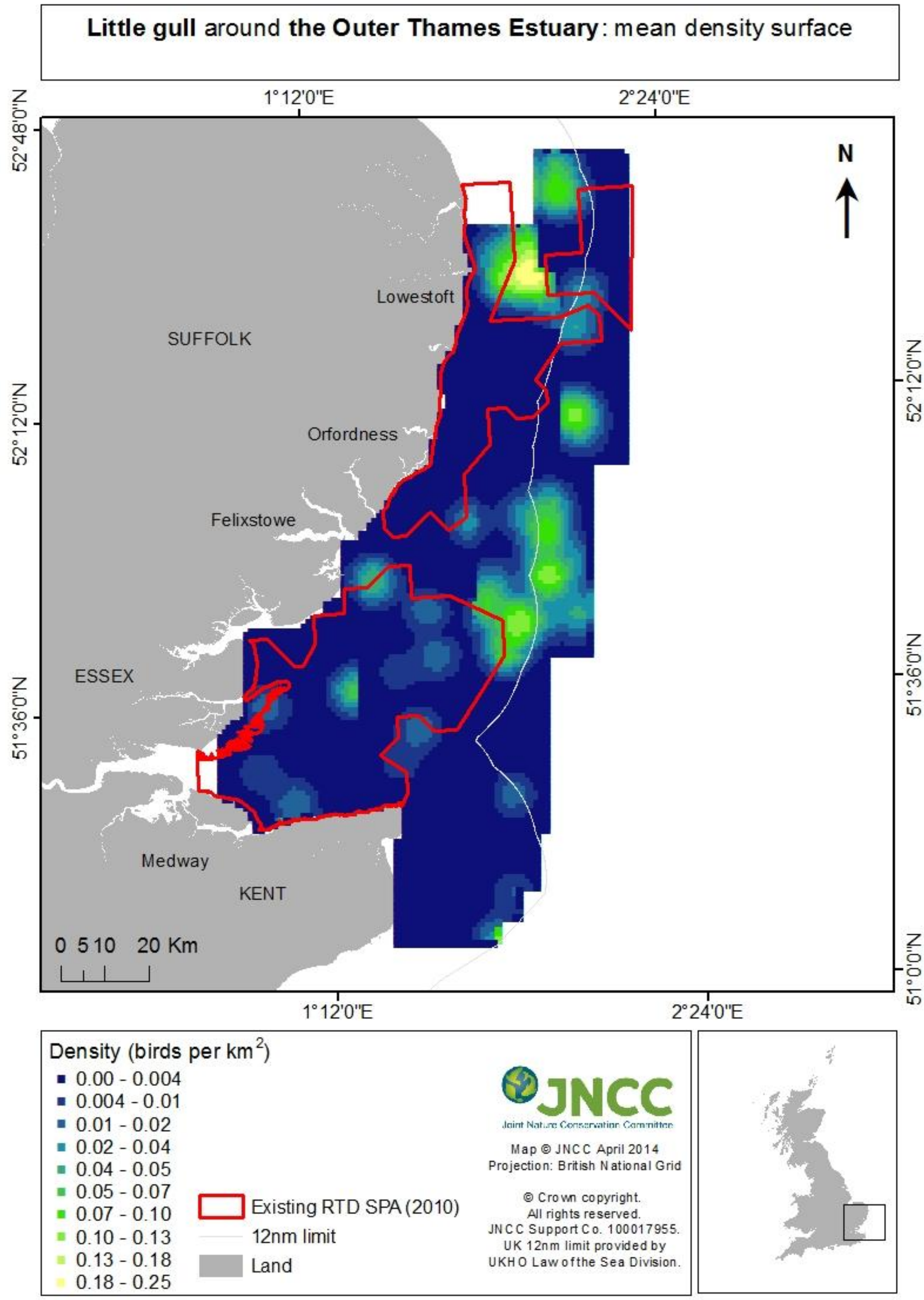


Figure 7. Estimated mean density surface of little gull recorded from aerial surveys within the Outer Thames Estuary area of search (2003/04, 2004/05, 2005/06, 2006/07, 2007/08).

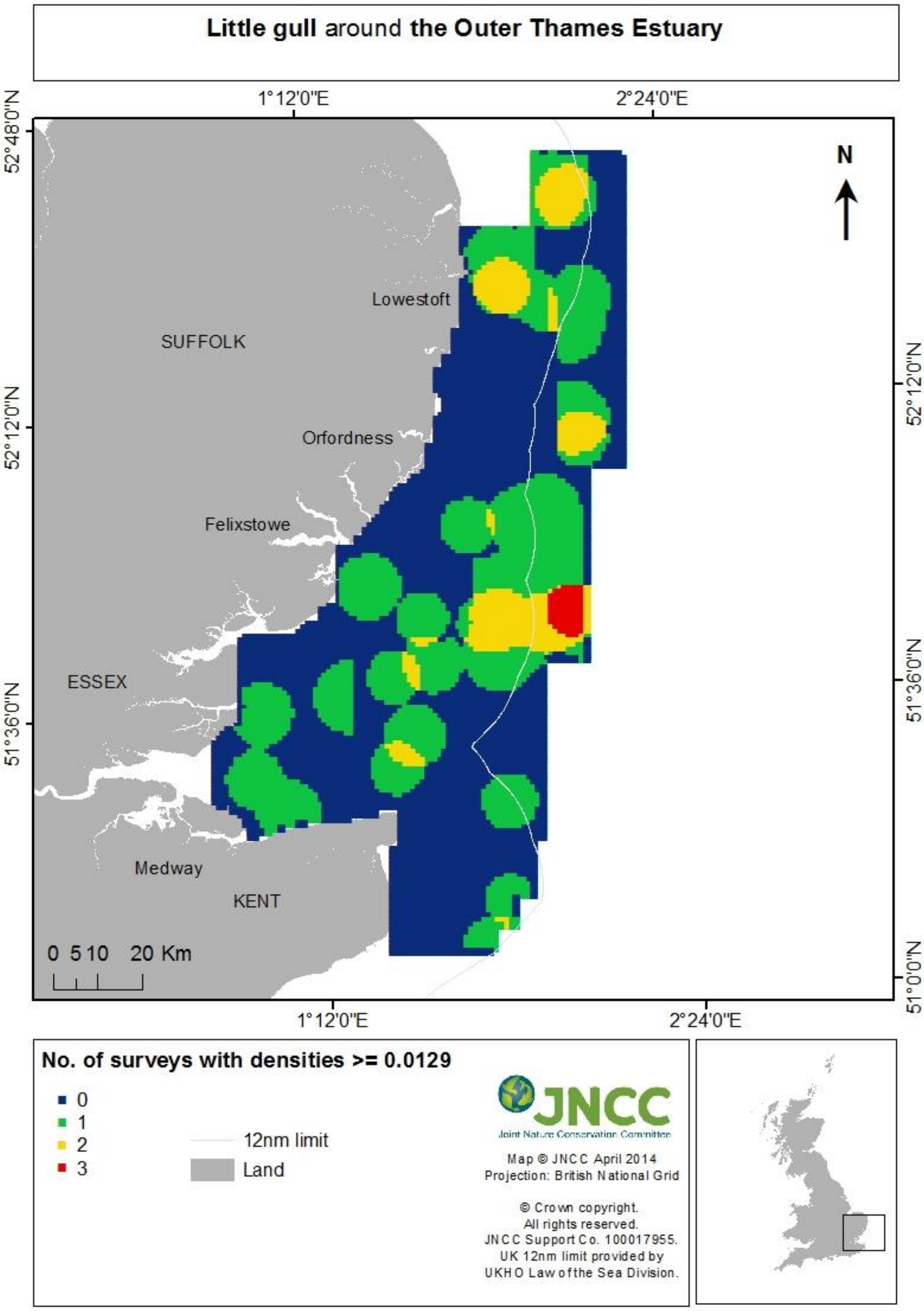


Figure 8. The number of surveys on which little gull densities met or exceeded the maximum curvature density threshold (0.0129 birds per km^2) in the Outer Thames Estuary area of search.

3.1.2 Great cormorant

Great cormorant observations were concentrated along the coastlines of the inner Thames Estuary, particularly along the north Kent coast (Figure 9). The mean density surface (Figure 10) reflects this pattern, and identifies two areas where the highest densities of cormorant were located, off the north Kent coast and at the mouth of the Colne and Blackwater estuaries.

The survey coverage of this part of the area of search was much more consistent. The inner Thames estuary area particularly the area to the south along the Kent coast was covered by seventeen surveys over the five winter seasons (2003/04 to 2007/08). These two main aggregations of cormorant were consistently occurring throughout the surveys and seasons. There were a number of smaller lower density aggregations that occurred along the coast between Felixstowe and Lowestoft and a few observations of cormorant further offshore close to the 12nm line. The higher density area that can be seen off Lowestoft close to the 12nm line is based on observations of cormorant from one survey. This area was surveyed five times as can be seen from the survey effort in Figure 3.

Most of the high density cormorant areas are within the existing Outer Thames Estuary SPA boundary.

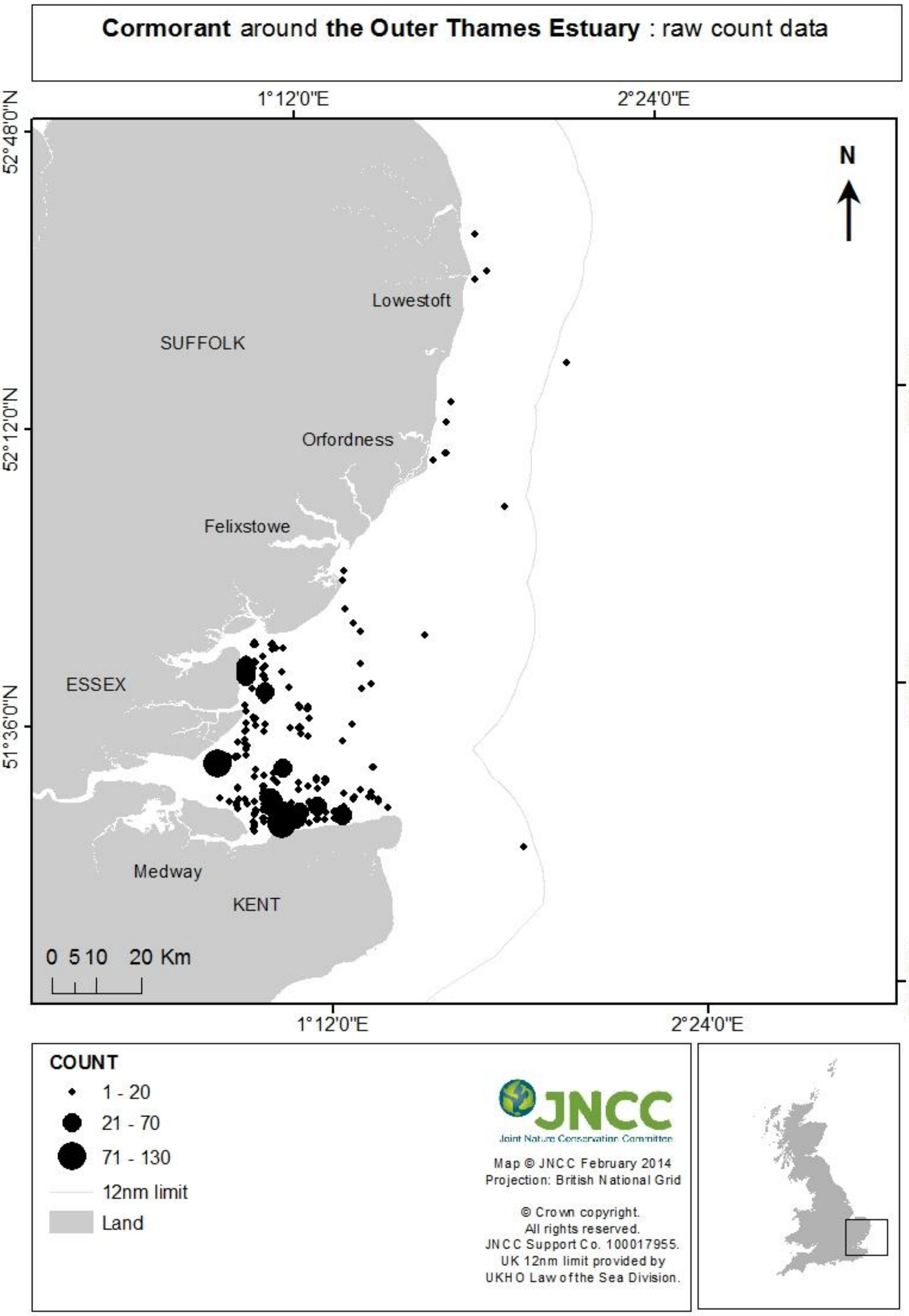


Figure 9. Raw count data of great cormorant recorded during WWT consulting aerial surveys within the Outer Thames Estuary area of search (2003/04, 2004/05, 2005/06, 2006/07, 2007/08).

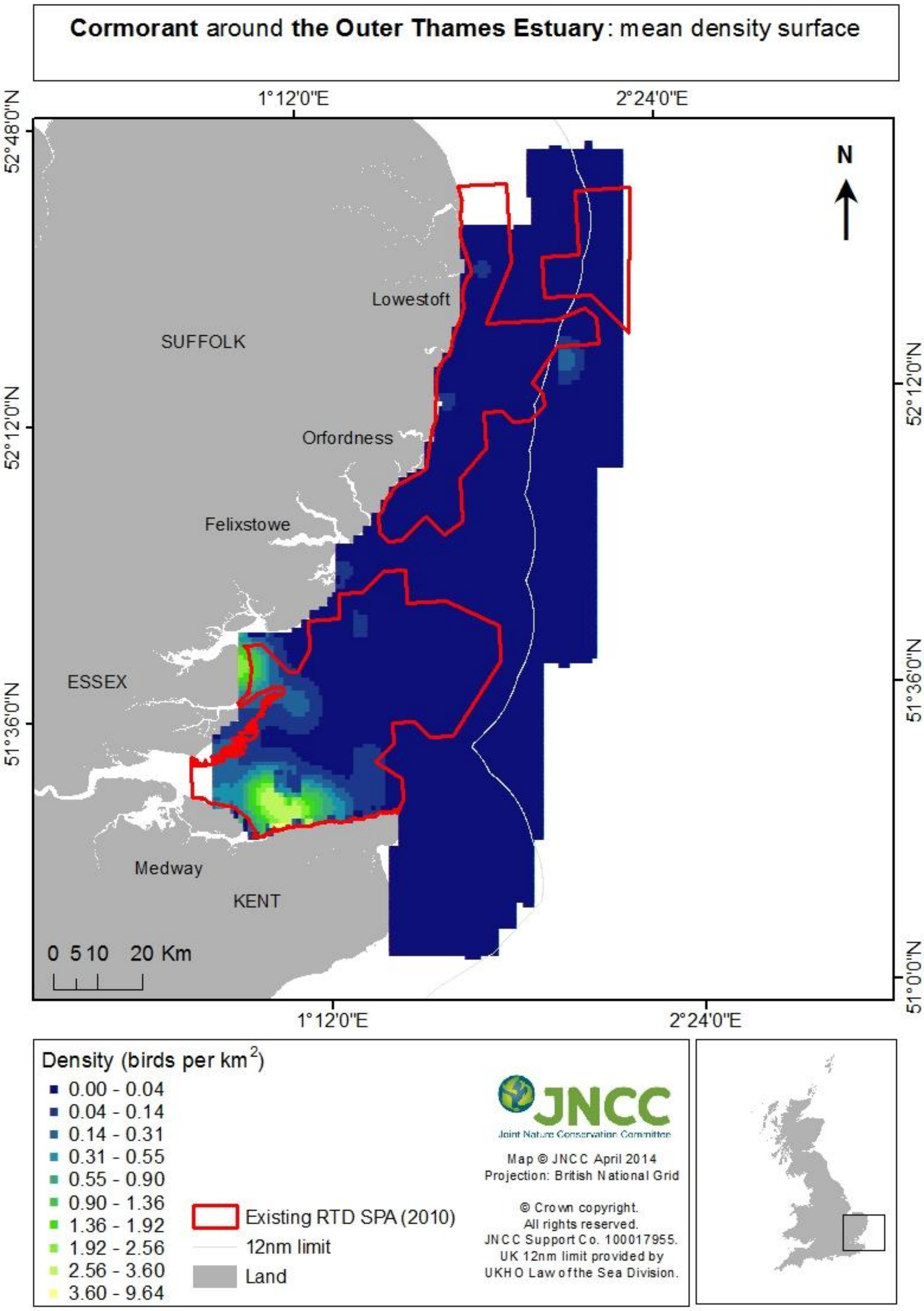


Figure 10. Estimated mean density surface of great cormorant from aerial surveys in the Outer Thames Estuary area of search. In this analysis a density surface was produced for each of 14 surveys and a mean density surface produced from these.

3.2 Numbers of birds in the Outer Thames Estuary area of search

A population estimate for little gull and great cormorant was produced for each survey (Table 1 and Table 2). From these individual survey estimates a mean of the peak population estimate was calculated for each species and assessed under the UK SPA selection guidelines.

The survey coverage within the area of search was not consistent (Figure 3 and Figure B1). None of the surveys covered the entire area of search and many had very limited spatial coverage. The resulting population estimates may therefore underestimate the true numbers of birds present. The peak estimates that were used in the mean of peak calculation are indicated in Tables 1 and 2. Some of the population estimates have a high uncertainty, indicated by wide confidence intervals, often a result of low counts of birds recorded during the survey. Population estimates with a percentage coefficient of variation (%CV) greater than 70% were not used in calculating the mean of peak.

3.2.1 Little gull

The mean of peak population estimate for little gull in the Outer Thames Estuary area of search was 258 individuals, however this was based on only two winter seasons.

Little gulls are difficult to distinguish from other small gull species on aerial surveys, and many little gulls may have been recorded as small gull species. As a result, little gulls were certainly under recorded on some aerial surveys. It is not possible to estimate the proportion of little gulls recorded as small gull species, relative to other small gull species. Only birds indentified as little gulls were therefore included in the analyses, and population estimates presented are likely to be underestimates of the true numbers of birds.

The main areas of little gull distribution within the area of search were off Felixstowe and Lowestoft around the 12nm line. Survey data for little gulls were available for five winter seasons (2003/04 - 2007/08), however the spatial coverage of the surveys in March 2005 and in the entire 2007/08 winter season did not cover the areas known to be important for little gulls, based on their distribution from all available surveys. Therefore these surveys were excluded from the mean of peak calculation.

There was a seasonal pattern evident in the data from 2004/05 and 2005/06 with high numbers of little gull recorded at the start of the winter period (Oct/Nov/Dec) and fewer birds present at the end of the winter period (Jan/Feb/Mar). Seasons (2003/04 and 2006/07), for which there were no surveys in October, November or December, may not have captured the peak numbers of little gull present during that winter season. These seasons were not included in the mean of peak calculation.

The mean of peak population estimate (258 individuals) presented here for little gull is based on the two seasons (2004/05 and 2005/06) for which reliable population estimates were available (Table 1). The population estimates for these two seasons were produced from surveys that had relatively good, though not complete coverage of the area of search and the surveys were undertaken throughout the winter season including the early part of the season (October to December) when higher numbers of little gull were present. However, a mean of peak population estimate based on two seasons is insufficient to be assessed against the criteria for regularity, under the SPA Guidelines.

Surveys from an additional three seasons were undertaken in the Outer Thames area of search. The 2007/08 season was not included in the mean of peak estimate because it did not survey the main areas where little gull observations were recorded. Only the Inner

Thames Estuary area was surveyed in 2007/08, this did not provide a representative sample for little gull in the Outer Thames area of search, no little gull were recorded on these surveys. The surveys in the 2003/04 and 2006/07 seasons were not included in the mean of peak estimate because they did not survey during the months of peak little gull abundance (October-December) and are therefore likely to underestimate the true numbers of little gull that were present in these seasons. In addition, the population estimates produced from these surveys were based on very few observations (≤4 individuals), and as a result there was lower confidence in these population estimates indicated by the high %CV values.

Little gull were observed in the area in four consecutive seasons, though the numbers recorded (in 2003/04 and 2006/07) were low and there was high variability around the estimates indicated by the high percentage coefficient of variation (%CV). These data suggest little gull may regularly use the site, but whether the area regularly supports numbers that are of importance relative to other inshore areas of search in the UK cannot be determined based on the survey data that is currently available.

Table 1. Population estimates for little gull in the Outer Thames Estuary area of search. A number of surveys were excluded (if the spatial or temporal coverage was insufficient to provide a representative estimate) these are indicated by grey text in the table. *indicates surveys that did not sample during the months of peak abundance. **Bold** text indicates the estimate used to calculate the mean of peak. CI indicates confidence intervals; N indicates the total number of individuals recorded during each survey period while Obs. refers to the number of clusters that were input to the analysis.

Season	Date	Estimate	Lower CI	Upper CI	CV%	N	Obs.	Main areas of little gull distribution surveyed?
2003/04	**Nov 03**	**N/A**						little gulls not specifically recorded
	Dec 03	**N/A**						
	Feb 04*	6*	1	34	100.13	1	1	
2004/05	Oct-Nov 04	0	0	0	0	0	0	
	Nov-Dec 04	**136**	62	299	41.1	21	21	
	Jan-Feb 05	60	29	125	38.52	10	9	
	Feb-Mar 05	0	0	0	0	0	0	
	Mar. 05	0	0	0	0	0	0	No
2005/06	**Nov-05**	**379**	194	737	34.77	62	29	
	Dec 05	13	4	47	70.2	2	2	
	Jan Feb 06	40	18	88	41.6	6	6	
	Feb Mar 06	0	0	0	0	0	0	
2006/07	Jan-Feb 07	0	0	0	0	0	0	
	Feb-Mar 07*	23*	4	127	86.44	4	2	
2007/08	Nov-07*	0	0	0	0	0	0	No
	Dec-07	0	0	0	0	0	0	
	Feb-08	0	0	0	0	0	0	
	Mar-08	0	0	0	0	0	0	
mean of peak		**258**	(2 seasons)					

3.2.2 Great cormorant

The mean of peak population estimate for great cormorant in the Outer Thames Estuary area of search was 1,077 individuals, based on five winter seasons (2003/04 - 2007/08). This is just below the 1% biogeographic threshold of 1,200.

One survey in February – March 2006 had an exceptionally high population estimate for great cormorant. A more conservative estimate of the numbers of cormorant that were consistently recorded by aerial survey is 293 (5 year mean of peak) which does not include the exceptionally high count (Table 2).

Both European shag and great cormorant were recorded on the surveys. Only those observations identified as cormorant were included in the analyses i.e. uncertain observations shag/cormorant were not included. Most shag or cormorant observations were recorded to species level and few European shag were recorded on the surveys, 83% of observations were great cormorant.

The main area of great cormorant distribution was off the north Kent coast close to the mouth of the Thames, based on all available observations of great cormorant. There was better survey coverage of this main area of great cormorant distribution, than was available for little gull. December 2005 was the only survey that was excluded as it did not survey this area.
In contrast to little gull, it was possible to generate survey-specific detection functions for great cormorant. In most cases a half-normal or hazard rate model was used. A uniform model was used on seven surveys where cluster size was low (<15). The confidence intervals and percentage coefficient of variation (%CV) indicated the population estimates were reliable. Estimates with a percentage coefficient of variation greater than 70% were not used to calculate the mean of peak population estimate (Table 2).

The high estimate in February – March 2006 is supported by the raw count data; though the percentage coefficient of variation is relatively high and indicates some variability around this estimate, but not to the point that it was excluded as unreliable. All other surveys recorded considerably lower numbers of cormorant and this is clearly an exceptionally high count (Table 2).

The numbers of great cormorant within the Outer Thames Estuary area of search do not exceed the 1% biogeographic threshold. Five years of data were available for great cormorant but the threshold was only exceeded in one season, 2005/06 (Table 2).

Table 2. Population estimates for great cormorant in the Outer Thames Estuary area of search. **Bold** text indicates the estimate used to calculate the mean of peak. CI indicates confidence intervals; N indicates the total number of individuals recorded during each survey period while Obs. refers to the number of observations that were input to the analysis, i.e. each recorded sighting which could be an individual or a flock of birds. [1] indicates data subjected to truncation hence the lower CI reflects the actual sample size used in the analysis.

	Survey	Estimate	Lower CI	Upper CI	% CV	N	Obs.
2003/2004	Nov 2003	48	13	100	56.3	19	10
	Dec 2003	111	41	197	53.6	88	16
	Feb 2004	**243**	77	512	44.8	183	35
2004/2005	Oct/Nov 2004	117	52	201	36.8	38	21
	Nov/Dec 2004	**283**	118	478	33.8	97	45
	Jan/Feb 2005	224	104	481	40.6	39	26
	Feb/Mar 2005	84[1]	4*	226	86.6	36	7
	Mar 2005	8[1]	3*	20	73.5	23	4
2005/2006	Nov 2005	209	84	484	38.7	166	27
	Dec 2005	Did not survey the area of main cormorant distribution					
	Jan/Feb 2006	80	15	169	53.7	22	10
	Feb/Mar 2006 *	**4,129 ***	56	8,840	69	681	28
2006/2007	**Jan/Feb 2007**	**620**	77	1,455	66.2	91	16
	Feb/Mar 2007	19	11	50	52.6	7	6
2007/2008	**Nov 2007**	**109**	50	214	40	23	21
	Dec 2007	135	32	301	55.7	49	14
	Feb 2008	371	16	986	70.7	87	8
	Mar 2008	1,196[1]	17	2,816	87.6	232	18
mean of peak		**1,077**	5 seasons				
mean of peak		293	5 seasons. Excludes * and uses 209 from Nov 2005				

4 Discussion

The mean of peak population estimate for little gull in the Outer Thames Estuary area of search was 258 individuals based on two years of data. Two years of data are insufficient to determine whether this estimated population is regularly occurring in the area of search under the SPA Guidelines.

A seasonal trend was evident from the data with higher numbers of little gulls present early in the winter season during the months of October to December. On this basis a number of seasons that did not sample during these months were not included in the mean of peak analysis as they are likely to have underestimated the numbers of little gull present during that season. Similarly, a number of surveys did not cover the main areas of little gull distribution and as they could not be considered to provide a representative estimate for little gull in the area of search they were not included in the mean of peak calculation. The areas that were covered within the area of search varied between surveys. Despite these constraints these data were analysed, on the basis that it is the best that is currently available.

Little gull occurred in low numbers on many surveys, resulting in estimates with large coefficients of variation, implying considerable uncertainty. This could be due to the natural high variability of the species, but also to surveys not being representative due to poor spatial and temporal coverage, or to difficulty distinguishing little gull from other small gull species.

Small aggregations of little gull occurred throughout the Outer Thames area of search but with some variability between years. To assess the consistency of these aggregations a hotspot analysis was produced Figure 8. This showed that the aggregations of little gull were dispersed throughout the site, the most consistent location, where aggregations of little gull occurred in three surveys, was around the 12nm line off Felixstowe.

WWT consulting (Bradbury *et al* 2014) analysed these data for seabird sensitivity mapping using Density Surface Modelling (DSM), which is an alternative technique used for spatial modelling of seabird densities. Their analyses of wintering birds (October–March) were at a 3km x 3km grid scale around English EEZ (Exclusive Economic Zone) waters but they are comparable with the results presented here. The analysis by WWT consulting identified higher density areas of little gull in the Greater Wash area and Liverpool Bay, compared to the Outer Thames Estuary. The higher density area from the Wash extends around the Norfolk coast south to Felixstowe. This corresponds to the higher density little gull area identified in this report in the north of the Outer Thames Estuary area of search.

To conclude, the numbers of little gull estimated to occur in the Outer Thames Estuary during winter (258, two year mean of peak) show that this is an important site. It is the third largest population estimate for little gull of the inshore areas of search around the UK. However, the data also show considerable spatio-temporal variability. The data currently available are insufficient to establish a regularly occurring population estimate under the SPA Guidelines. Compared to other inshore areas of search, the Greater Wash and Liverpool Bay supported higher estimated populations of little gull than those in the Outer Thames Estuary, and the distribution of the birds within these sites was consistently present within a more defined area.

The mean of peak population estimate for great cormorant in the Outer Thames Estuary area of search was 1,077 individuals based on five years of data. However, these numbers of great cormorant were not consistently occurring but based on an exceptionally high count from one season. Without this high count a more conservative estimate of the numbers of cormorant that are consistently supported within the Outer Thames Estuary area of search is provided by the five year mean of peak of 293 that excludes the exceptionally high count and takes the next highest count from that season.

Unlike little gull, aggregations of great cormorants were consistently present in the inner Thames Estuary. This part of the area of search was covered on each of the surveys over the five winter seasons (2003-2008) with the exception of the December 2005 survey. The high count from February/March 2006 is clearly unusually given the range of the population estimates from other surveys (8-1,196 individuals). There is also some variability around this estimate indicated by the relatively high percentage coefficient of variation of 69%, this alone is not a basis for excluding this high estimate but the evidence from all other surveys suggest that the number of cormorant normally present within this site is considerably lower (Table 2, page 23).

Additional recent data were available on the numbers and distribution of great cormorant in the Outer Thames Estuary. Digital aerial survey of the existing Outer Thames Estuary SPA were conducted by APEM in January and February 2013, which recorded a peak count of 698 great cormorants in January 2013 (APEM 2013). Although the methods used to produce a population estimate from these surveys (design based modelling and generalised additive modelling) differed from the analysis in this report the results still provide a useful independent assessment of the numbers cormorant occurring within the site. Distribution of great cormorant from these digitals aerial surveys was similar to that recorded on the earlier visual aerial surveys analysed in this report, with the highest concentration of observations in the inner Thames Estuary, and additional observations close to the coastline further north in the area of search and few offshore. The analyses by WWT consulting (Bradbury *et al* 2014) at the scale of 3km x 3km also identified higher density areas of great cormorant in the inner Thames Estuary and particularly along the north Kent coast. Most of the higher density aggregations of cormorant identified by this analysis are contained within the existing boundary for red-throated diver as can be seen in Figure 10.

Based on these data the number of great cormorant supported by the Outer Thames Estuary does not exceed the 1% biogeographic threshold of 1,200 individuals. However the area supports considerable numbers of great cormorant during the winter months. Of the inshore areas of search surveyed by aerial survey around the UK the Outer Thames Estuary supports the second highest population of great cormorant after Liverpool Bay.

Within the Outer Thames Estuary area of search neither great cormorant nor little gull were regularly present in sufficient numbers to meet the UK SPA selection guidelines. Nonetheless for reference purposes Appendix 1 delineates important aggregations of these species within the area of search and presents the numbers for each within their species specific boundaries and within the existing Outer Thames Estuary SPA.

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Appendix 1 – Delineating important aggregations of little gull and great cormorant within the Outer Thames Estuary SPA

Neither great cormorant nor little gull were regularly present in sufficient numbers to meet the UK SPA selection guidelines within the Outer Thames Estuary area of search. However, for reference purposes important aggregations of these species within the area of search are delineated and the numbers of each within their species specific boundaries and within the existing Outer Thames Estuary SPA are presented below.

Identifying the most suitable areas for birds at sea presents particular challenges as physical features or habitat boundaries are rarely visible and are not readily detectable without time-consuming and costly data collection and analysis. Identifying important areas at sea is therefore usually a process driven by the dispersion of the birds themselves.

Maximum curvature was used to delineate areas of high bird density on the mean modelled density surface. Maximum curvature identifies the point of greatest change in a curve in the relationship between two values (Mel'nikov 1995). It is a relatively objective, and repeatable, method to identify a threshold density for determining the important parts of aggregated species' distributions. Grid cells hosting densities above the threshold density may be deemed as important and used to define a boundary around the important parts of the distribution (O'Brien *et al* 2012).

Application of maximum curvature follows a stepwise procedure. Large areas of a density surface might have no observations of a particular species, i.e. zero density. These areas were excluded from the analysis because the threshold density identified by maximum curvature analysis is sensitive to the size of the area considered (Webb *et al* 2009). These areas were excluded using the software *Geospatial Modelling Environment* (Beyer 2012) to draw one or more minimum convex polygons (MCPs) around the raw observations. These MCPs were then over-laid on the mean modelled density surface and any cells with a zero density within the MCPs were excluded from the maximum curvature analysis. The remaining grid cells were then ranked from high to low based on bird density. The relationship between the cumulative number of birds and cumulative area is not linear but curved, increasing rapidly at first as high density areas are selected and then increasing more slowly as larger areas are required to capture the same number of birds in low density areas. Maximum curvature identifies the point of greatest change in the relationship between the cumulative modelled number of birds and the cumulative area that supports that number of birds (see Cannone (2004) and Holt and Mantua (2009) for examples of the application of maximum curvature elsewhere in ecology). The point of maximum curvature is used as the threshold density to inform boundary placement as this represents the point of optimal trade-off between the gain (increased numbers of birds) and the cost (increased area within a boundary), see O'Brien *et al* (2012) for more details. It was determined by fitting a statistical model, either exponential, or double exponential (depending on which best fitted the observed data) to best fit the relationship between cumulative usage against cumulative area supporting that usage. Maximum curvature analysis has been used extensively in JNCC's marine SPA work (e.g. O'Brien *et al* 2012; O'Brien 2014). It should be noted that this procedure is applied to determine a seaward boundary only; the final landward boundary will be determined by Natural England.

In this way species specific maximum curvature boundaries were identified. The high bird density areas defined by the maximum curvature threshold density for little gull and great cormorant are presented in Figures A1 and A2 respectively. The threshold density for great cormorant was 0.1207 birds per km^2 and for little gull 0.0129 birds per km^2.

The boundaries presented below are around the grid cells above each species specific maximum curvature threshold, they have not been combined into a composite species boundary.

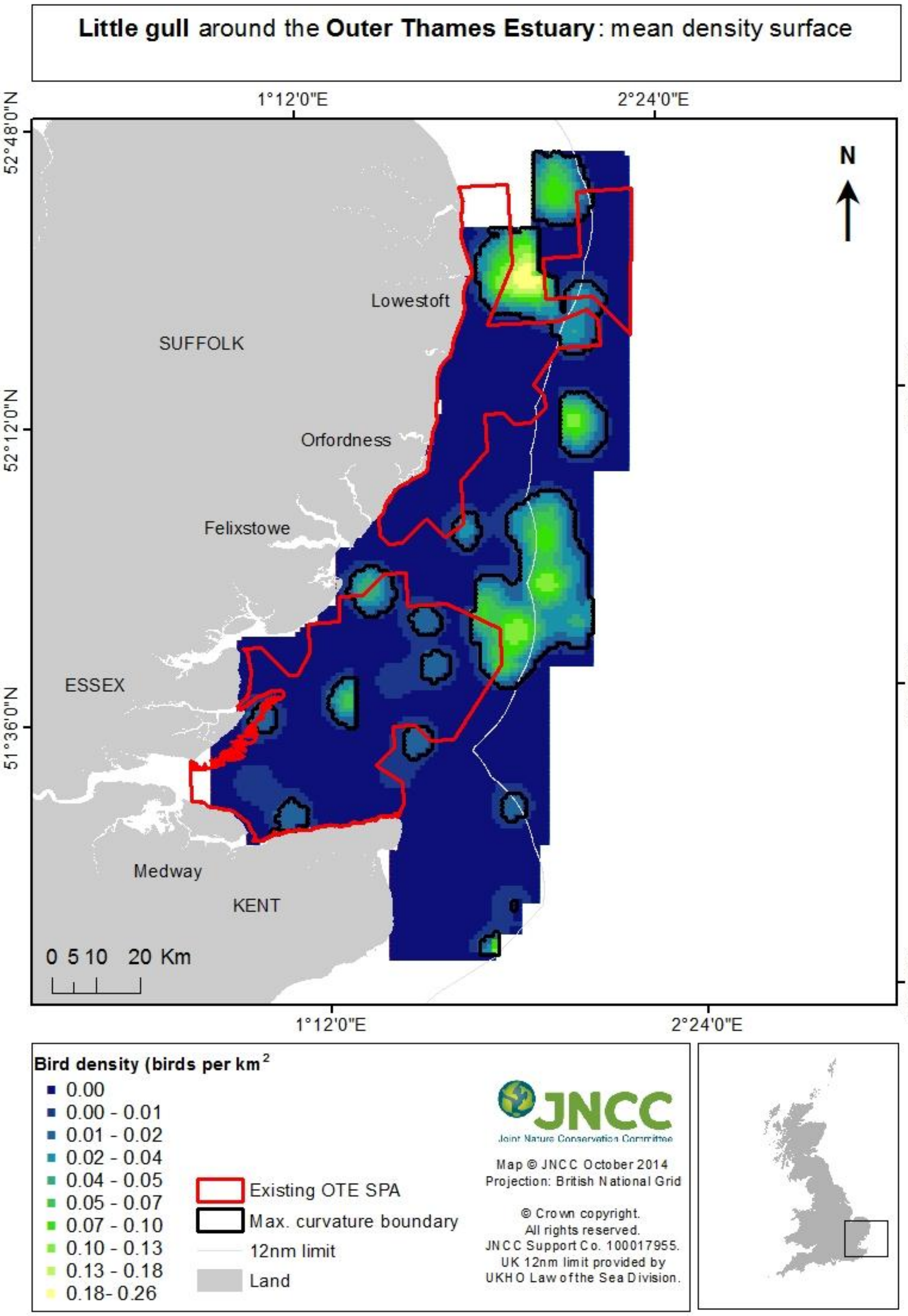


Figure A1. Estimated mean density surface for little gull with the threshold densities (0.0129 birds per km^2) delineated, as identified by maximum curvature presented with the existing Outer Thames Estuary SPA boundary.

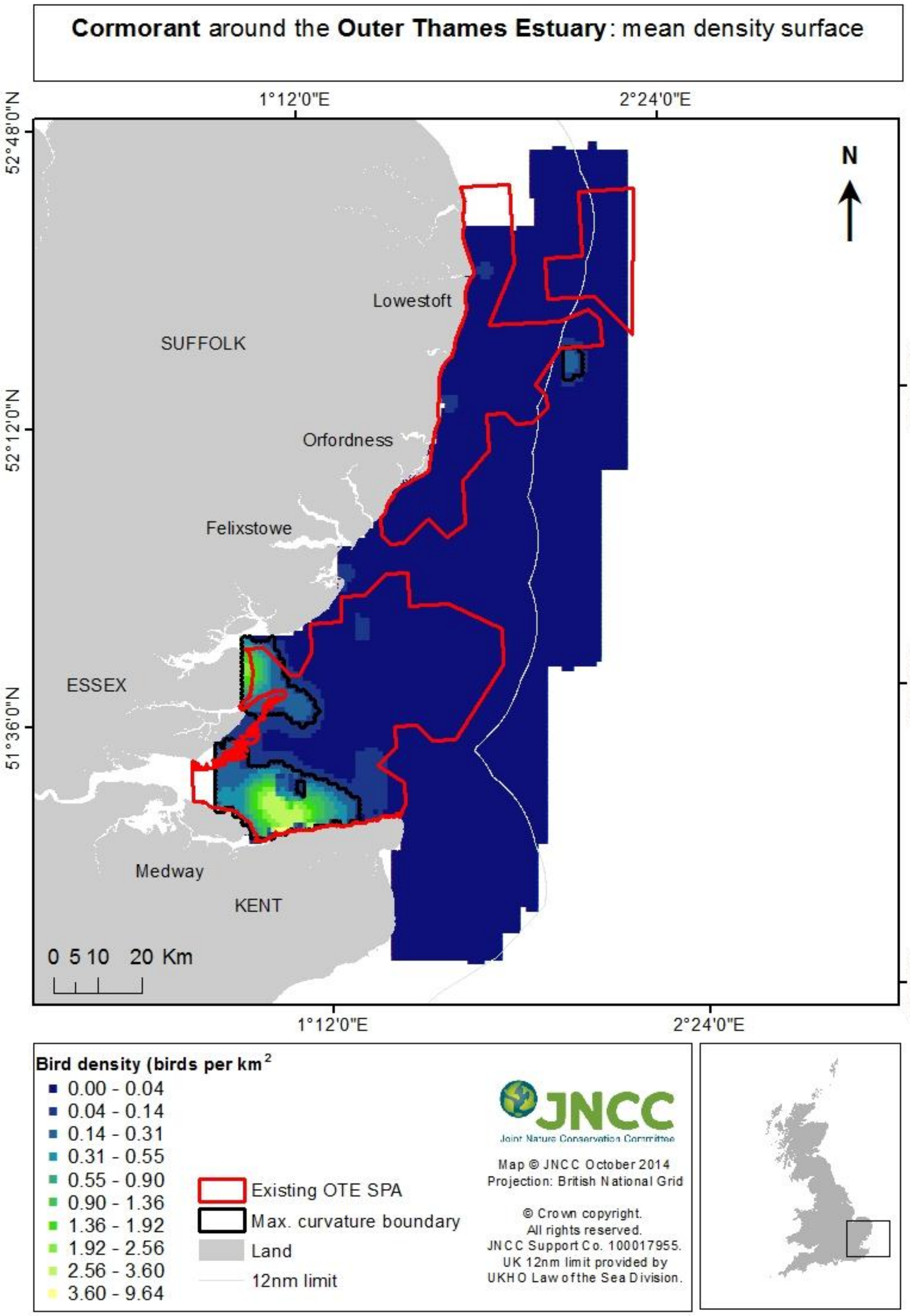


Figure A2. Estimated mean density surface for great cormorant with the threshold densities (0.1207 birds per km^2) delineated, as identified by maximum curvature presented with the existing Outer Thames Estuary SPA boundary.

Estimating numbers of birds within the Outer Thames Estuary SPA boundary and the species specific boundaries

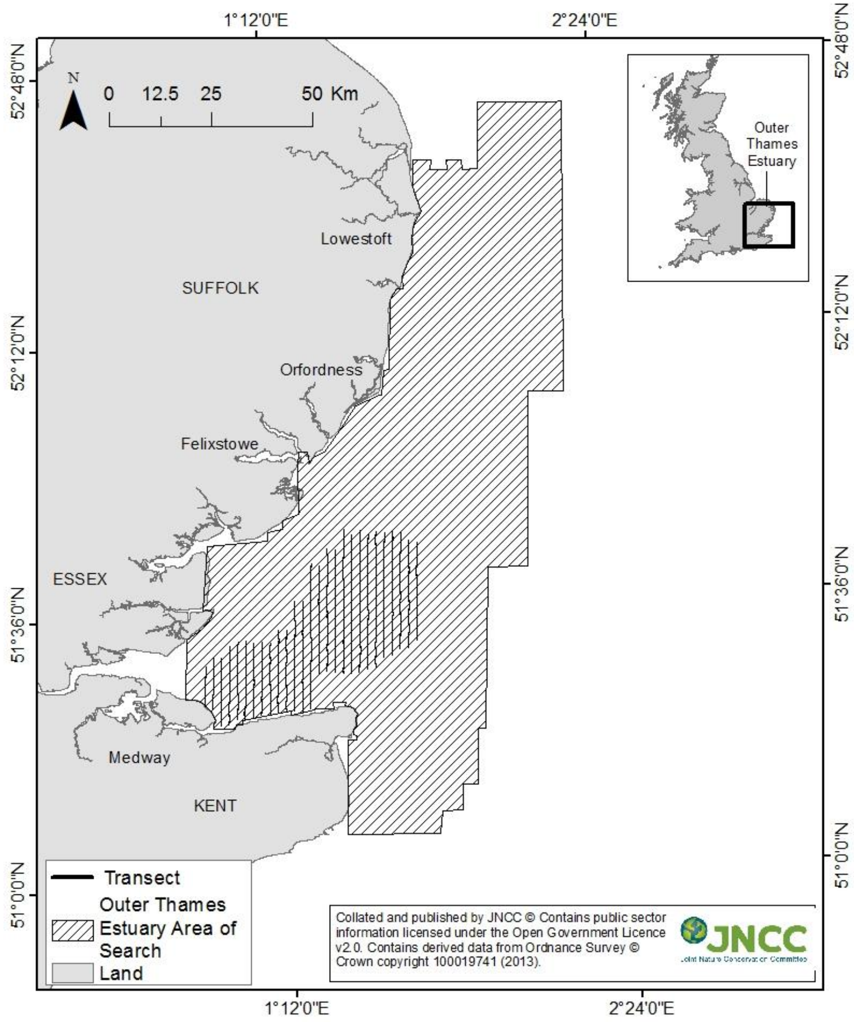
Distance sampling methods provide the most reliable assessment of the numbers of birds within an area, but this method can generate biased estimates if the same data are used to estimate the population for an area of search, and then used again to determine the numbers of birds in a part of the area of search (S. Buckland and E. Rexstad, pers. comm.). Therefore, in order to estimate population sizes within a boundary, the modelled density surfaces generated for each individual survey were used.

For each density surface i.e. each survey, the densities of all cells that had their centre point within the boundary were summed. This provided a population estimate within the existing Outer Thames Estuary boundary for that survey. The mean of peak population estimates for little gull and great cormorant were then calculated and are presented in Table A1 below.

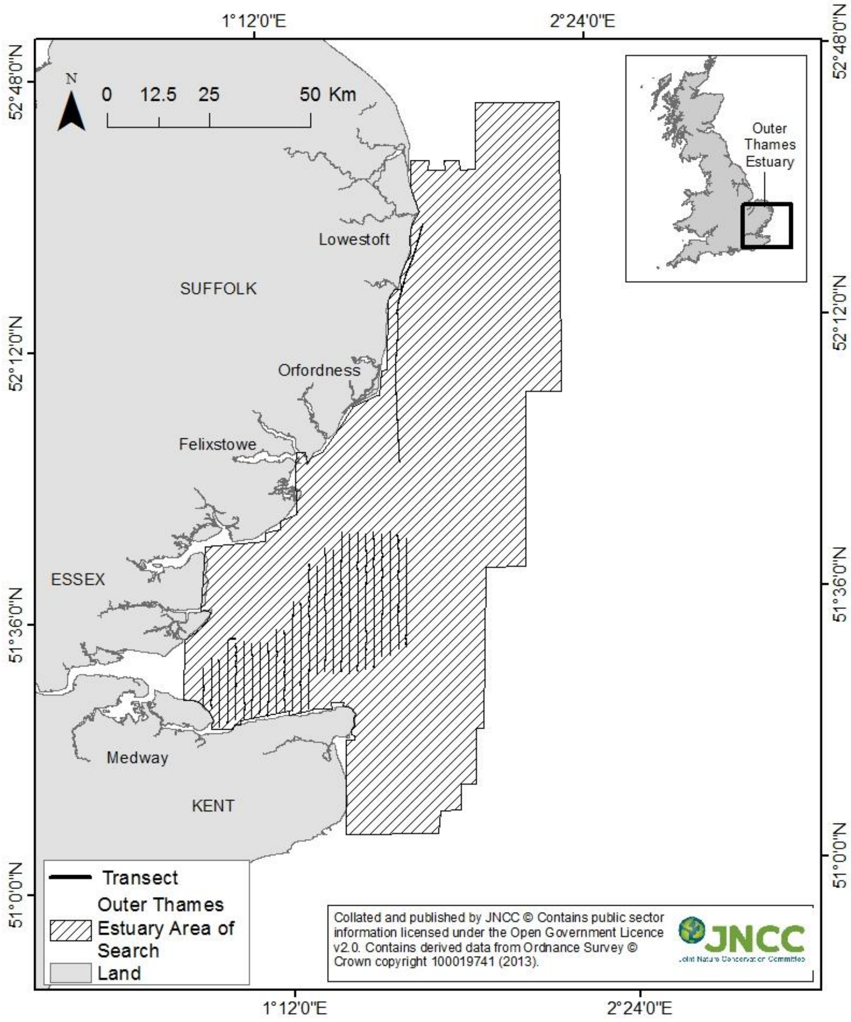
Table A1. Population estimates for little gull and great cormorant within the existing Outer Thames Estuary SPA.

		little gull			**great cormorant**		
Survey date	**Season**	**Sum within Max. curvature boundary**	**Sum within Outer Thames Estuary SPA**	**Peak**	**Sum within Max. curvature boundary**	**Sum within Outer Thames Estuary SPA**	**Peak**
Nov 2003	2003/04	N/A	N/A		28	44	
Dec 2003	2003/04	N/A	N/A		98	111	
Feb 2004	2003/04	**0**	**6***	**6**	**178**	**225**	**225**
Oct & Nov 2004	2004/05	0	0		70	105	
Nov & Dec 2004	2004/05	**129**	**37**	**37**	**205**	**246**	**246**
Jan & Feb 2005	2004/05	28	36		164	194	
Feb & Mar 2005	2004/05	0	0		62	73	
Mar 2005	2004/05	N/A	N/A		8	8	
Nov 2005	2005/06	**361**	**35**	**35**	146	152	
Dec 2005	2005/06	7	0		N/A	N/A	
Jan & Feb 2006	2005/06	26	17		68	61	
Feb & Mar 2006	2005/06	0	0		**4,096**	**3,636**	**3,636**
Jan & Feb 2007	2006/07	0	0		**592**	**615**	**615**
Feb & Mar 2007	2006/07	**16**	**20***	**20**	14	15	
Nov 2007	2007/08	N/A	N/A		**93**	**86**	**86**
Dec 2007	2007/08	N/A	N/A		60	54	
Feb 2008	2007/08	N/A	N/A		366	365	
Mar 2008	2007/08	N/A	N/A		1,163	1,185	
MoP		245	2 seasons	**36**	1,033	5 seasons	**962**

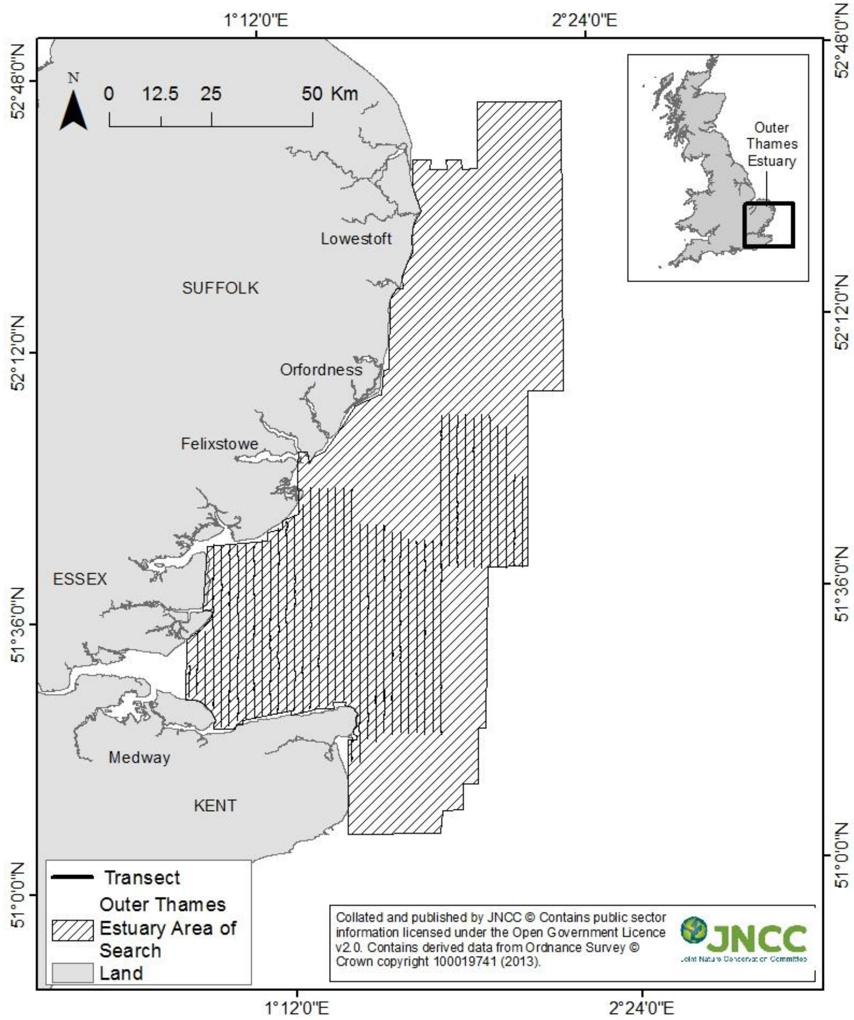
Appendix 2 – survey effort within the Outer Thames Estuary area of search



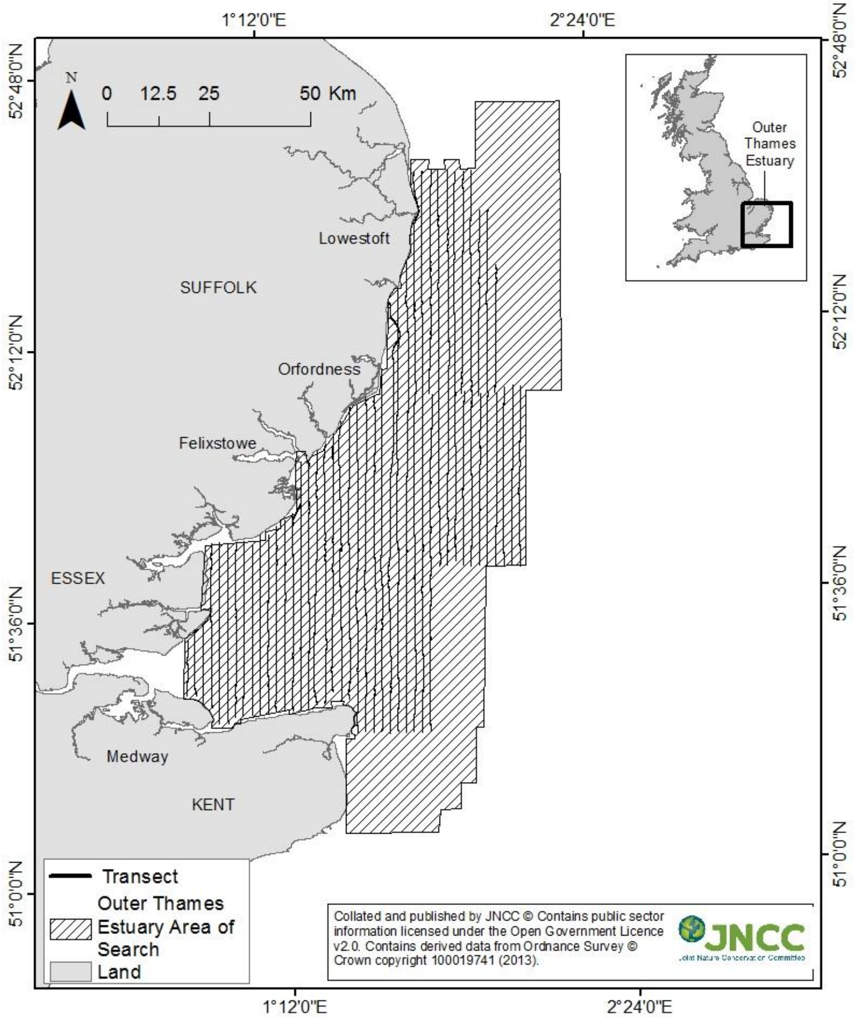
a) Winter season 2003/04 - Nov



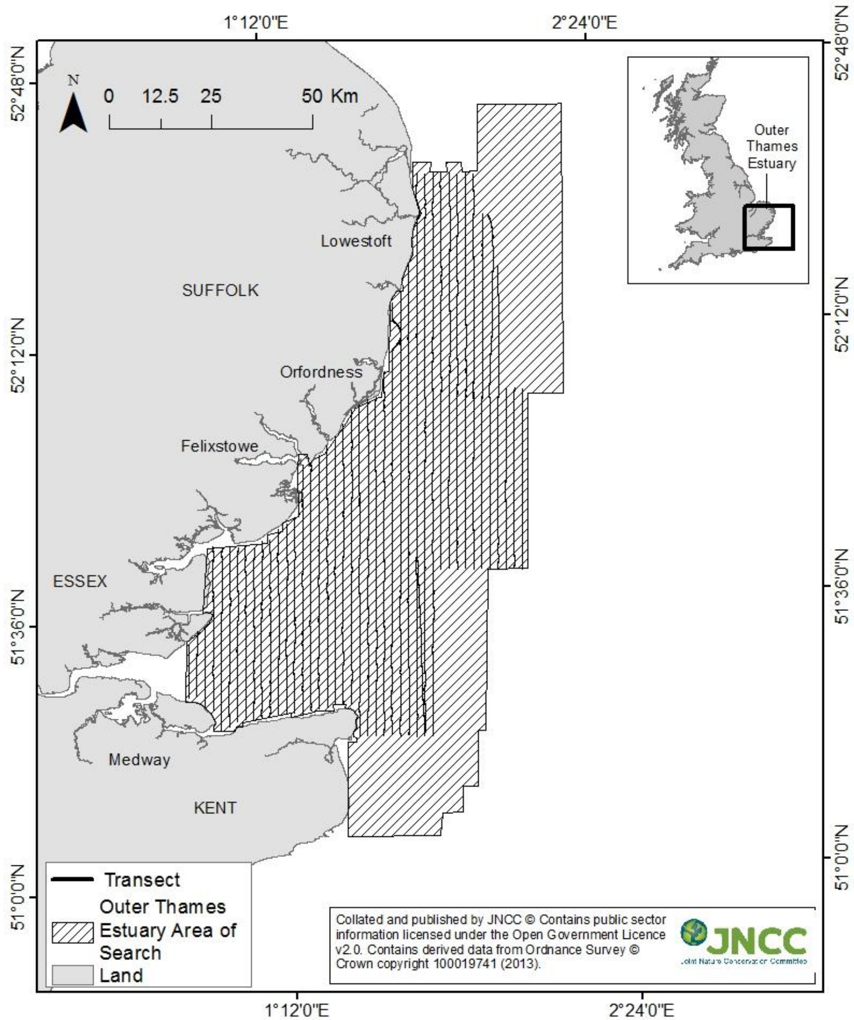
b) Winter season 2003/04 - Dec



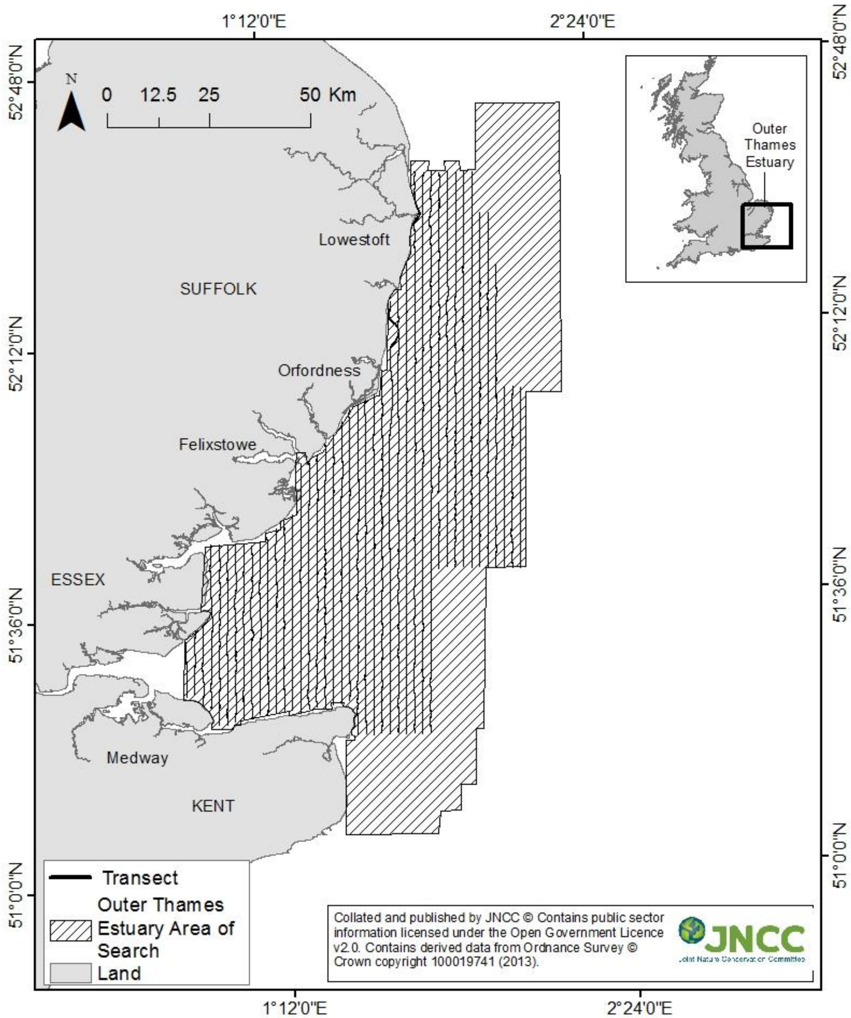
c) Winter season 2003/04 – Feb



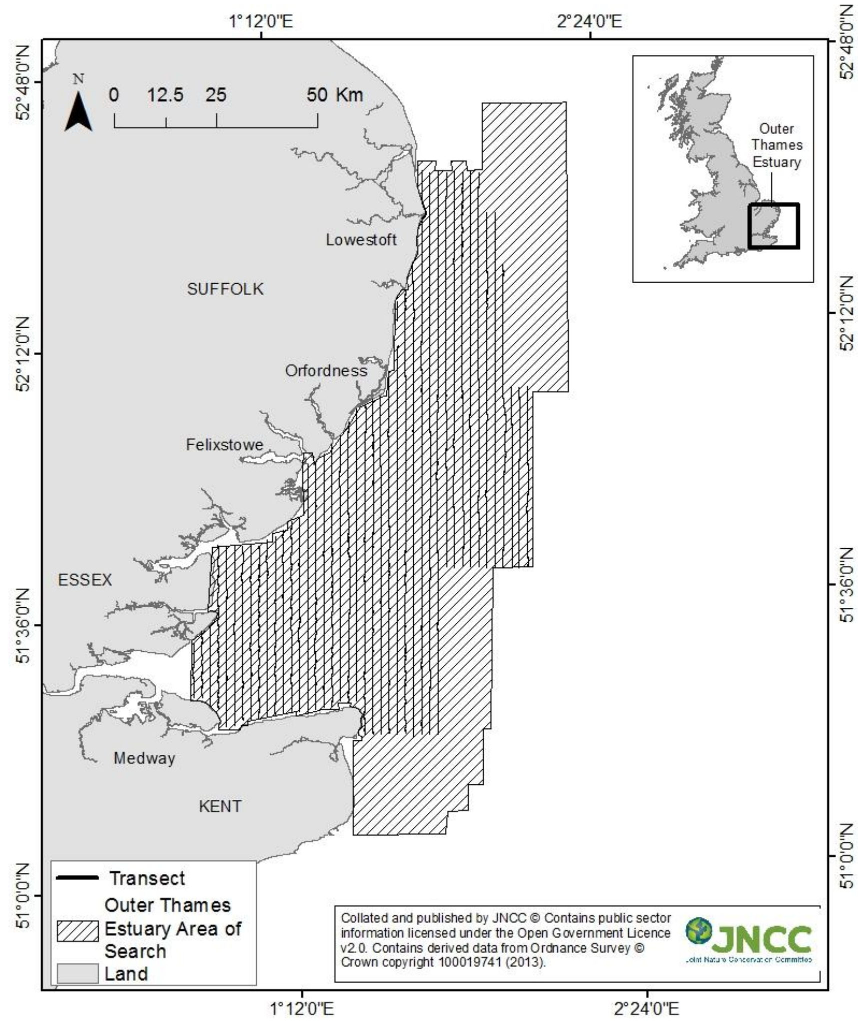
d) Winter season 2004/05 – Oct/Nov



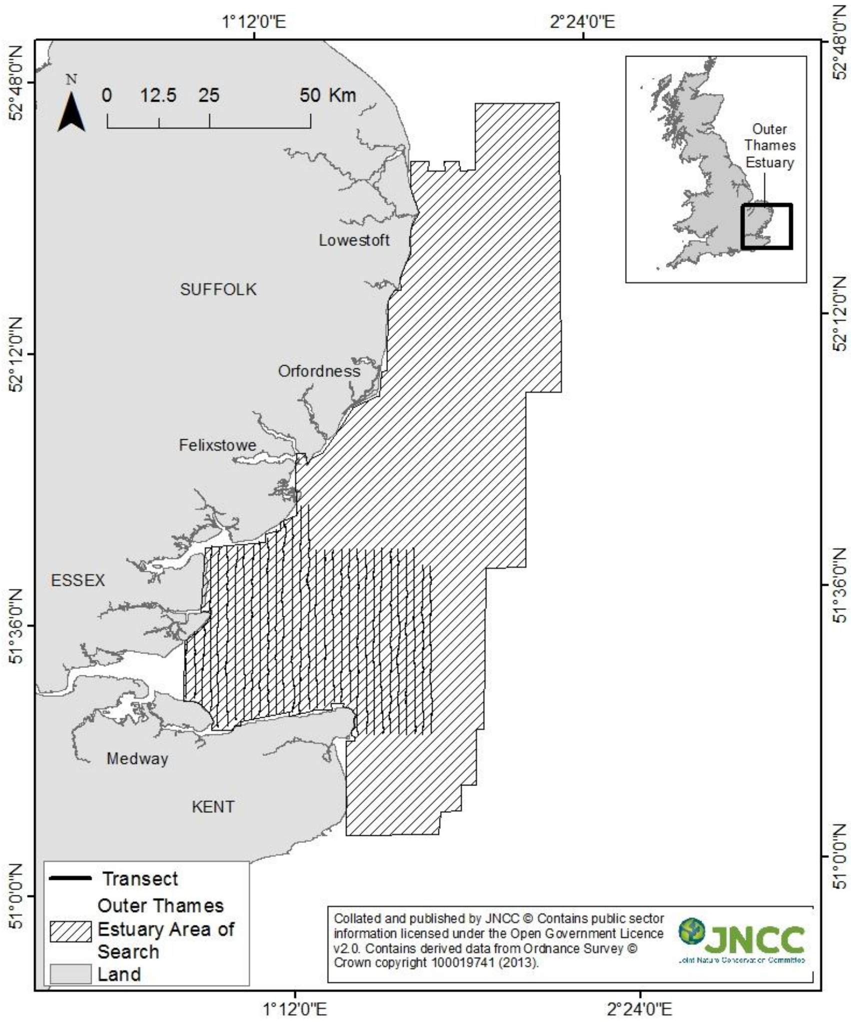
e) Winter season 2004/05 – Nov/Dec



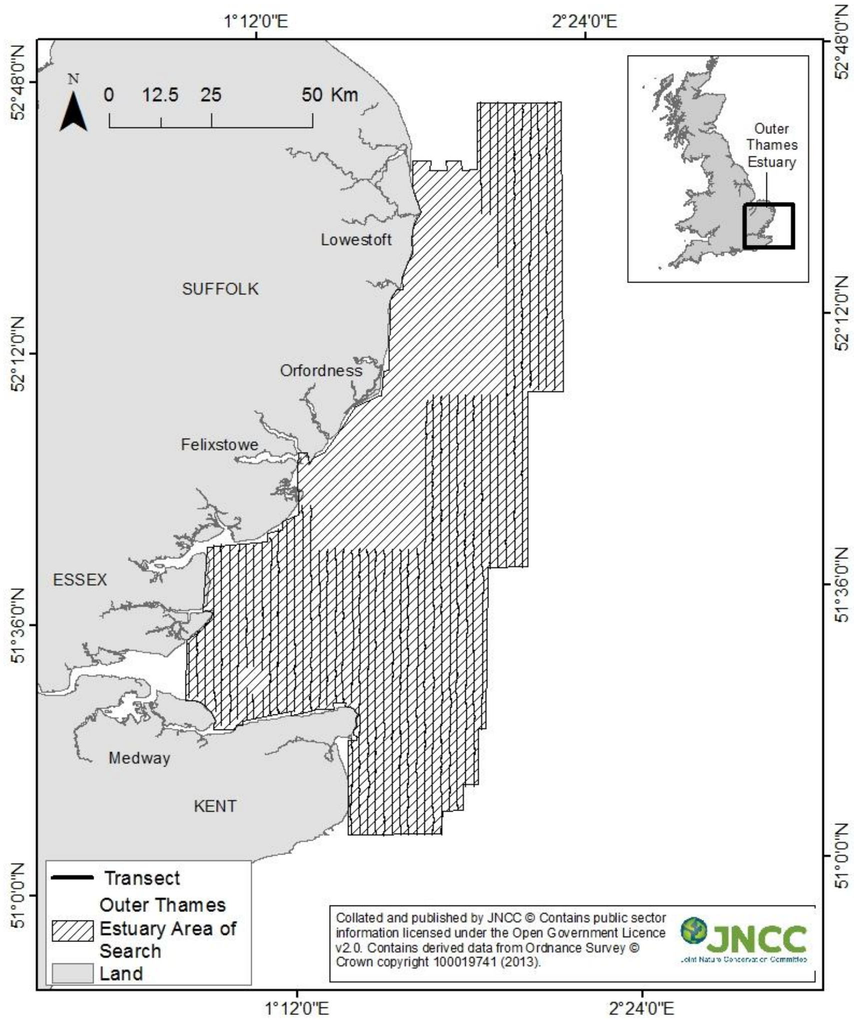
f) Winter season 2004/05 – Jan/Feb



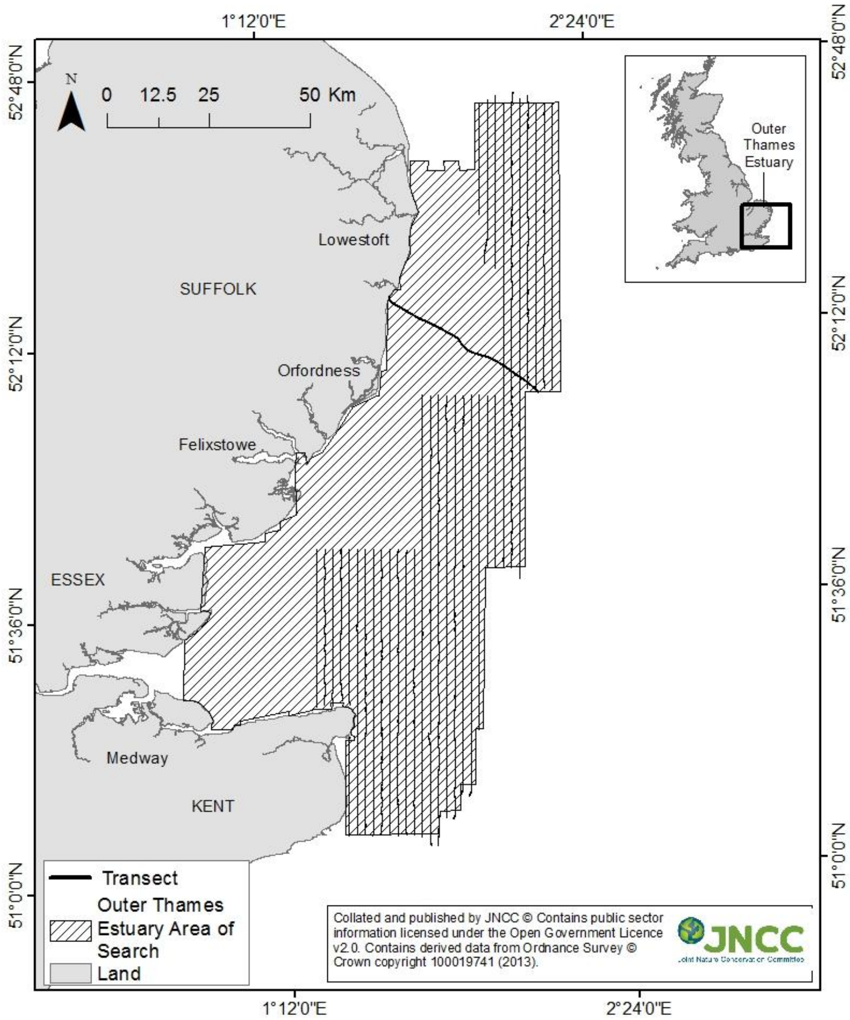
g) Winter season 2004/05 – Feb/Mar



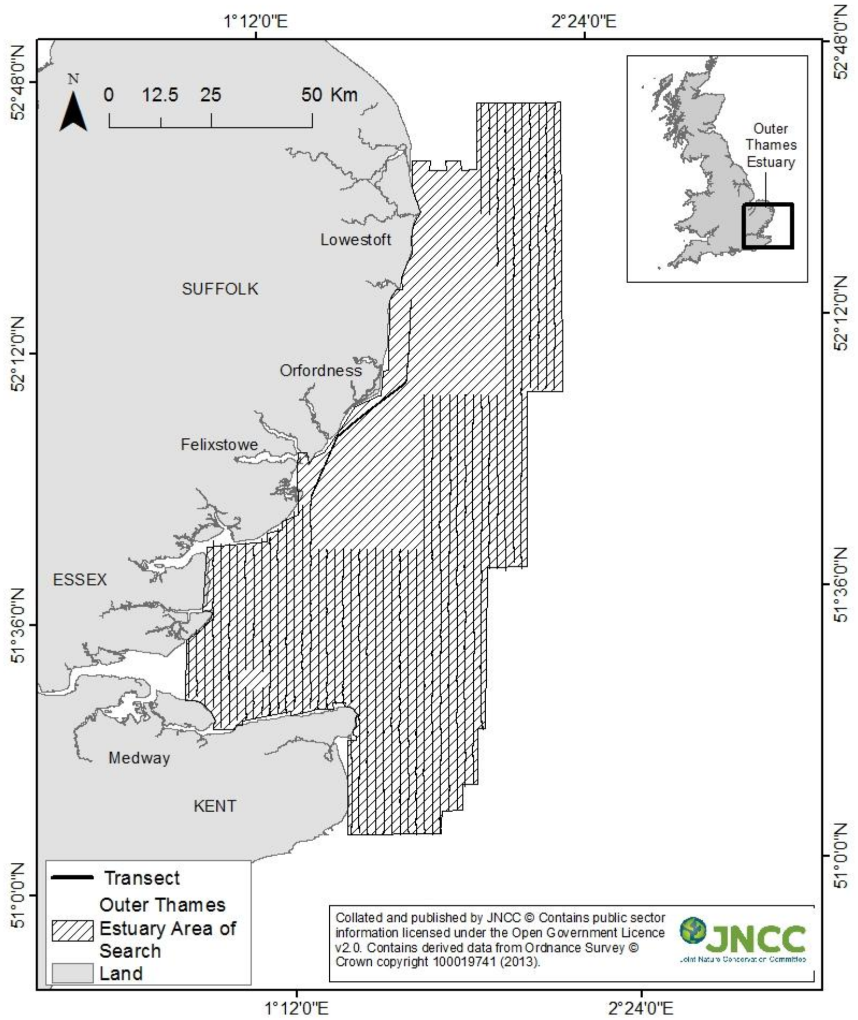
h) Winter season 2004/05 – Mar



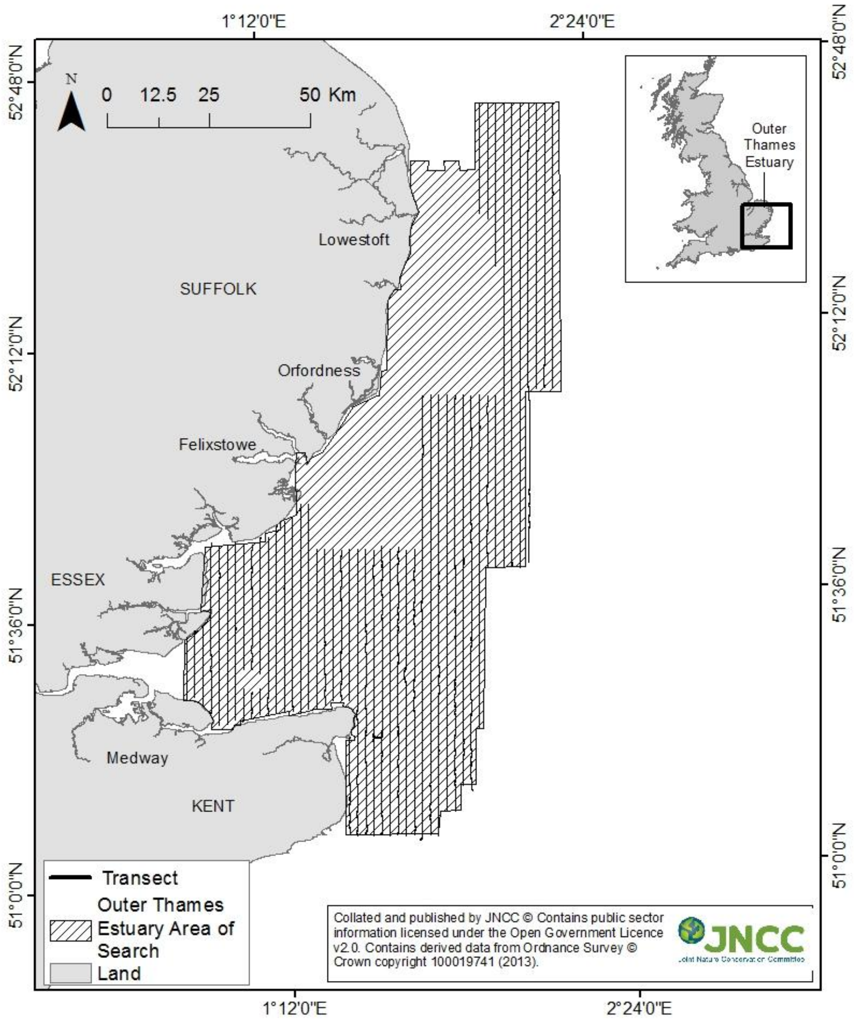
i) Winter season 2005/06 – Nov



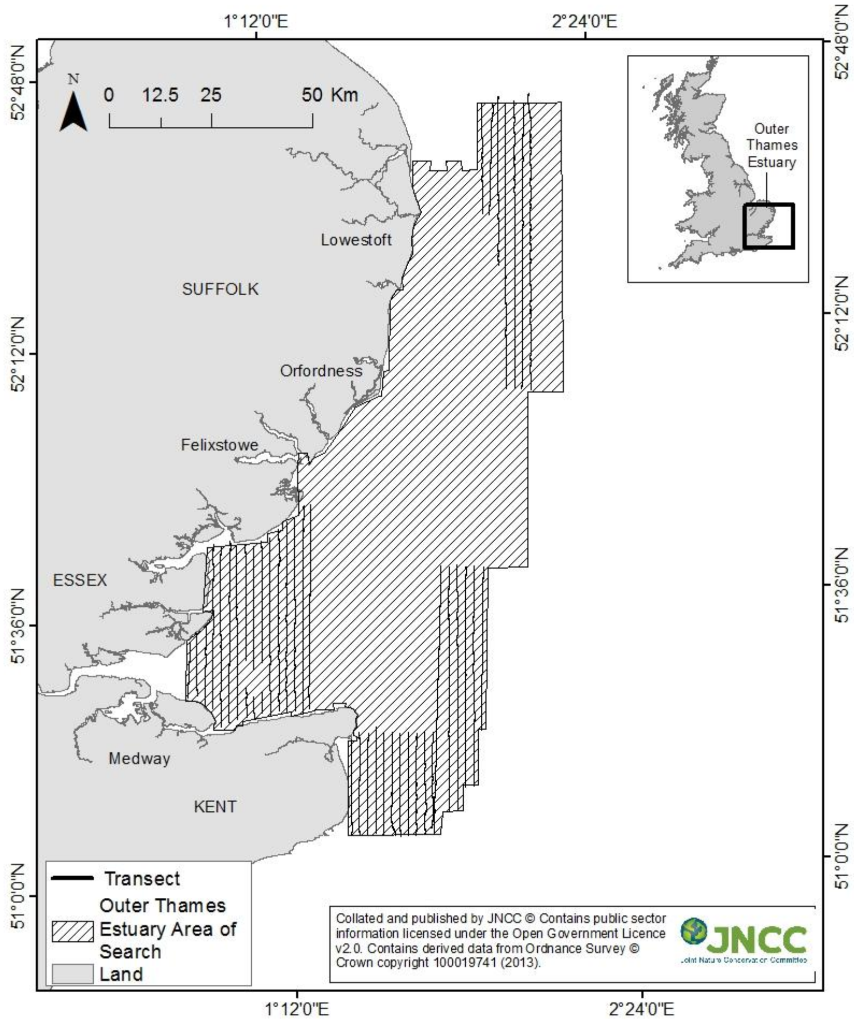
j) Winter season 2005/06 – Dec



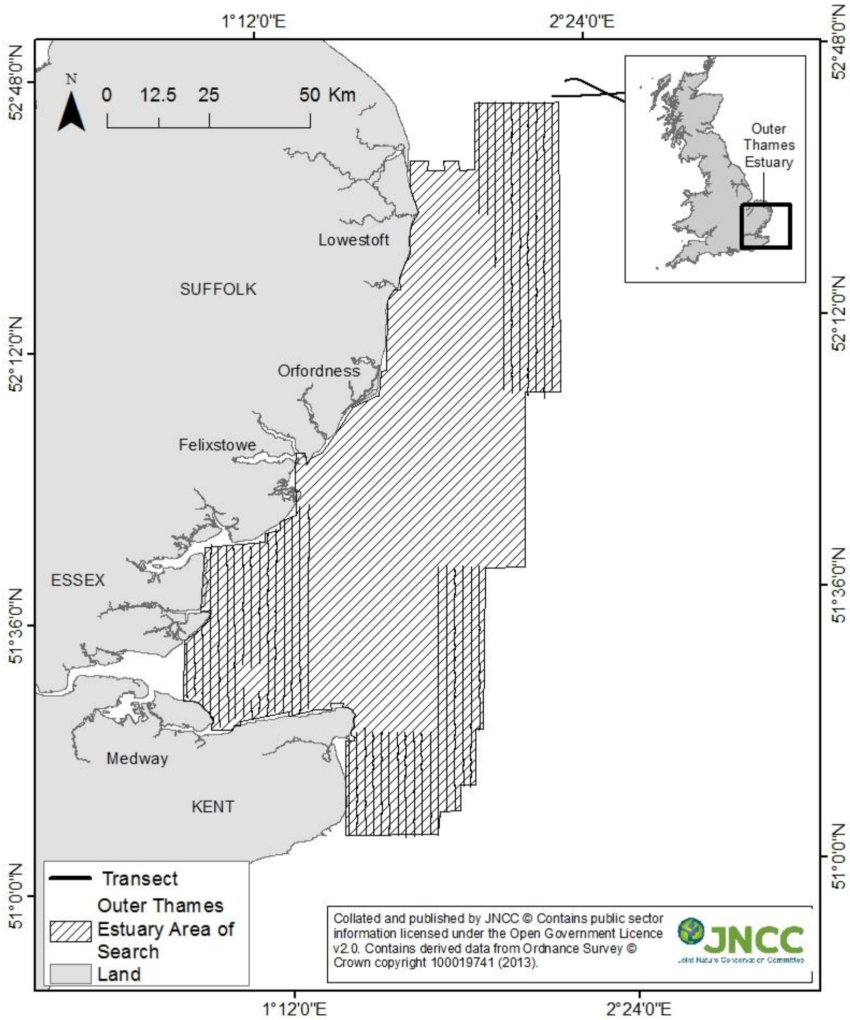
k) Winter season 2005/06 – Jan/Feb



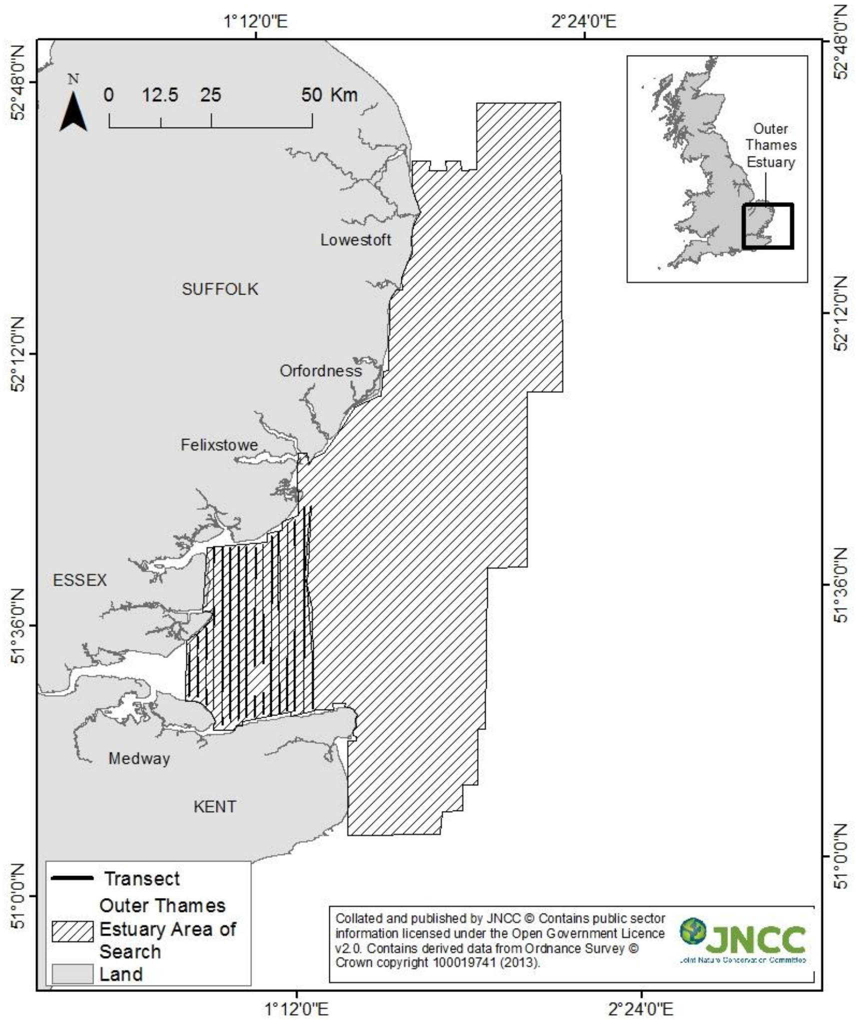
l) Winter season 2005/06 – Feb/Mar



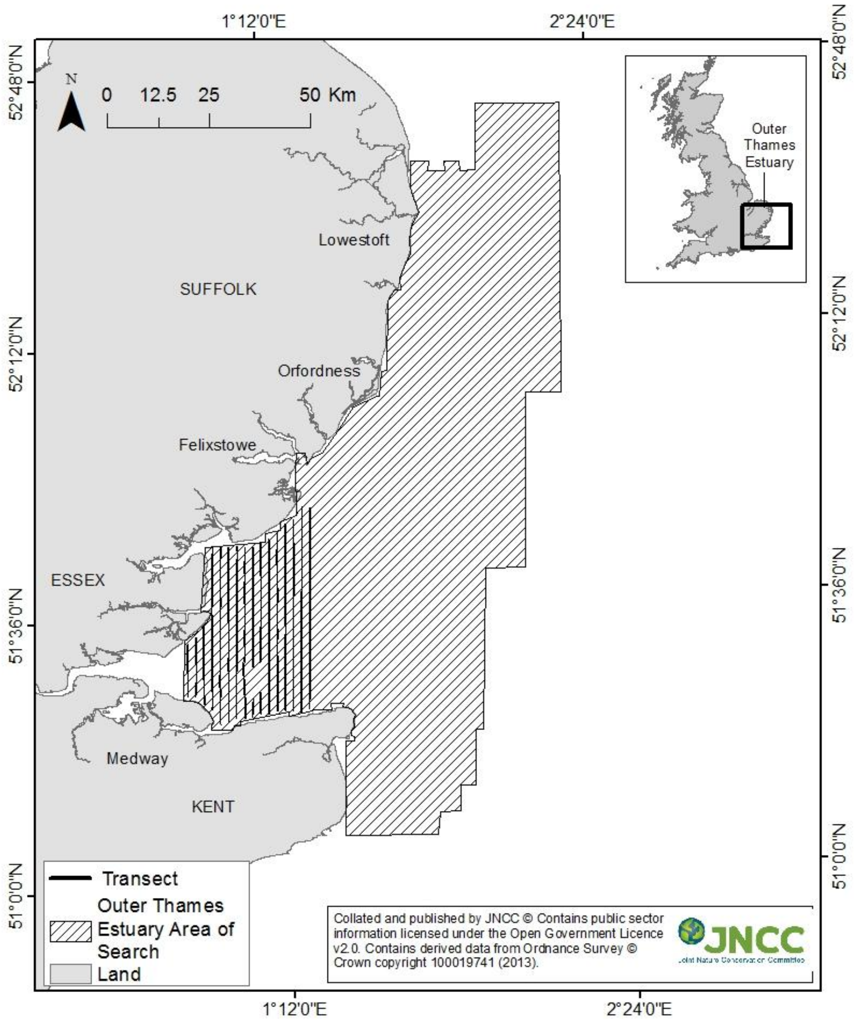
m) Winter season 2006/07 – Jan/Feb



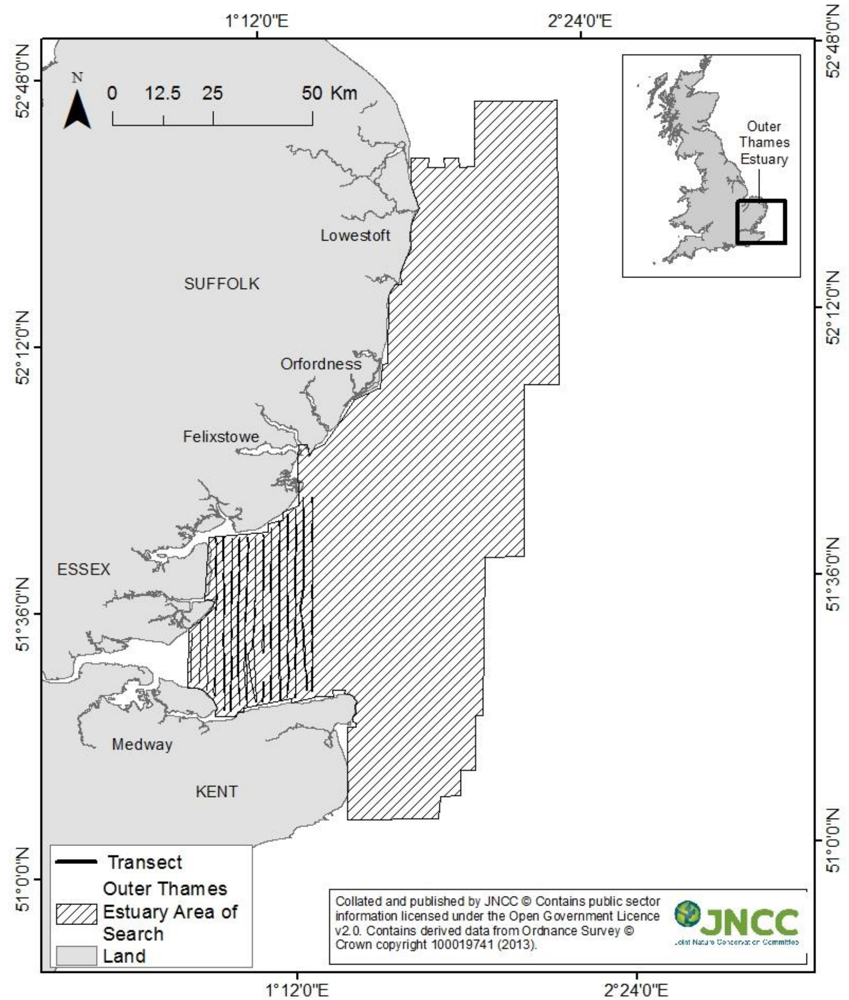
n) Winter season 2006/07 – Feb/Mar



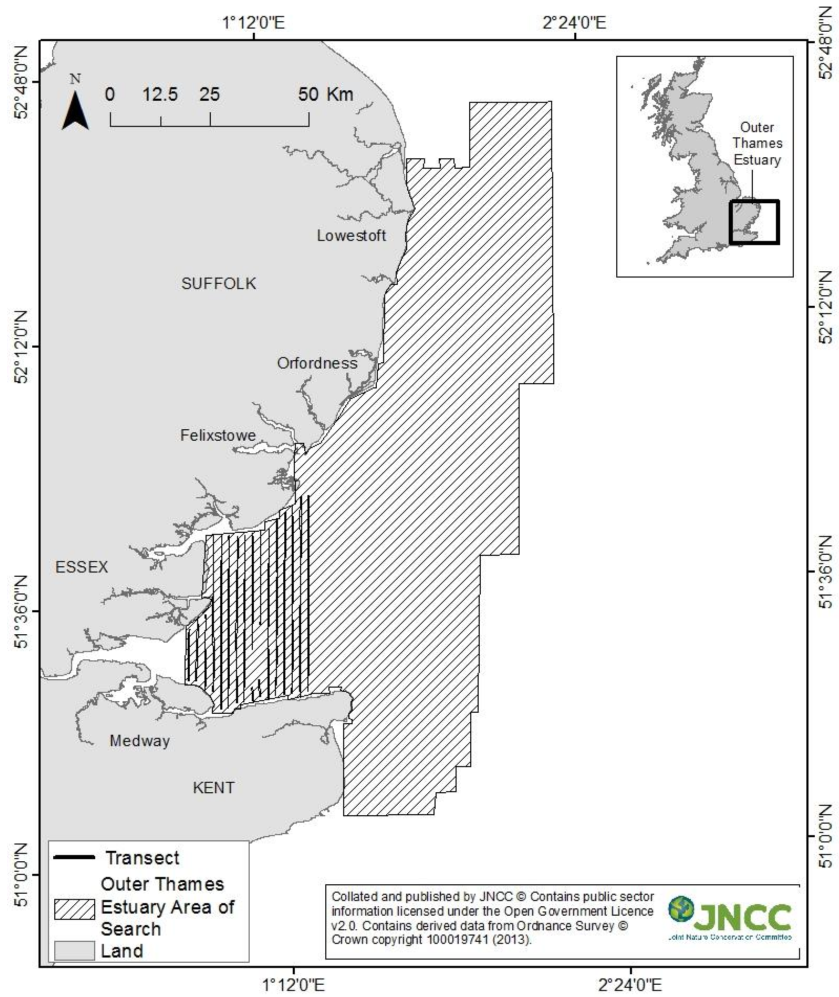
o) Winter season 2007/08 – Nov



p) Winter season 2007/08 – Dec



q) Winter season 2007/08 – Feb



r) Winter season 2007/08 – Mar

Figure B1 Spatial coverage of the aerial surveys in relation to the Outer Thames Estuary area of search for each of the winter seasons.

Table B1. Dates for surveys undertaken in the Outer Thames Estuary area of search. In many cases one survey of the area was split over a number of dates, the dates that together make a single survey are shown in the table below.

Winter season	Survey	Date
2003/04	Nov-2003	27 Nov 2003
	Dec-2003	17 Dec 2003
	Feb-2004	15 Feb 2004 16 Feb 2004 26 Feb 2004
2004/05	Oct-Nov 2004	31 Oct 2004 12 Nov 2004
	Nov-Dec 2004	24 Nov 2004 25 Nov 2004 03 Dec 2004 04 Dec 2004 05 Dec 2004
	Jan-Feb 2005	14 Jan 2005 15 Jan 2005 03 Feb 2005
	Feb-Mar 2005	28 Feb 2005 06 Mar 2005 07 Mar 2005 08 Mar 2005
	Mar 2005	13 Mar 2005 15 Mar 2005
2005/06	Nov-2005	13 Nov 2005 16 Nov 2005 17 Nov 2005
	Dec 2005	06 Dec 2005 07 Dec 2005 08 Dec 2005 09 Dec 2005
	Jan-Feb 2006	13 Jan 2006 14 Jan 2006 18 Jan 2006 10 Feb 2006
	Feb-Mar 2006	18 Feb 2006 02 Mar 2006 03 Mar 2006 07 Mar 2006
2006/07	Jan-Feb 2007	31 Jan 2007 02 Feb 2007 03 Feb 2007
	Feb-Mar 2007	18 Feb 2007 08 Mar 2007
2007/08	Nov 2007	24 Nov 2007
	Dec 2007	30 Dec 2007
	Feb 2008	02 Feb 2008
	Mar 2008	09 Mar 2008