



Population trends of harbour and grey seals in the Greater Thames Estuary



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ABSTRACT

In this paper, results from two decades of seal population data for the Greater Thames Estuary between 2003 to 2019 are presented, together with the results of two harbour seal pup surveys conducted in 2011 and 2018. Counts of hauled out harbour and grey seals were conducted during aerial surveys and these have been scaled up to estimate population sizes. Most recent population estimates suggest ~900 harbour and ~3,200 grey seals reside in the Greater Thames Estuary. Both species have shown an upward population trend since surveys began in 2003. The wide distribution and growing number of seals across the Greater Thames Estuary over the last two decades shows the importance of this region for both species. It also highlights the value of long-term monitoring data to compliment seal surveys taking place elsewhere in the UK.

INTRODUCTION

The two species of seal present in the UK, the harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*), are listed in Annex II of the EU Habitats Directive, and 16 Special Areas of Conservation (SACs) have been designated specifically for seals in the UK. Recent estimated population sizes in the UK are 43,450 (95% CI 35,550-57,900) (Thompson *et al.* 2019) and 150,000 individuals (95% CI 131,000-171,600) (SCOS 2018) for harbour and grey seals, respectively. Over the last few decades variations have been observed in harbour (Thompson *et al.* 2019) and grey seal abundance in the UK. Harbour seal population growth has been punctuated by two outbreaks of Phocine Distemper Virus (PDV) in 1988 and 2002, especially affecting this species on the east coast of England. Recent estimates suggest the UK harbour seal population has increased since the late 2000s and is close to the level observed in 1990 (SCOS 2018). Grey seal population trends across the UK have shown increases, with continual growth in the total pup production since regular surveys began in 1960 (SCOS 2018). However, trends in species abundance vary at a

local level. To appropriately manage these species, it is crucial to understand their abundance and distribution. UK harbour and grey seal populations have been regularly monitored since the 1960s although the intensity of monitoring has varied with location and species (Russell *et al.* 2019, Thompson *et al.* 2019). The Greater Thames Estuary seal populations were one of the least understood until the early 2000s. From the Zoological Society of London's (ZSL) public sightings reports it was clear both harbour and grey seals occurred in the Thames year-round (Castello y Tickell & Barker 2015). Infrequent population surveys were completed in the Greater Thames Estuary between 2003 and 2012, followed by annual population surveys covering the whole region completed since 2013 by ZSL, Bramley Associates (BA) and Sea Mammal Research Unit (SMRU). In addition, harbour seal pup surveys were conducted in 2011 by SMRU and in 2018 by ZSL. This paper presents population trends for the Greater Thames Estuary between 2003 and 2019 and the results of the harbour seal pup surveys.

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MATERIALS AND METHODS:

The Greater Thames Estuary study area (hereafter referred to as the “Thames”) is defined in this paper as the body of water between the counties of Kent and Essex delineated by Gravesend in the west, Felixstowe in the north and Deal in the south, and contains several constituent estuaries including the Medway and Swale (Figures 2 and 3). These are characterised by mobile sediments, large shifting sandbanks and high tidal current streams.

Population surveys were completed during the harbour seal moult period in August, when seals spend the greatest proportion of their time hauled out on land (Lonergan *et al.* 2013). Surveys were timed to coincide with the expected peak numbers of seals ashore during the first three weeks of August (Thompson *et al.* 2005). Although the survey is primarily aimed at censusing harbour seals, a comprehensive count of grey seals is also obtained.

The surveys followed a standard protocol used for seal surveys of estuarine habitats around the rest of the UK (SCOS 2018). Surveys were conducted using oblique aerial photography from fixed-wing aircraft flying at speeds of 110-130 mph. All seals were photographed from an altitude of approximately 100 m above the ground. The 2003, 2008, 2010 and 2018 surveys, covered the whole of the Thames in the period two hours either side of low water on one day. Surveys in 2013-2017 and 2019 covered the Thames in a three-day period, with aerial surveys conducted one hour either side of low tide on consecutive days. In 2013-2017 some of the constituent estuaries, such as the Medway, were covered by a boat rather than by plane. These boat surveys took place two hours either side of low tide. When seals were encountered, a waypoint was taken using a Garmin eTrex10 and photographs captured. Photographs were analysed post-survey independently by two researchers to allow for an accurate count and

identification to species level; these counts were compared, disparities discussed, and a final count agreed.

Additionally, in 2011 and 2018 harbour seal pup surveys were carried out during late June/early July when it is estimated that the peak number of pups would be encountered (Thompson *et al.* 2016). The pup surveys utilised the same methodology as the population surveys. Population estimates were calculated by adjusting the counts for the proportion of the harbour and grey seal populations expected to be hauled out, and therefore countable, during the survey window. During the harbour seal moult, 72% of the harbour seal population have been estimated to be hauled out (0.72, 95% CI: 0.54-0.88) (Lonergan *et al.* 2013) and 23.9% of grey seals (0.239, 95% CI: 0.193-0.286) (SCOS 2016). Pup counts were not adjusted.

All population count data (2003-2019) was modelled in R (version 3.6.1, R Core Team 2019) and the diagnostic plots examined for goodness of fit (Appendix 1). The harbour and grey seal counts were modelled as a function of year using Generalised Linear Models (GLM). Bootstrap Confidence Intervals (CIs) were generated in R by resampling the count data with replacement 1000 times, calculating the growth rate for each replicate, and taking the 0.025 and 0.975 percentiles of the resulting distribution of growth rates. The count data was further analysed using QGIS 3.4.13 to compare spatial distribution across the region. The 2019 counts are presented together with other locations occupied in previous surveys (see Figures 2 and 3). For previous surveys, where there were multiple overlapping waypoints of seal locations, these were consolidated to a single point to more clearly show presence at the site/sandbank scale. The pup data has not been statistically analysed but is presented below (see Figure 4 for 2018 distribution).

RESULTS:

Estimates show a higher population of grey seals than harbour seals living in the Thames. By examining the 2003-2019 data, a clear population increase for both harbour and grey seals can be seen (Table 1).

The GLM for the series of counts demonstrated an increase at an average of 8.99% per annum for harbour seals (bootstrap 95% CI 6.79-11.19) and 12.62% per annum for grey seals (bootstrap 95% CI 7.71-17.52) (Figure 1; Appendix 1).

Grey seals were seen in high numbers in offshore sandbanks such as Kentish Knock and Goodwin Sands (Figure 2). In contrast, harbour seals appeared in smaller

groups throughout the Thames (Figure 3), with slightly higher group size observed in the coastal Dengie Flats, Hamford Water, Swale Estuary, Pegwell Bay and outer sandbanks Margate Sands, Goodwin Knoll and Goodwin Sands.

During a harbour seal pup survey in 2011, 47 pups were counted, and in 2018, 138 pups were counted. From the 2018 survey it appeared that Hamford Water and Dengie Flats were particularly important habitat for pups, however they were found distributed throughout the Thames (Figure 4).

Table 1: Thames harbour and grey seal population estimates. SMRU = Sea Mammal research Unit, ZSL = Zoological Society of London, BA = Bramley Associates

Year	Survey lead	Harbour seal population estimate (95% CI)	Grey seal population estimate (95% CI)
2003	SMRU	250 (205 – 333)	402 (336 – 500)
2008	SMRU	443 (363 – 591)	669 (559 – 833)
2010	SMRU	526 (431 – 702)	1644 (1374 – 2047)
2013	ZSL, BA	654 (535 – 872)	812 (678 – 1010)
2014	ZSL, BA	679 (556 – 906)	1879 (1570 – 2339)
2015	ZSL, BA	626 (513 – 835)	1900 (1587 – 2365)
2016	ZSL, BA	964 (789 – 1285)	2013 (1682 – 2505)
2017	ZSL, BA	1104 (903 – 1472)	2406 (2010 – 2995)
2018	SMRU	1026 (840 – 1369)	2490 (2080 – 3099)
2019	ZSL, BA	932 (763 – 1243)	3243 (2710 – 4036)

Figure 1: 2003-2019 counts and fitted trend for Thames grey seal (a) and harbour seal population (b) (95% CI shown)

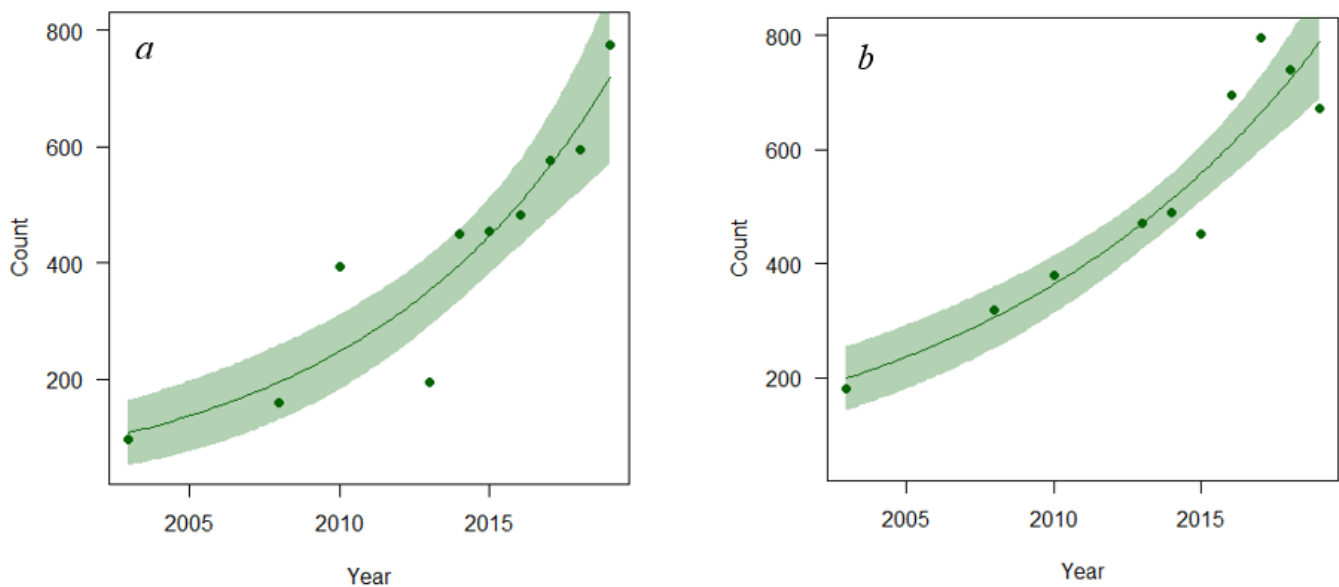


Figure 2: 2019 count of grey seals and other sites occupied by grey seals in previous surveys

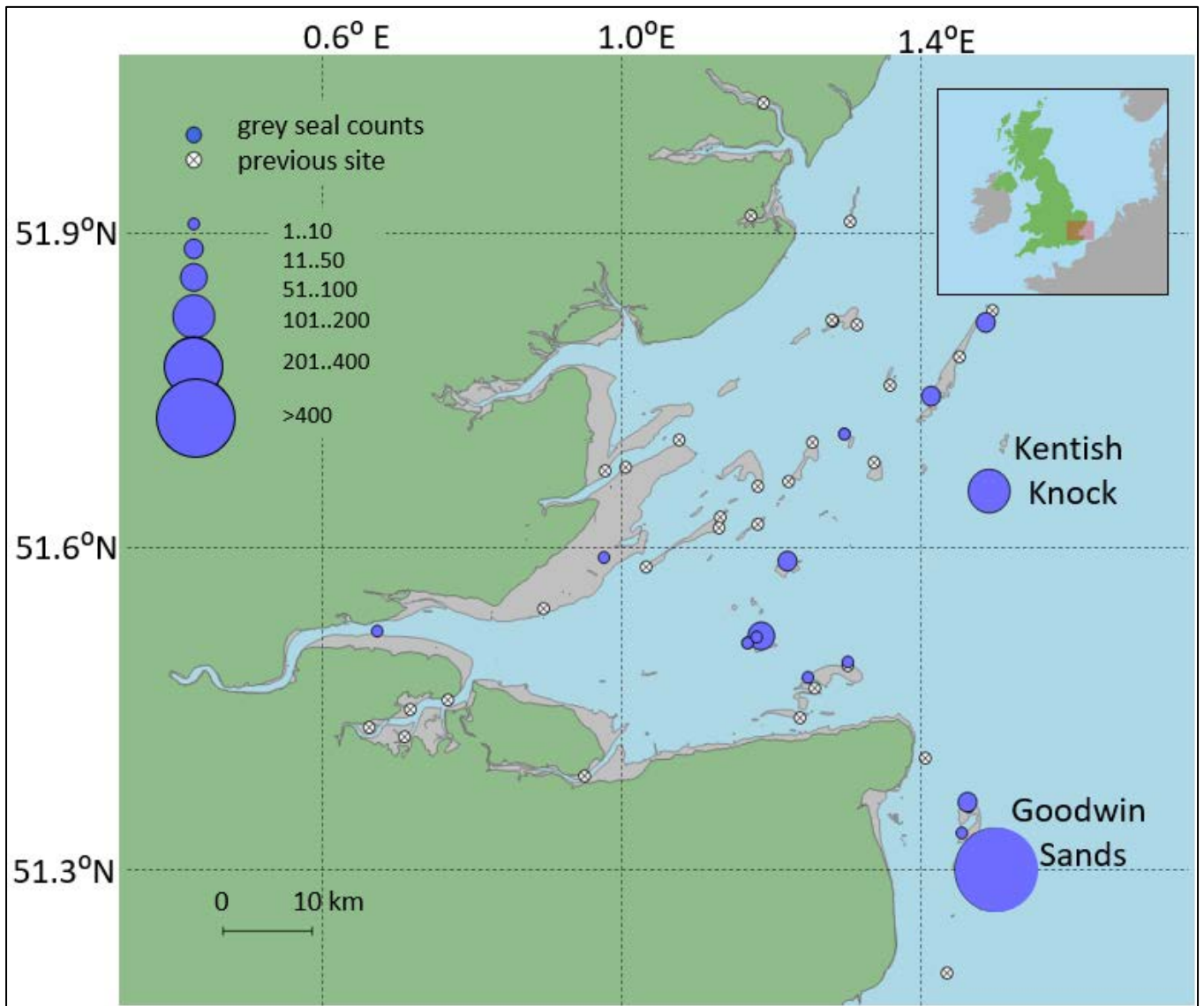


Figure 3: 2019 count of harbour seals and other sites occupied by harbour seals in previous survey

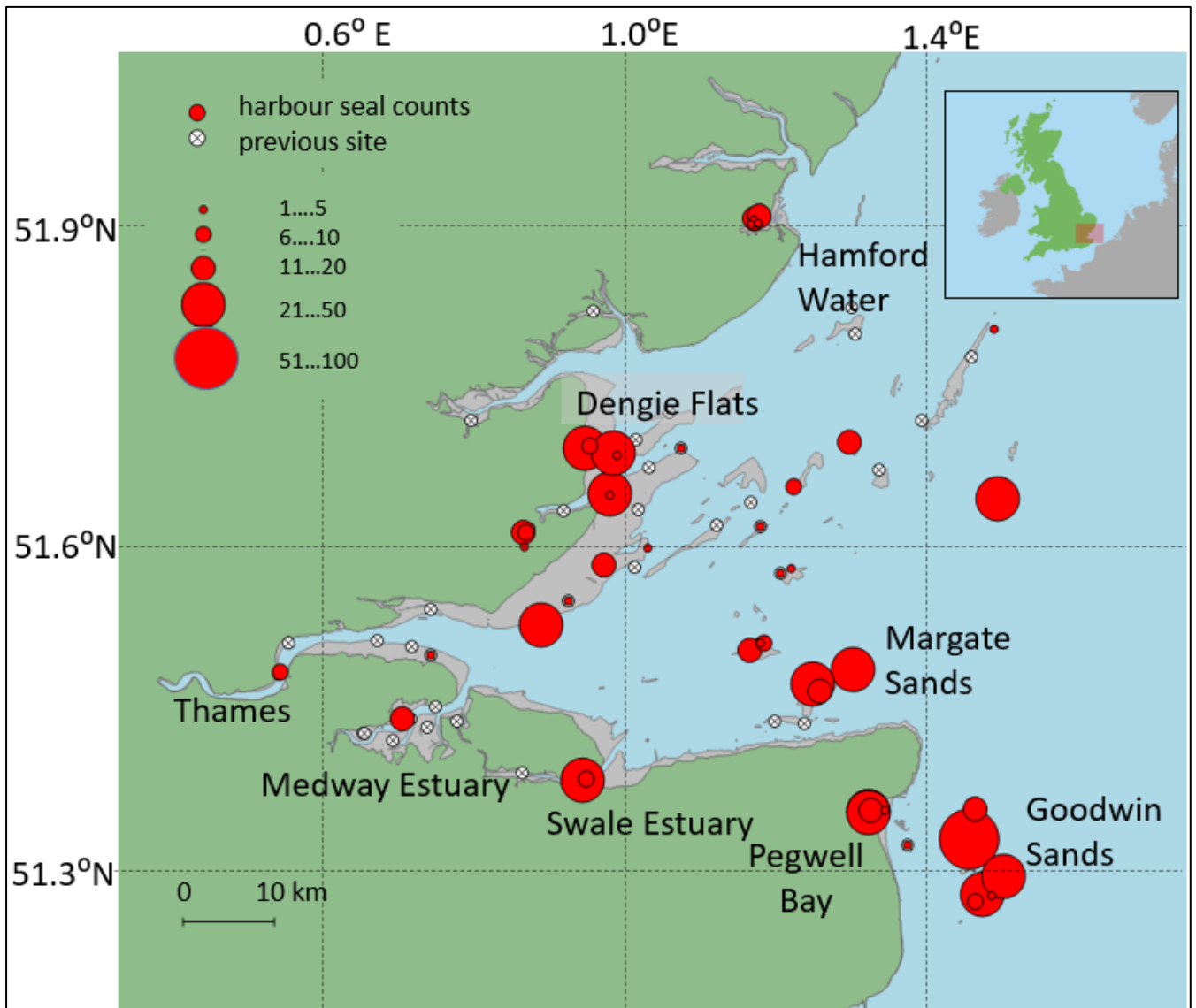
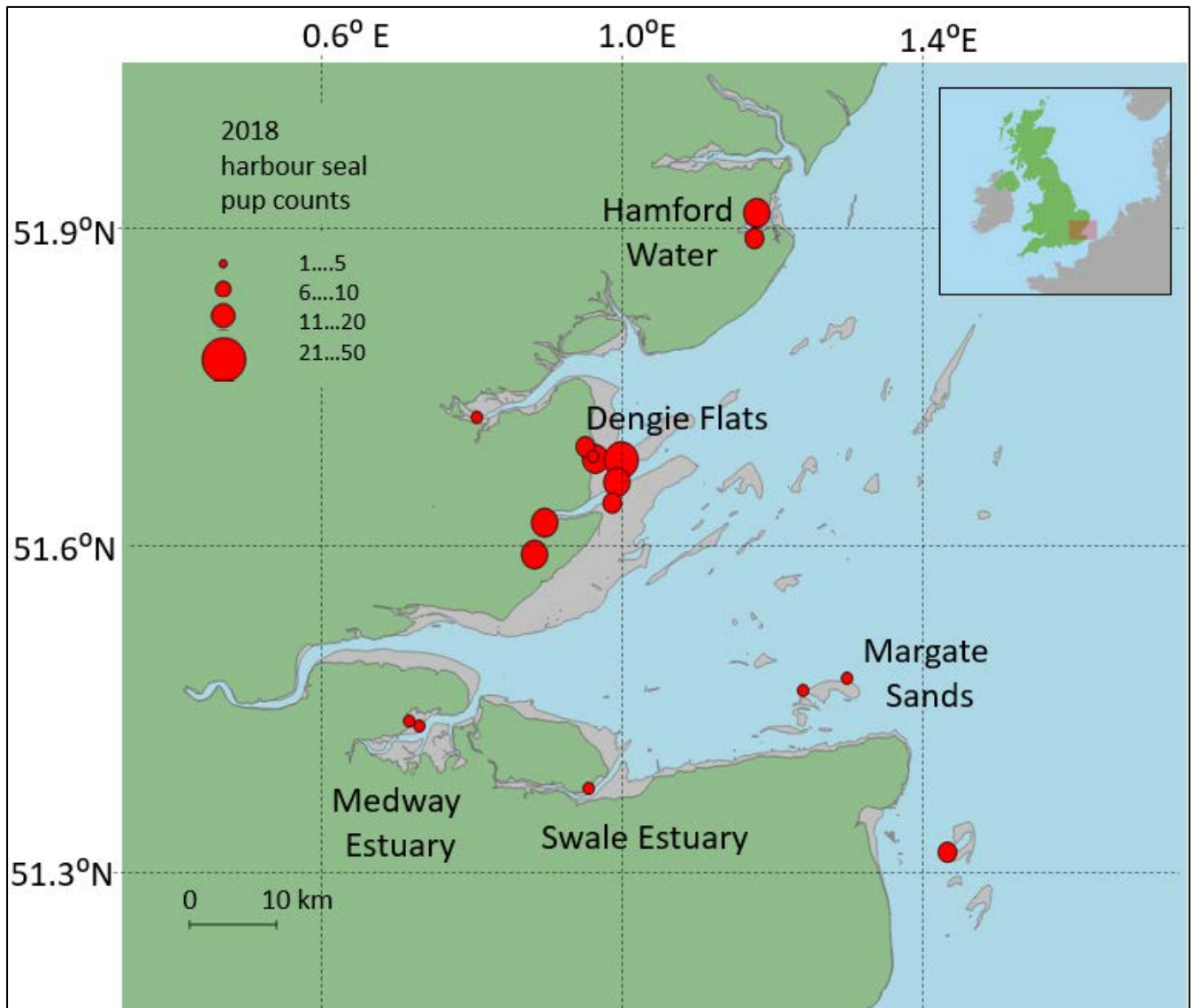


Figure 4: Distribution and count of harbour seal pups (2018)



DISCUSSION:

Both species have demonstrated high annual growth rates. The Thames grey seal population trend is consistent with grey seal data from other parts of the east coast (SCOS 2018). However, data for other south-east England harbour seal populations (north of the Thames) suggest that these have levelled off following a rapid increase between 2006 and 2010 (Thompson *et al.* 2019). The harbour seal population in the Wash (north of the Thames) has increased by ~50% since 2003, whilst the Thames population has increased by a factor of four over the same period. It is possible that the Thames harbour seal population could be starting to level off (see counts 2017-2019 Table 1), but more data are needed to confirm this.

Presently there is no definitive explanation for the upward trend observed in the Thames. Harbour seals on the east coast of England did suffer population declines from PDV in the late 1980s and early 2000s and so the perceived increase in harbour seal numbers over the last two decades could be a return to pre-epidemic levels, however no information exists for the Thames before 2003 and so this hypothesis cannot be tested. It is also not known why the growth rate observed for the Thames population is higher than for other south-east harbour seal populations like the Wash.

Only two pup surveys for harbour seals have occurred to date in the Thames. These indicated pupping habitat, but more surveys are needed before trends or key habitats are identified. Grey seals do not breed in the Thames however the pup production in nearby breeding colonies in Suffolk and Norfolk have shown rapid expansion – the pup production at colonies on the English east coast has increased at 10.9% p.a. between 2014 and 2016 (SCOS 2018).

The distribution of harbour and grey seals throughout the

Thames indicates different habitat preferences of each species. From our studies, harbour seals, in general, group in smaller numbers but are widely spread across salt marsh, coastal creek and outer sandbank habitats. Grey seals do occur within harbour seal groups at the inshore and coastal sites, usually in small numbers. However, they occur in groups of several hundred on some outer sandbanks.

This study has shown the importance of long-term monitoring for understanding population trends and distribution. However, it is important to note that these surveys demonstrate only a snapshot in time. Seals are mobile species and haul out areas may vary seasonally or at different times across the tide. It also should be noted that counts are converted to population estimates by understanding the proportion of grey and harbour seals that are hauled out at any one time. However, Thompson *et al.* (2019) states that different sex and age classes likely haul out for differing times during the moult, and as age-sex composition of the Thames populations is not known, this could affect the scaling factor and subsequent population estimates made.

This study has demonstrated the importance of the Thames for grey and harbour seals. Based on the 2019 counts, the Thames represents ~13% of the total estimated English harbour seal population and ~5% of the total estimated English grey seal population (SCOS 2018). The long-term dataset has proved critical in helping understand the population trends over the last two decades and the importance of continuing this type of monitoring. Results have been provided to the Special Committee on Seas (SCOS) each year to aid advice produced to government on matters relating to management of seal populations.

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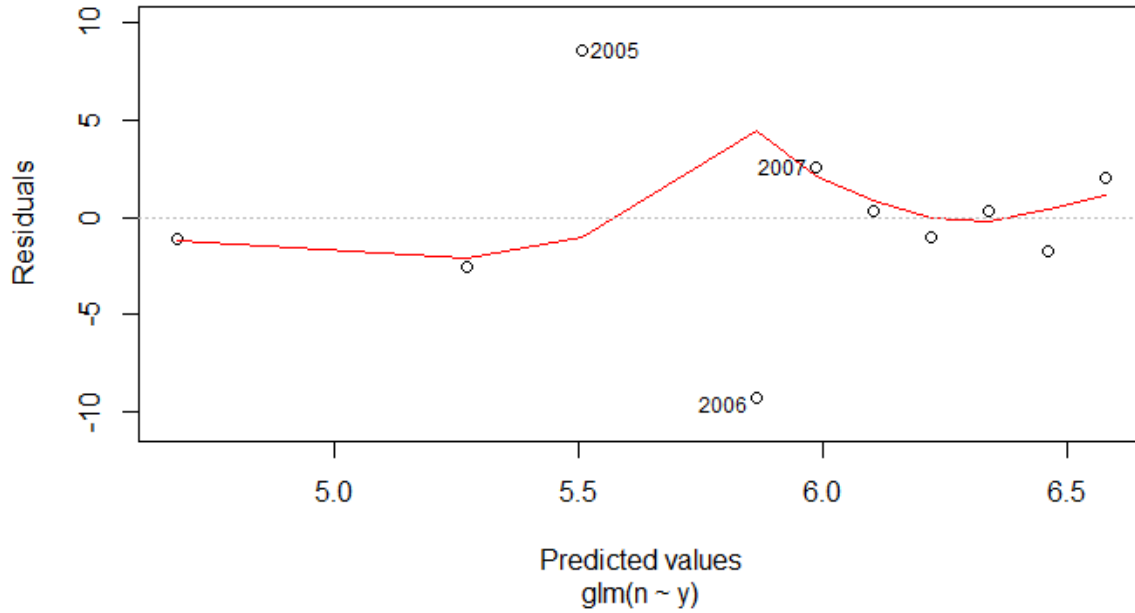
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Appendix 1:

Residuals versus fitted goodness of fit curve for GLM model made with quasi-Poisson regression for a) grey seal and b) harbour seal.

a)



b)

