

Greater Thames Estuary Harbour Seal Population Survey



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Project Aim

To understand how harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) use the Greater Thames Estuary and to calculate a harbour seal population estimate for the region.

Introduction

The harbour seal (*Phoca vitulina*) is the smaller of the two species of seal present in the UK, growing up to 1.7m long and weighing between 80 to 100 kg. The UK harbour seal population was minimally estimated in 2012 by the Sea Mammal Research Unit (SMRU) at 36,500 individuals (95% CI 29,900 – 49,700) (SCOS 2014). Harbour seal population growth across the UK has been punctuated by two epizootics of Phocine Distemper Virus (PDV) in 1988 and 2002. During these epizootics, 52% and 22% of harbour seals on the east coast of England died respectively (Thompson *et al.* 2010). The east coast harbour seal population has since increased, reaching pre-PDV levels for the first time in 2013 (SCOS 2014).

However, some Scottish harbour seal populations have experienced dramatic declines that are not linked to PDV and is a cause for concern (SCOS 2014). The Orkney and North Coast harbour seal populations have declined by approximately 11% per year since 2006; the Shetland harbour seal population declined by 30% between 2000 and 2006; and the Firth of Tay and Eden Estuary harbour seal population has declined by 43% between 2012 and 2013 (SCOS 2014). These declines could only be caused by a sustained high level of reproductive failure or increased rate of mortality and are being researched by SMRU (Thompson *et al.* 2010, Matthiopoulos *et al.* 2013). Hypotheses of main drivers for these declines include competition for prey with grey seals, which results in decreased condition, decreased fecundity and/or increased mortality in harbour seals or increased mortality from harmful algal toxin uptake (SCOS 2014). In part due to these declines, the harbour seal is listed as a UK Biodiversity Action Plan priority species (JNCC 2010).

The grey seal (*Halichoerus grypus*) is the larger of the two species of seal present in the UK, growing up to 2.1m long and weighing up to over 300 Kg (SCOS 2013). The UK grey seal population was estimated in 2013 by SMRU as 111,600 individuals (95% CI 92,000-137,900) with pup production estimated at 56,988 in 2012 (95% CI 56,317-57,683) (SCOS 2014). The UK grey seal population accounts for 38% of the global grey seal population, which is split into three regions: Western Atlantic, Eastern Atlantic and Baltic (Thomson and Härkönen 2008, SCOS 2014).

Over the last ten years, grey seal breeding colonies have rapidly expanded along the east coast of England; in Berwickshire, Lincolnshire, Norfolk and Suffolk (SOCS 2013). Pup production in long-established colonies has grown exponentially (e.g. Donna Nook) and there has been rapid expansion of newer colonies along the coastline (SCOS 2013). SMRU's pup production estimate for Lincolnshire, Norfolk and Suffolk was 3,359 pups in 2012, an increase of approximately 14% compared to the 2011 estimate (SCOS 2013). The sustained

rapid growth of grey seal colonies on the east coast of England is in contrast to the rest of the UK, where pup production rates are stabilising and population growth is levelling off (SCOS 2013).

Grey seals and harbour seals share resource requirements, in particular food and haul out sites, so interspecific competition is likely to occur when resources are in short supply (Svensson 2012, van Neer *et al.* 2014, Russel *et al.* 2015). Following the exponential increase in grey seal numbers and the recovery of harbour seal populations to pre-2002 PDV levels on the east coast of England, it is likely that there is increased pressure on resources used by seals in the region. This may lead to increased interspecific competition between grey seals and harbour seals in the following ways.

Competition for prey

Grey seals and harbour seals are generalist predators and feed upon a variety of fish species including sandeels, gadoids (cod, whiting, haddock, ling), flatfish (plaice, sole, flounder, dab), herring, sprat, octopus and squid (Svensson 2012, SCOS 2014, Russel *et al.* 2015). The species of prey targeted varies temporally and spatially in response to the changing availability of different fish species in the proximity of haul out sites (Smout *et al.* 2014). Grey seals and harbour seals have similar diets and there is significant overlap in the prey species they target in each region (Brown *et al.* 2012, Gosh *et al.* 2014).

Competition for suitable haul out sites

An important part of grey and harbour seal behaviour is to haul out on sand banks or mud flats to rest after foraging activities, to moult and to breed. Intertidal haul out sites are used by both species throughout the year and can cause interspecific competition. However, competition for haul out sites during the breeding period is reduced due to the temporal difference in breeding season for the two species (Svensson 2012, Hamilton 2014).

Grey seal predation

Observations from Helgoland Düne (Germany) show grey seals attacking and preying upon harbour seals and observations on the Isle of May (Scotland) and Orkney (Scotland) show adult grey seals preying upon grey seal pups (van Neer *et al.* 2015, Thompson *et al.* 2015). The large quantities of muscle and blubber taken from the animals suggest that this behaviour is active predation (van Neer *et al.* 2015). This 'new' behaviour may only have been recently observed due to the increased population size causing an increased likelihood of observing an infrequent behaviour (van Neer *et al.* 2015). However, it may also be a newly evolved behaviour in response to reduced fish stocks, changing prey spectrum and increased proximity of seals at haul out sites (van Neer *et al.* 2015).

Spread of Phocine Distemper Virus (PDV)

Grey seals are carriers of PDV; they can be infected by the virus but it does not normally cause severe and acute disease as they have a stronger neutralising immune response than harbour seals (Härkönen and Harding 2010, Duignan *et al.* 1997). Grey seals are thought to act as important vectors of PDV and have been identified as the main reason PDV spread across different European harbour seal populations during the 1988 and 2002 epizootics (Härkönen and Harding 2010, Duignan *et al.* 2014). An increased abundance of grey seals on the east coast of England could increase the transmission rate of PDV in the region (Svensson 2012). PDV outbreaks in the North East Atlantic appear to have a 13 year interval, so assuming this applies to future epizootics, the next outbreak is predicted for 2016 (Härkönen and Harding 2010, SCOS 2013). Recent modelling suggests that the next PDV outbreak would affect 82% of the harbour seal population in the Wadden Sea (Bodewes *et al.* 2013). Recent research in Sweden shows that harbour seals are resilient to interspecific competition with grey seals until a PDV outbreak reduces their competitive advantage, thus allowing grey seal populations to grow (Svensson 2012).

Problem Statement

Before ZSL started the Thames Harbour Seal Conservation Project in 2011, the Greater Thames Estuary harbour seal population was one of the least understood seal populations in the country. Very little was known about the abundance of seals in the region, whether seal populations were increasing or declining, seal ecology (e.g. preferred haul out sites and foraging grounds) and behaviour. ZSL has been gathering vital ecological data through a telemetry study of 10 harbour seals and annual population surveys during the harbour seal moult period in August (Barker 2015).

ZSL's focus is on gathering data on the harbour seal population in the Greater Thames Estuary to inform conservation and management for this Biodiversity Action Plan priority species. However, it is also important to better understand the grey seal population in the region to identify potential impacts on the harbour seal through interspecific competition. During the harbour seal population surveys any grey seals encountered are recorded. In December 2014, ZSL completed a grey seal breeding survey in the region, during the peak grey seal breeding season to identify whether any grey seal breeding colonies are located in the Greater Thames Estuary. Neither grey seals nor grey pups were found during the survey, suggesting that grey seals do not breed in the region and might be seasonal visitors of the Greater Thames Estuary (Barker 2015).

Methodology

The study area encompasses the estuarine area of the Greater Thames Estuary, which is delineated by Gravesend in the West, Felixstowe in the North and Deal in the South. The marine environment of the Greater Thames Estuary is varied, but characterised by mobile sediments, large shifting sand banks, areas of shallow water, deep water channels and high tidal current streams (Natural England Departmental Brief 2010). The Greater Thames Estuary has a varied coastline and contains seven smaller estuaries: Swale Estuary, Medway Estuary, Roach Estuary, Blackwater Estuary, Colne Estuary, Stour Estuary and Orwell Estuary.

Harbour Seal Population Survey

The Thames harbour seal population survey is completed at the beginning of August each year, to coincide with the peak harbour seal moult period, when seals spend the greatest proportion of their time hauled out on land and are therefore visible to count (SCOS 2014). It combines three aerial, two boat and two land-based transects to make a comprehensive count of harbour seals in the region. The transects were conducted within two hours either side of low tide, when the greatest number of seals are likely to be hauled out, as per SMRU monitoring protocol.

The aerial transects were completed over the outer estuary sand banks as large areas can be covered in a relatively short period of time. Boat surveys, completed on a RIB, were completed on the smaller estuaries and more industrial areas as it is more difficult to detect seals from air around infrastructure (jettys, harbours, mooring points, bridges etc.), more complex habitats (marshland, mudflats and sand flats) and in areas where aircrafts are prohibited e.g. near power stations.

When seal(s) were encountered, a GPS waypoint was inputted onto a GARMIN eTrex10 handheld GPS unit and counts were made by two people. During the boat and land transects, the number and species of seals were verified and agreed by the observers. During the aerial surveys, photographs were taken each time seal(s) were encountered, to allow for an accurate count and identification to species level during post-survey analysis. Additional notes were taken, if necessary, to aid the identification process. The photos were analysed independently by two researchers; these counts were compared, disparities were discussed

and the final count was agreed. A harbour seal population estimate was calculated by rescaling the count data using SMRU protocol. Previous research indicates that 72% of a harbour seal population is likely to be hauled out during the moult period, if the sex ratio is assumed to be 1:1, a population estimate can be calculated by: $(\text{seal count} / 72) \times 100$ (Lonergan *et al.* 2012, SCOS 2012).

Results

The 2015 harbour seal population survey was completed between 16 August and 19 August; 451 harbour seals and 454 grey seals were encountered (Fig. 1, Table 1). This data suggests that the harbour seal population estimate for the Greater Thames Estuary is 626 individuals. Both the number of harbour seals counted in 2015 and the harbour seal population estimate were slightly lower than the previous two years (Table 1). The 2014 harbour seal population count was completed between 11 August and 13 August: 489 harbour seals and 449 grey seals were encountered and the harbour seal population estimate was 679 individuals (Annex 1 (Fig.4), Table 1). The 2013 harbour seal population count was completed on 7th, 12th and 13th August; 482 harbour seals and 203 grey seals were encountered and the harbour seal population estimate was 669 individuals (Annex 1 (Fig. 5),, Table 1).

Harbour seals encountered in the three surveys (2013, 2014 and 2015) showed consistency in the location of haul out sites, with 17 sandbanks being used by harbour seals in all three years, suggesting that there may be fidelity to particular haul out sites in the Greater Thames Estuary (Fig. 2). Haul out sites for the harbour seal are located throughout the Greater Thames Estuary, but larger colonies tend to occur on coastal sand banks. Grey seal haul out locations in the three years are less consistent, with just 7 sandbanks being used by grey seals in all three years (Fig. 3). A considerably larger colony of grey seals are consistently found on the Goodwin Sands than anywhere else in the Greater Thames Estuary (Fig. 3)

Table 1: Comparison of seal counts over three ZSL surveys

Survey	Harbour Seals	<i>Harbour seal population estimate</i>	Grey Seals	All seals
2015 Harbour Seal Population Survey	451	626	454	911
2014 Harbour Seal Population Survey	489	679	449	938
2013 Harbour Seal Population Survey	482	669	203	685

Figure 1:
 Location of seals sighted during ZSL's Harbour Seal Population Survey in August 2015 (the area of the circle corresponds with the number of seals in that location).

Legend:

2015 population survey

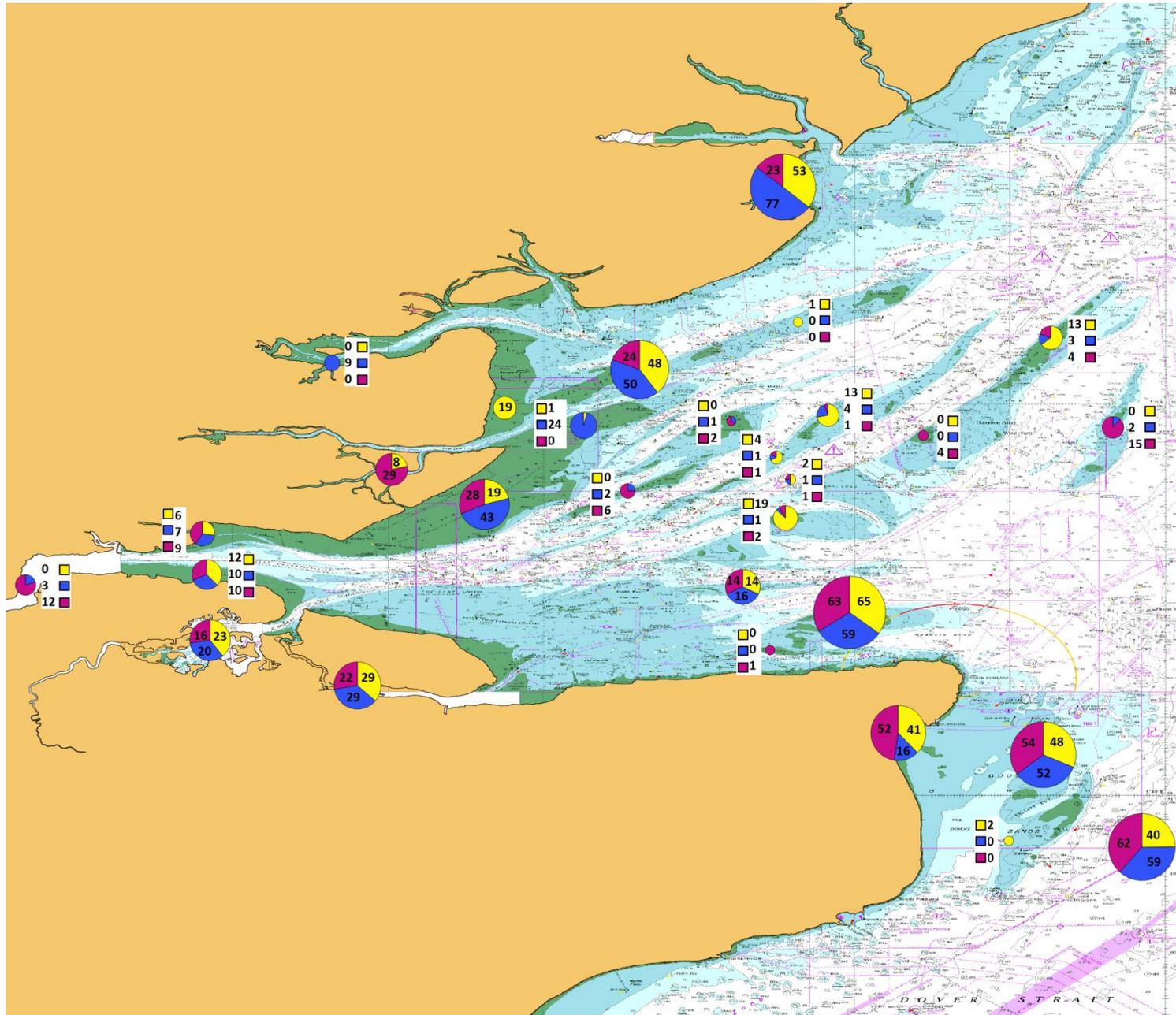
- Grey seal colony
- Harbour seal colony
- Mixed seal colony
- Boat survey route
- Aerial survey route
- Land

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Figure 2:
Comparison of harbour seal location over three surveys (the area of the circle corresponds with the number of harbour seals in that location).



Legend:

August 2015 survey

● Harbour seal

August 2014 survey

● Harbour seal

August 2013 survey

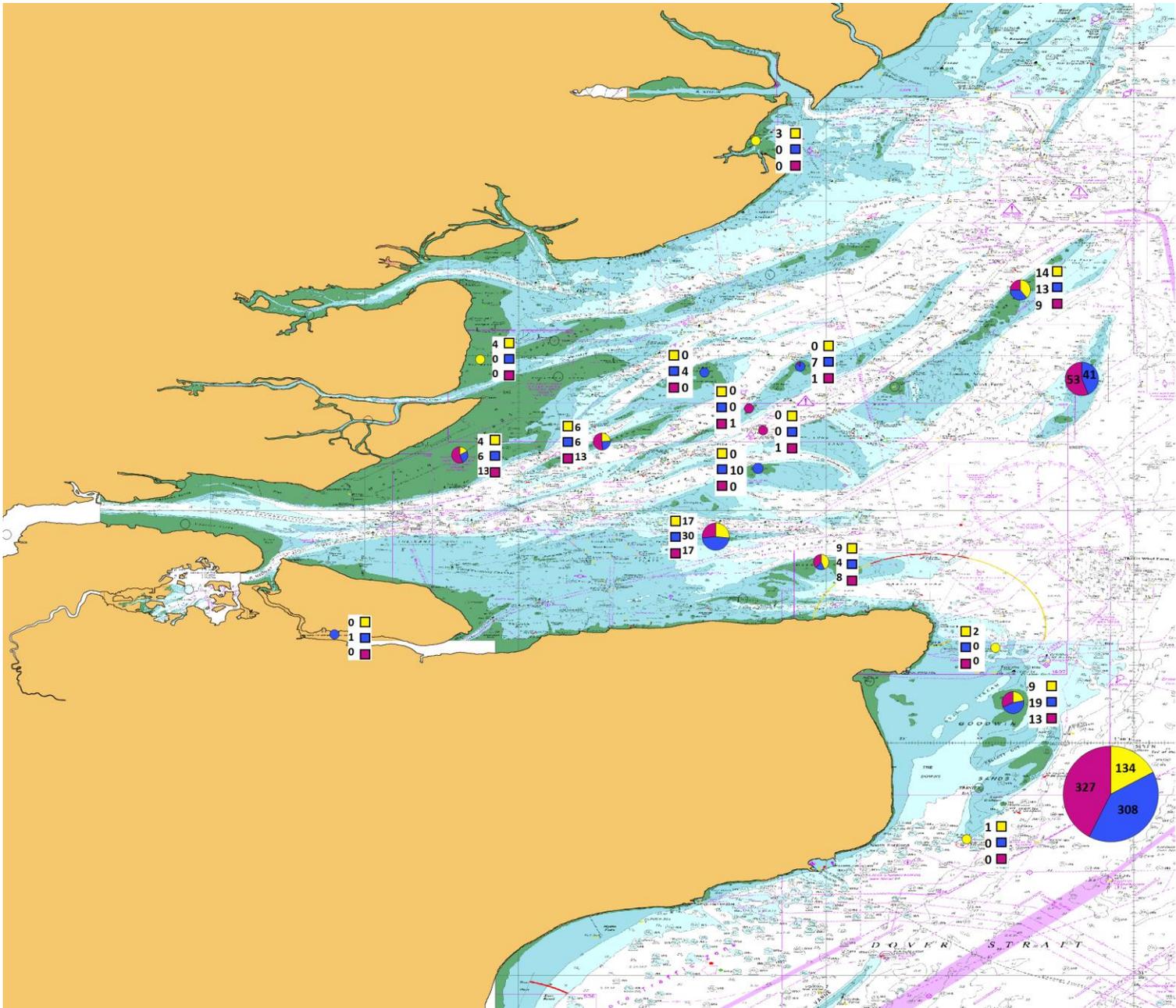
● Harbour seal

■ Land

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Figure 3: Comparison of grey seal location over three surveys (the area of the circle corresponds with the number of grey seals in that location).

Legend:

- August 2015 survey
 - Grey seal
- August 2014 survey
 - Grey seal
- August 2013 survey
 - Grey seal
- Land

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Discussion

The harbour seal population estimate for the Greater Thames Estuary ranges between 631 and 679 harbour seals, with an average of 660 harbour seals. The consistency of the population estimate over the three years suggests that the Greater Thames Estuary has a resident harbour seal population. The harbour seal population is not equally distributed in the Greater Thames Estuary; larger harbour seal colonies are mostly found on coastal sandbanks. This may be due to calmer water conditions in these areas, ability to haul out onto the coast at high tide or close proximity to important food resources. By completing the harbour seal population survey each year, following the same methodology, we can build a long-term dataset to understand harbour seal population dynamics in the region.

Although the number of harbour seals counted in 2015 was lower than in 2013 and 2014, the difference was only 53 seals and 43 seals respectively, which suggests that the population could be stable. The 2015 harbour seal population count represents 10% of the English and Welsh harbour seal minimum population estimate (SCOS 2014). If harbour seal populations continue to decline in West Scotland, North Coast & Orkney, Moray Firth and East Scotland; the Greater Thames Estuary harbour seal population may become increasingly important at a national level and harbour seal ecology in this region needs to be better understood.

In June 2015 and December 2015, opportunistic boat surveys were completed on the River Roach and River Stour to observe the harbour seal colonies regularly sighted in these areas. The survey on the River Roach confirmed that this area is important for harbour seal pupping, with a total of 22 adult harbour seals and 12 harbour seal pups identified. In 2016, we plan to fundraise to complete a harbour seal breeding survey throughout the Greater Thames Estuary to accurately estimate the number of pups born each year in the region. The survey on the River Stour confirmed that harbour seals use this area throughout the year, with 40 adult harbour seals identified. Interestingly, during this survey a large adult male grey seal was observed displaying aggressive behaviour towards a harbour seal by chasing it off a sand bank and then continuing the chase in the water. This behaviour may be due to overlapping territories of the two species.

During the 2015 harbour seal population survey the number of grey seals encountered was very similar to the 2014 survey (454 grey seals and 449 grey seals respectively). The continued presence of a large number of grey seals in the Greater Thames Estuary may have implications on competition for prey, competition for haul out sites, predation and transmission of PDV between grey seals and harbour seals. Thus, it is important to continue recording grey seals during the harbour seal population surveys each year and conduct new research in the region to better understand interspecific competition between the species.

The Goodwin Sands remained as a very important haul out site for grey seals in the region; 340 grey seals were identified on the Goodwin Sands during the 2015 harbour seal population survey, which accounts for 75% of all the grey seals counted in the region. It is possible that Goodwin Sands is an important haul out site for seals travelling from mainland Europe to the UK, as it is one of the most easterly sand banks in the Greater Thames Estuary. Further study on this area, especially photo identification or tagging work, could provide interesting results on the behaviour of grey seals using Goodwin Sands.

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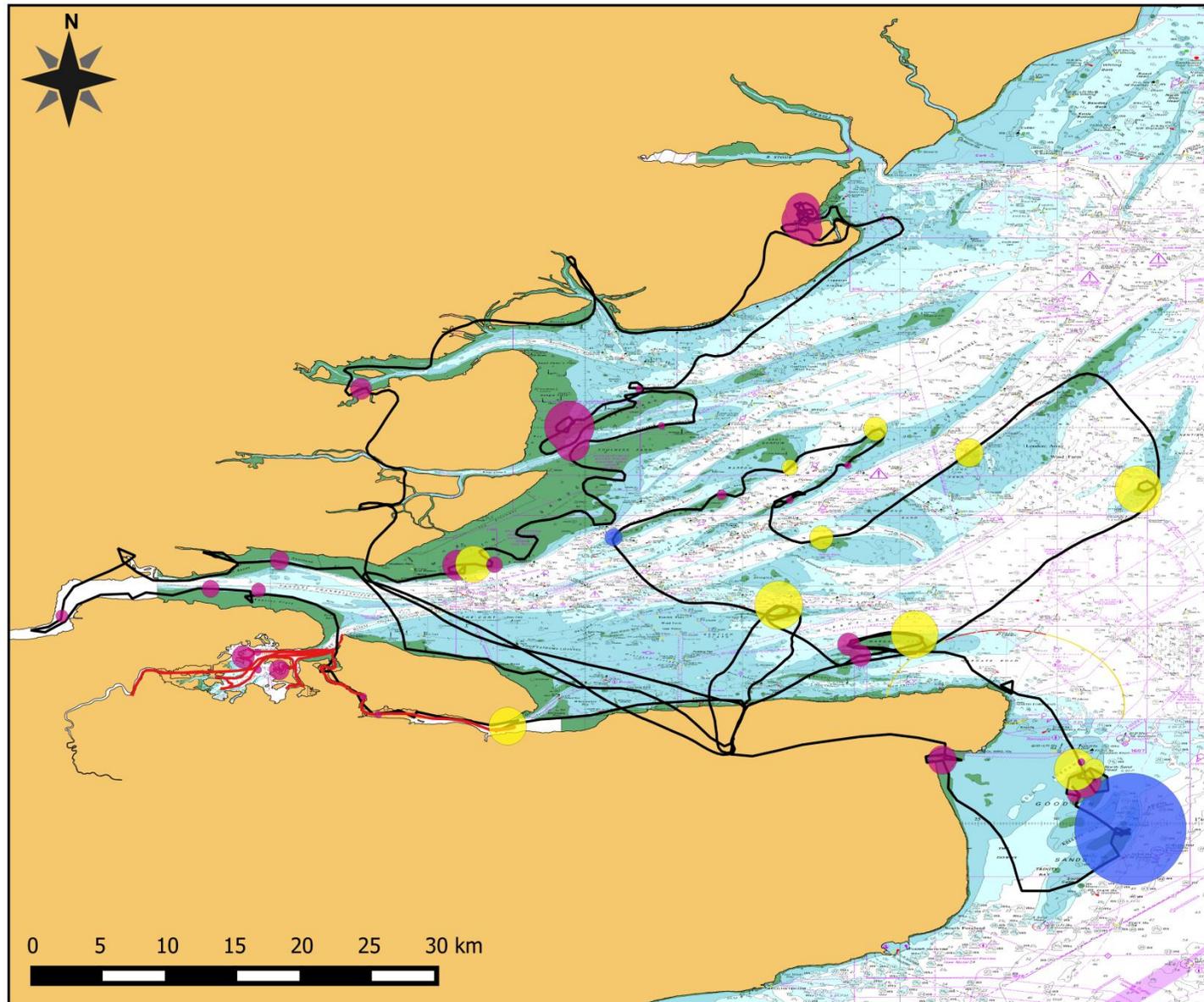
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Annex 1:



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Figure 4:

Location of seals sighted during ZSL's Harbour Seal Population Survey in August 2014 (the area of the circle corresponds with the number of seals in that location).

Legend:

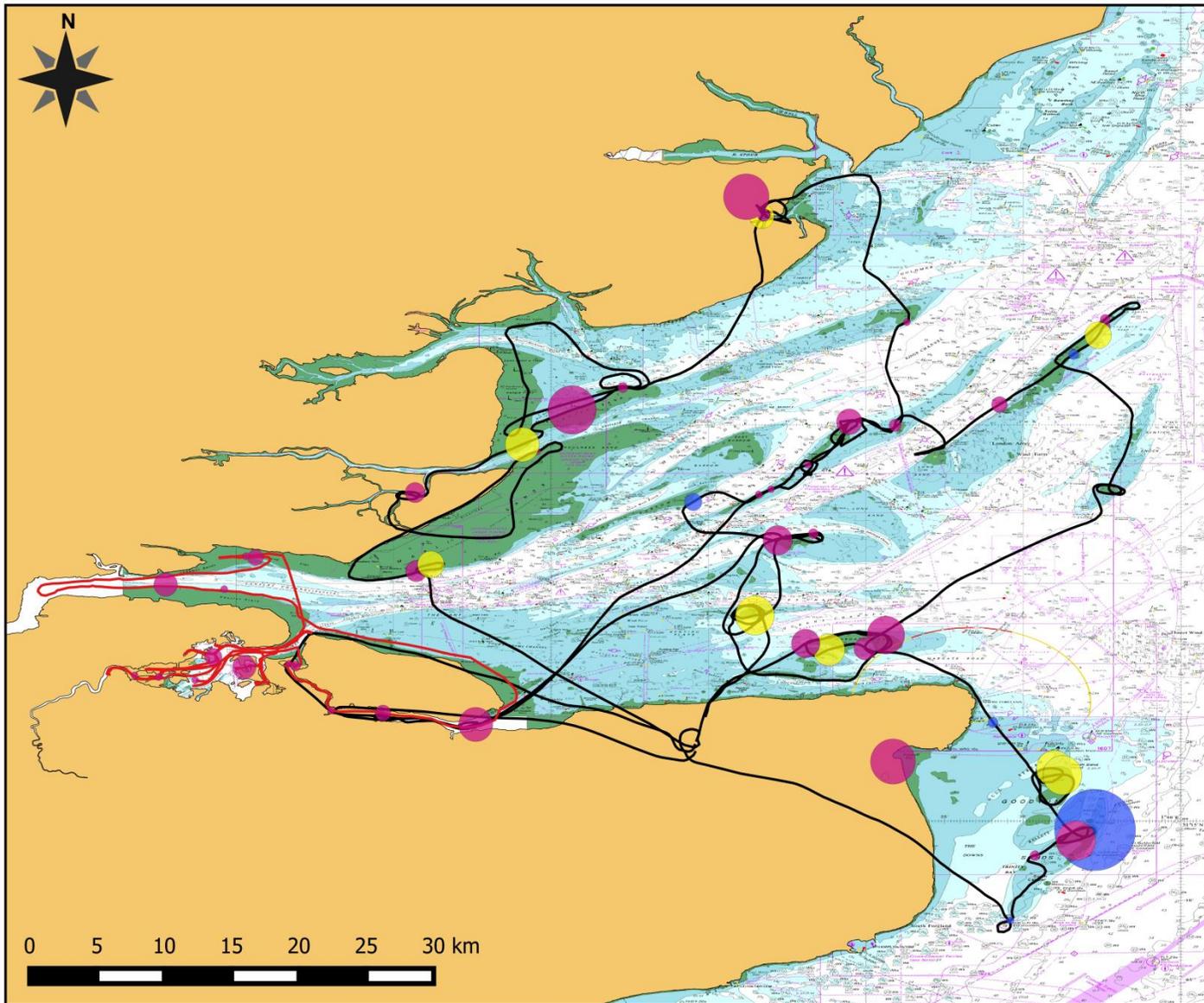
2014 population survey

- Grey seal colony
- Harbour seal colony
- Mixed seal colony
- Aerial survey route
- Boat survey route
- Land

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Figure 5:

Location of seals sighted during ZSL's Harbour Seal Population Survey in August 2013 (the area of the circle corresponds with the number of seals in that location)

Legend:

2013 population survey

- Grey seal colony
- Harbour seal colony
- Mixed seal colony
- Aerial survey route
- Boat survey route
- Land

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