



**BTO Research Report No. 654**

**Analysis of Lesser Black-backed Gull  
data to inform  
meta-population studies**

Authors

Viola H. Ross-Smith, Mark J. Grantham, Robert A. Robinson  
and Jacquie A. Clark

Report of work carried out by The British Trust for Ornithology  
under contract to Natural England

April 2014

© British Trust for Ornithology  
The British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU  
Registered Charity No. 216652

British Trust for Ornithology

BTO Research Report No. 654

**Analysis of Lesser Black-backed Gull  
data to inform meta-population studies**

Viola H. Ross-Smith, Mark J. Grantham, Robert A. Robinson  
and Jacquie A. Clark

Report of work carried out by The British Trust for Ornithology  
April 2014

Published in April 2014 by the  
British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, U.K.

Copyright © British Trust for Ornithology 2014

ISBN 978-1-908581-37-2

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form, or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publishers.

## CONTENTS

<b>List of tables .....</b>	<b>5</b>
<b>List of figures .....</b>	<b>7</b>
<b>EXECUTIVE SUMMARY .....</b>	<b>9</b>
<b>1 REVIEW OF LITERATURE .....</b>	<b>11</b>
1.1 Introduction.....	11
1.2 Classification and distribution .....	13
1.3 Breeding biology.....	13
1.4 International population trends .....	15
1.5 Population trends in the UK and England .....	16
1.6 Causes of Lesser Black-backed Gull population fluctuations in England.....	18
<b>2 SITE SPECIFIC CHANGES .....</b>	<b>23</b>
<b>3 ANALYSIS OF THE MOVEMENTS OF LESSER BLACK-BACKED GULL IN ENGLAND USING RING-RECOVERIES .....</b>	<b>25</b>
3.1 Introduction.....	25
3.2 Recoveries .....	25
<b>4 DISCUSSION .....</b>	<b>45</b>
<b>5 RECOMMENDATIONS .....</b>	<b>51</b>
<b>6 REFERENCES .....</b>	<b>53</b>
<b>7 ACKNOWLEDGEMENTS .....</b>	<b>59</b>



## LIST OF TABLES

<b>Table 1.</b> Productivity estimates of Lesser Black-backed Gulls breeding in the UK. ....	20
<b>Table 2.</b> Theoretical increase in a Lesser Black-backed Gull colony founded by 10 pairs in year 1, to illustrate how rapidly a colony may be able to grow. ....	20
<b>Table 3.</b> Number of recoveries of Lesser Black-backed Gulls in the BTO ring recovery database ringed in England, divided by age at ringing. ....	25
<b>Table 4.</b> Percentage of dead recoveries by distance moved of birds ringed while pulli at five main English sites. Distance bands shown are in km. ....	26
<b>Table 5.</b> Number of movements of birds ringed while pulli between (and within) the five main English ringing sites. ....	34
<b>Table 6.</b> Numbers of ringed birds reported by year during culling in Bowland. ....	35
<b>Table 7.</b> Numbers of bird from five main ringing sites found during culling in Bowland (ringed as pulli). ....	35
<b>Table 8.</b> Percentage of resightings by distance moved of birds ringed while pulli at five main English sites. Distance bands shown are in km. ....	36
<b>Table 9.</b> Number of resightings at Gloucester Landfill of colour-ringed pulli from the main five English sites. ....	36
<b>Table 10.</b> Numbers of recoveries/resightings of birds ringed as adults at five main English sites. ....	42
<b>Table 11.</b> Percentage of recoveries/resightings by distance moved of birds ringed while adults at three main English areas/sites. ....	42
<b>Table 12.</b> Number of recoveries by age band of foreign-ringed birds (ringed as pulli) found in England in the breeding season. ....	43



## LIST OF FIGURES

<b>Figure 1.</b> English protected sites where breeding Lesser Black-backed Gulls are a qualifying feature. ....	<b>Error! Bookmark not defined.</b>
<b>Figure 2.</b> Estimated adult Lesser Black-backed Gull survival on Skomer Island, Pembrokeshire, part of the Skokholm and Skomer SPA, Wales (JNCC 2012).....	14
<b>Figure 3.</b> Population abundance index for Lesser Black-backed Gulls in the UK 1986-2012 showing a rise and subsequent fall (JNCC 2012). ....	17
<b>Figure 4.</b> Nest counts at the Orford Ness Lesser Black-backed Gull colony between 1968 and 2013 (part of the Alde-Ore SPA) (Piotrowski 2003, M Marsh <i>personal communication</i> ). ....	17
<b>Figure 5.</b> Nest counts at the South Walney Lesser Black-backed Gull colony between 1986 and 2012 (part of the Morecambe Bay SPA) (JNCC 2012). ....	18
<b>Figure 6.</b> Lesser Black-backed Gull breeding success between 2000 and 2012 at English colonies assessed by the Seabird Monitoring Programme. ....	23
<b>Figure 7.</b> Kernel maps of dead recoveries of birds ringed as pulli from three English sites/areas. ....	27
<b>Figure 8.</b> Proportion of dead recoveries in the breeding season (April-July) of birds ringed while pulli in various distance bands, grouped by age (years since ringing). ....	28
<b>Figure 9.</b> Proportion of dead recoveries outside the breeding season (October to February) of birds ringed while pulli in various distance bands, grouped by age (years since ringing).....	29
<b>Figure 10.</b> Proportion of dead recoveries of birds ringed while pulli in various distance bands, grouped by 'site' ringed and age (years since ringing).....	30
<b>Figure 11.</b> Proportion of dead recoveries of birds ringed as pulli in various distance bands, grouped by age (years since ringing). Local movements (<=20km) and culled birds are excluded. ....	31
<b>Figure 12.</b> Proportion of dead recoveries by month for birds ringed while pulli from the main English areas/sites. ....	32
<b>Figure 13.</b> Proportion of dead recoveries by season (breeding season is April-July, winter is October-February) of birds ringed as pulli in various distance bands, from the three main English areas/sites (culled birds excluded).....	33
<b>Figure 14.</b> Proportion of dead recoveries of adults (found 5+ years after ringing) by season (breeding season is April-July, winter is October-February) of birds ringed as pulli at the three main English areas/sites (culled birds excluded). ....	33
<b>Figure 15.</b> Kernel maps of resightings of birds ringed in the breeding season (April-July) at Gloucester Landfill and resighted in the breeding season elsewhere.....	37

<b>Figure 16.</b> Percentage of resightings by month for birds ringed as pulli from the five main English sites (all recoveries included).....	38
<b>Figure 17.</b> Proportion of resightings of birds ringed as pulli and resighted as adults (found 5+ years after ringing) in various distance bands, from three main English areas/sites (local movements (<= 40 km) excluded).....	39
<b>Figure 18.</b> Kernel maps of resightings in the breeding season (April-July) of birds ringed as pulli from three English areas/sites. ....	<b>Error! Bookmark not defined.</b>
<b>Figure 19.</b> Proportion of resightings of birds ringed as pulli in various distance bands, from three main English areas/sites (local movements (<= 40 km) excluded). ....	40
<b>Figure 20.</b> Proportion of resightings of birds ringed as adults in various distance bands, from five main English sites (local movements (<= 40 km) excluded). ....	43

## EXECUTIVE SUMMARY

- 1 Lesser Black-backed Gull numbers in England have fluctuated in recent decades. Both breeding and wintering populations rose sharply in the latter half of the Twentieth Century, mostly due to increases at a small number of colonies and changes in migratory behaviour. However, there was a 31% decline in breeding birds between 2000 and 2011 (largely because of losses at the same key colonies – population trends vary widely between colonies) and this species is on the Birds of Conservation Concern Amber List. It can be taken under three General Licences issued under the Wildlife and Countryside Act 1981, allowing population control in certain circumstances. Lesser Black-backed Gulls are not well monitored in urban areas, where there has been rapid population growth, and where this species may be considered a pest. There is a clear need to review the Lesser Black-backed Gull's population trends and ecology in England to clarify its conservation status.
- 2 The Lesser Black-backed Gull's population expansion in England was brought about by the species' ability nest in a variety of habitats, including urban areas, to exploit a wide range of feeding opportunities and improvements in legal protection. Perturbations in the population level have occurred in the past both overall and at particular colonies and it is possible that such changes are characteristic of this species. Changes to landfill and fishing practices appear to have restricted the foods available to birds nesting at large, rural colonies, leading to low productivity. This has contributed to population declines at these sites. In some cases, breeding birds have also been affected by predation, culling and disturbance. Birds nesting in urban areas are typically not subject to predation pressure and food stress, and generally have access to ample, almost predator-free, nesting habitat on rooftops. Control measures at urban colonies have met with limited success. Their productivity is therefore thought to be higher than in non-urban colonies, and their population trend apparently increasing.
- 3 Like other seabirds, Lesser Black-backed Gulls are long-lived and have a high annual survival rate. They are largely philopatric and faithful to their nest site and partner. However, they are adaptable and birds will recruit to areas other than their natal colony if no nests sites are available, and breeders may change colony, especially following disturbance or poor breeding success (which can be caused by culling or naturally). It is vital to characterise the extent of these movements and what drives them.
- 4 Recovery data show that Lesser Black-backed Gulls hatched in colonies from the east of England can recruit to colonies in France, the Netherlands, Belgium and Germany, and vice versa. Lesser Black-backed Gulls breeding in the Netherlands and Belgium are thought to be a different subspecies (*Larus fuscus intermedius*) to those breeding in England (*Larus fuscus graellsii*). It is important to establish the extent of genetic interchange between these two subspecies, and whether birds leaving declining colonies in England might simply relocate to the Continent, such that decreases are not seen at a species level.

- 5 Recovery data and the literature suggest there may be different meta-populations of breeding Lesser Black-backed Gulls in the west of England (possibly separated into the northwest and the Severn Estuary region) and the east of England. Again it is important to ascertain how isolated meta-populations are to understand how the English Lesser Black-backed Gull population might be affected by future changes in food and habitat availability, as well as control measures, and how resilient it is to environmental change.
- 6 The report recommends several areas of research and that improved monitoring is vital to understand properly English Lesser Black-backed Gull population dynamics in order to formulate conservation policy.

## 1 REVIEW OF LITERATURE

### 1.1 Introduction

The Lesser Black-backed Gull *Larus fuscus* is a large white-headed gull species that breeds largely around the coasts of northern and western Europe (Cramp & Simmons 1983). Adults are distinguished from other closely related species that breed sympatrically (e.g. Herring Gull *Larus argentatus* and Yellow-legged Gull *Larus michahellis*) by their dark, slaty-grey to black mantle, yellow legs and red orbital ring (Olsen & Larsson 2004). In common with many gull species, the global Lesser Black-backed Gull population rose substantially during the Twentieth Century (Mitchell *et al.* 2004, Wetlands International 2014), but in some areas this trend has levelled off or reversed in recent years, including in the UK (JNCC 2012, Balmer *et al.* 2013, Wetlands International 2014).

In England, the Lesser Black-backed Gull is protected by the Wildlife and Countryside Act 1981 (as amended) (WCA 1981) making it an offence to kill or injure this species, and destroy their eggs or nests. Lesser Black-backed Gulls are fully protected where they are a notified feature of a Site of Special Scientific Interest (SSSI). The Lesser Black-backed Gull is also a qualifying species for several Special Protection Areas (SPAs), designated under the European Birds Directive (2009/147/EC), and sites protected by the Ramsar Convention (Stroud *et al.* 2001, Wetlands International 2014, Fig 1). However, this species can also currently be taken under three General Licences issued under the WCA 1981, allowing population control in certain circumstances, for example in the interests of public health and safety, and as such, breeding adults have been killed and their nests destroyed at various locations. However, the inclusion of Lesser Black-backed on these General Licences is now under review.

The recent population fluctuations highlight the need to review the status of the Lesser Black-backed Gull in England and, where possible, identify the causes of these changes so that recommendations can be made on appropriate future conservation and management measures. This piece of work aims to assist this process, both by synthesising the literature on Lesser Black-backed Gulls in England, and via an analysis of recoveries and re-sightings of birds ringed or found in Britain & Ireland and reported to the British Trust for Ornithology (BTO).

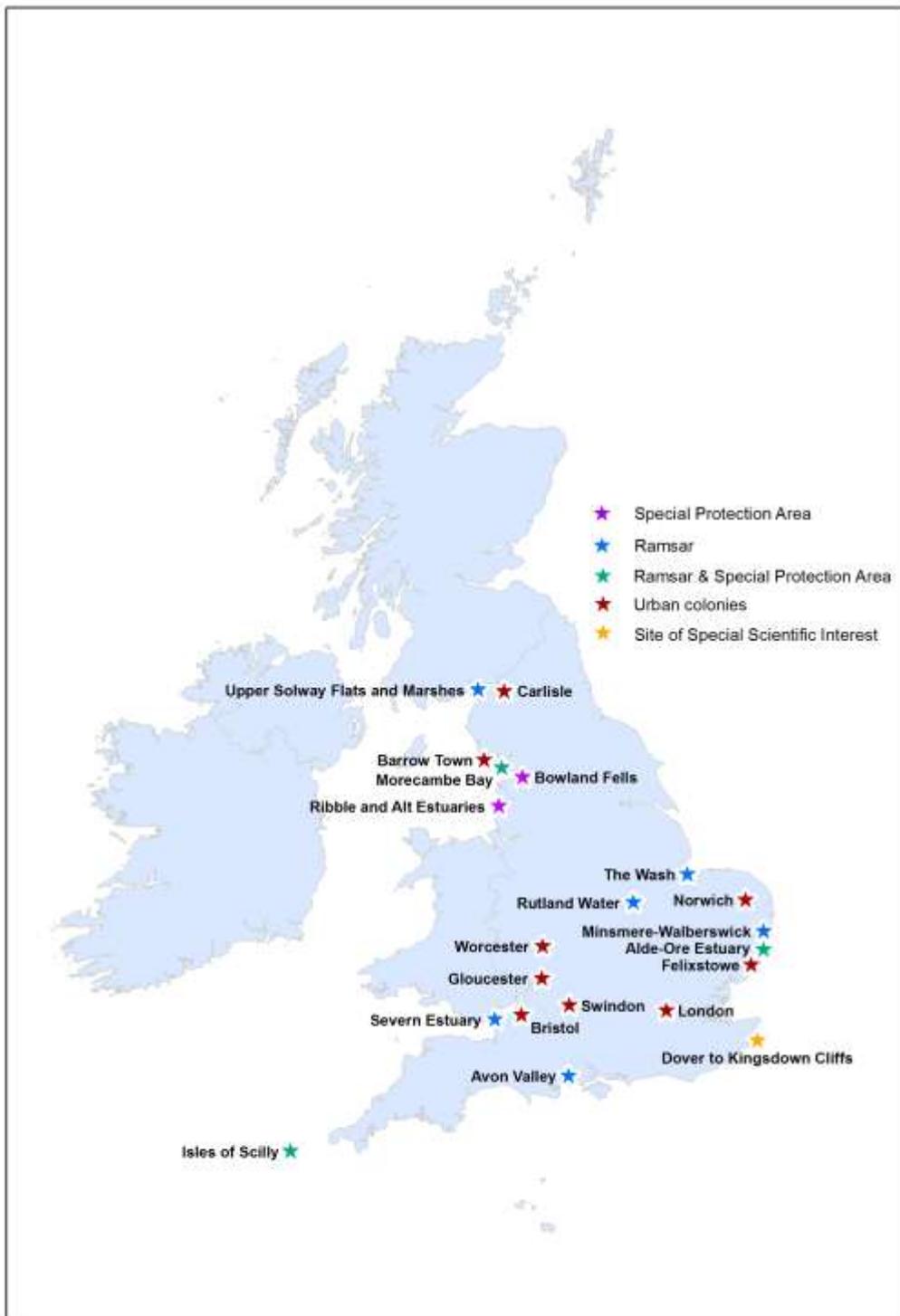


Figure 1. Map showing English protected sites where breeding Lesser Black-backed Gulls *Larus fuscus* are a protected feature and the more prominent urban colonies referred to in this review. Most SPAs are underpinned by several component SSSIs. Bowland Fells is currently a potential SPA.

## 1.2 Classification and distribution

The Lesser Black-backed Gull is a polytypic species with clinal variation in the darkness of its mantle and in size (Olsen & Larsson 2004). Populations also differ in their migratory strategies and the length of time required to attain full adult plumage (Olsen & Larsson 2004). This variation has provoked debate about how to classify the species, with particular focus on how many subspecies should be recognised (Liebers & Helbig 2002, Collinson *et al.* 2008). It has been traditionally suggested that there are five subspecies of Lesser Black-backed Gull; *graellsii*, *intermedius*, *fuscus*, *heuglini* and *taimyrensis*, although it has also been proposed that each of these groups be granted full species status (Liebers & Helbig 2002, Collinson *et al.* 2008). Presently, based on recent available genetic evidence, only the first three of these (*graellsii*, *intermedius* and *fuscus*) should be considered subspecies of *L. fuscus*, while the latter two (*heuglini* and *taimyrensis*) are classified as subspecies of a separate species, *L. heuglini* (Olsen & Larsson 2004, Collinson *et al.* 2008).

*L. f. fuscus* is the smallest and darkest of the Lesser Black-backed Gull subspecies. It achieves full adult plumage three years after hatching, and has a slenderer bill, longer wings and shorter legs compared to the other *L. fuscus* subspecies (Olsen & Larsson 2004). As its alternative name, the Baltic Gull, suggests, *L. f. fuscus* largely breeds on the Baltic coasts of Finland, Sweden and Estonia, with small populations on the northwest Russian coast and parts of northern Norway (Olsen & Larsson 2004, Hario & Nuutinen 2011), and migrates to sub-Saharan Africa in winter (Kylin *et al.* 2010, 2011, Bustnes *et al.* 2013).

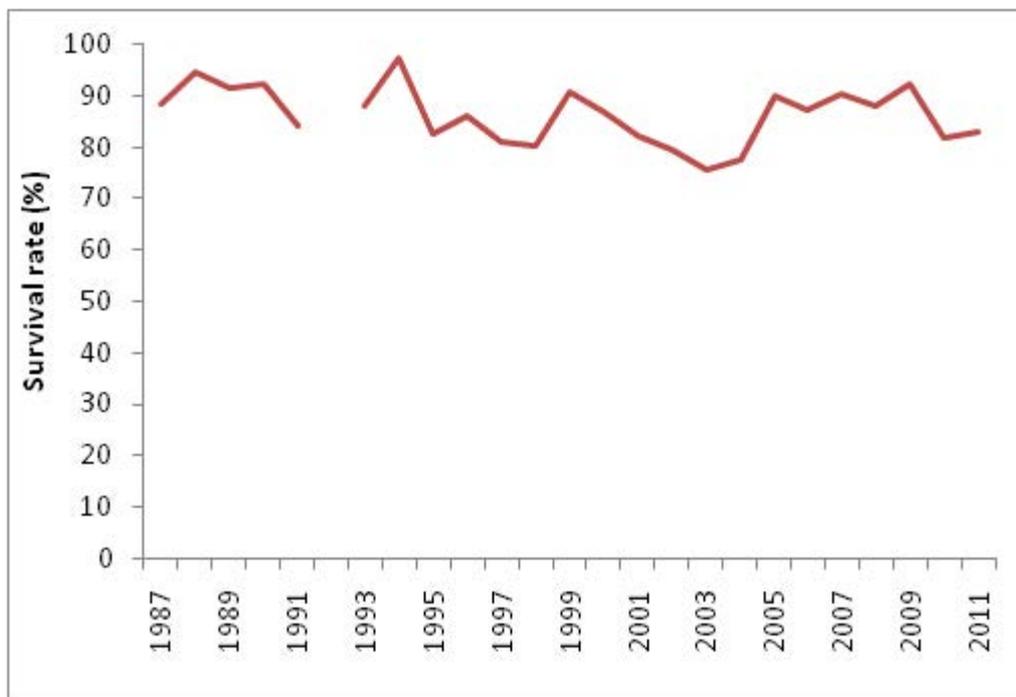
*L. f. intermedius* and *L. f. graellsii* are morphologically and behaviourally more similar to one another than they are to *fuscus*, to the extent that some argue they should be classified as a single subspecies (Sangster *et al.* 1999, cited in Collinson *et al.* 2008). Indeed, there is evidence of genetic mixing between *intermedius*, which normally breeds from Belgium and the Netherlands eastwards into western Scandinavia, and *graellsii*, which breeds in the United Kingdom, Ireland, France, northwest Spain, Portugal, Iceland and Greenland (Snow & Perrins 1998, Pioetrowski 2003, Boertmann 2008, Collinson *et al.* 2008, BirdLife International 2014). *Intermedius* tends to have a darker mantle than *graellsii*, but there is considerable overlap between subspecies (Olsen & Larsson 2004). Both take four years to attain adult plumage (Olsen & Larsson 2004), and largely winter in southwest Europe and northwest Africa (Marques *et al.* 2010, Hallgrimsson *et al.* 2012, Klaasen *et al.* 2012), although some Icelandic birds migrate to the eastern USA (Olsen & Larsson 2004), and increasingly birds remain in northern Europe throughout the year (Burton *et al.* 2013).

We are concerned here principally with the *graellsii* subspecies, which is thought to be the only one to breed in Britain, although there have been ring-recoveries of birds ringed in the Netherlands and found breeding in England, which may be *intermedius* (Piotrowski 2003, K Camphuysen *personal communication*). Individuals of the *intermedius* subspecies regularly occur in England in autumn and winter, while there have been very few records of individuals assignable to the *fuscus* subspecies in Britain or Ireland (BOU 2013).

## 1.3 Breeding biology

As with other gulls breeding in the Northern Hemisphere, Lesser Black-backed Gulls in Britain typically arrive at their nesting sites between late February and early May, lay their eggs between April and June, and hatch chicks between May and July. Incubation lasts approximately 28 days, and chicks take about five weeks to fledge (Tinbergen 1959, Harris 1964, MacRoberts & MacRoberts 1972, Mudge 1978, Hosey & Goodridge 1980, Ross-Smith

2009). Modal clutch size is three eggs (Harris 1964, Brown 1967, Bolton *et al.* 1992, Oro 1996, Ross-Smith 2009). This species shows strong natal philopatry, with birds, especially males, often recruiting to the colony where they themselves hatched (Brown 1967, O’Connell 1995, Rock 2005, Rock & Vaughan 2013) and, provided both members of a pair survive and breed together successfully, they normally return to the same partner at the same nest site each year (O’Connell 1995, Rock 2005, Rock & Vaughan 2013). However, successful colonies may ‘export’ individuals if suitable nesting habitat is not available, and birds apparently immigrate to successful colonies (Section 1.6). Breeding is often cited as starting when birds are four years old (Cramp & Simmons 1983), although some individuals delay breeding until they are seven years old (O’Connell 1995, Camphuysen 2013). For the purposes of this report, age at first breeding is taken as five years old. Sub-adults may return to breeding colonies to prospect for nest sites before recruitment (Brown 1967, Ross-Smith 2009, Camphuysen 2013). Under good conditions, breeding can be attempted every year (Cramp & Simmons 1983). However, a large proportion of the adult population has been found not to breed at some sites (O’Connell 1995, O’Connell *et al.* 1997, Calladine & Harris 1997, Camphuysen 2013), and a recent study from the Netherlands recorded birds breeding every other year (Camphuysen 2013). Lesser Black-backed Gulls that reach breeding age typically survive a further 10 years, but some individuals can live much longer<sup>1</sup>, and several studies have shown adult survival of more than 90% from one year to the next, both for colonies in England and elsewhere (e.g. Fig 2) (Wanless *et al.* 1996, Camphuysen & Gronert 2012, Rock & Vaughan 2013, Ross-Smith *et al.* 2013). Apparent survival of Lesser Black-backed Gulls breeding in Bristol is thought to have been reduced in recent years (Rock & Vaughan 2013), although anecdotal evidence suggests this may be a result of emigration of individuals to other urban breeding colonies.



**Figure 2. Estimated adult Lesser Black-backed Gull survival on Skomer Island, Pembrokeshire, part of the Skokholm and Skomer SPA, Wales (JNCC 2012).**

<sup>1</sup> The longevity record for Britain and Ireland is 34 years, 10 months and 27 days set by a bird ringed as a nestling at South Walney in 1965 and shot at Tarnbrook Fell (Bowland) in 2000 (Robinson & Clark 2013).

Lesser Black-backed Gulls normally nest colonially (Davis & Dunn 1976), and often in association with other gulls, commonly Herring Gulls (e.g. Tinbergen 1953, Harris 1964, Hario 1994, Kim & Monaghan 2006, Camphuysen & Gronert 2012, Ross-Smith *et al.* 2013). Those breeding at rural colonies will nest on slopes and cliffs, but not on the sheer rock faces favoured by related seabirds, such as the Black-legged Kittiwake *Rissa tridactyla*. Indeed, many Lesser Black-backed Gulls nest on flat ground (Harris 1964, Ross-Smith *et al.* 2013). Their nests are fairly simple, ranging from a scrape with little gathered nesting material, to a small bed of vegetation arranged in a shallow cup shape (Ross-Smith 2009). Various nesting materials can be used, including grass, sticks, plastic refuse and bones (Ross-Smith 2009). Lesser Black-backed Gulls exhibit a considerable degree of plasticity in their nest site selection which, combined with their ability to exploit diverse feeding opportunities, allows them to breed in a variety of habitats, including urban areas, where they often breed on rooftops (Monaghan & Coulson 1977, Raven & Coulson 1997, Rock 2005). Although nests can be in very exposed locations with no shelter of any kind, Lesser Black-backed Gulls generally prefer some sort of cover (i.e. vegetation, rocks, or man-made structures), which confers benefits such as protection from predators and regulation of nest microclimate (Harris 1964, Davis 1973, Brown 1967, Hosey & Goodridge 1980, Kim & Monaghan 2005, Ross-Smith 2009). However, birds usually avoid nesting in highly densely vegetated areas (Davis 1973, Davis & Dunn 1976, Ross-Smith 2009).

#### **1.4 International population trends**

In common with other large white-headed gull species, the global Lesser Black-backed Gull population grew rapidly in the Twentieth Century (Wetlands International 2014), although there have been declines in some areas in more recent years (BirdLife International 2014). Despite this drop in numbers, overall this species is categorised as “Least Concern” by the International Union for the Conservation of Nature (BirdLife International 2014).

Of all the Lesser Black-backed Gull subspecies, *L. f. fuscus* currently has the smallest population (around 18,000 – 19,000 breeding pairs, or 56,000 individuals, Wetlands International 2014) and has experienced a strong decrease in numbers in recent years to the extent that it is now considered by some to be globally threatened (Olsen & Larsson 2004). This reduction might be partly linked to pesticide use at its wintering grounds (Hario *et al.* 2004, Hario & Nuutinen 2011). There is evidence that the chemicals involved are passed on to embryos in the egg and cause liver failure in young chicks, leading to widespread breeding failure (Hario *et al.* 2004), although the level of contamination may now be reducing (Hario & Nuutinen 2011). Other factors, such as high levels of chick predation by Herring Gulls, have also influenced *fuscus* population trends at some colonies (Hario 1994).

Populations of both *L. f. intermedius* and *L. f. graellsii* experienced substantial growth through the mid- and late-Twentieth Century, bringing today’s numbers to approximately 325,000 - 440,000 for *intermedius* and 530,000 - 570,000 for *graellsii*. However, both subspecies have experienced population fluctuations in parts of their range in more recent years (e.g. Camphuysen *et al.* 2010, Sellers & Shackleton 2011).

## 1.5 Population trends in the UK and England

### 1.5.1 Breeding season

The most recent seabird census in Britain and Ireland (Seabird 2000) found approximately 112,000 Apparently Occupied Nests (AONs) of Lesser Black-backed Gulls in the UK, which equated to 62.6% of the biogeographic breeding population of the *graellsii* subspecies; of these, 57% (64,000) bred in England<sup>2</sup> (Mitchell *et al.* 2004). A large proportion of these English birds were concentrated in a small number of colonies, notably South Walney, Cumbria (19,487 AONs), Bowland Fells, Lancashire (18,518 AONs), Orford Ness, Suffolk (5,500 AONs) and the Isles of Scilly, Cornwall (3,606 AONs) (Mitchell *et al.* 2004). The breeding population at each of these sites was sufficiently high that they corresponded to more than 1% of the biogeographic population, and as such they (and in some cases, surrounding areas) were classified as SPAs<sup>3</sup> in 1990s and 2000s<sup>4</sup>. Other sites are designated as nationally important for breeding Lesser Black-backed Gulls, and are protected under the Ramsar Convention (Fig 1). Many of these breeding colonies became established in the early to mid-Twentieth Century and grew rapidly thereafter (e.g. Brown 1967, Greenhalgh *et al.* 1974) (see also Fig 3).

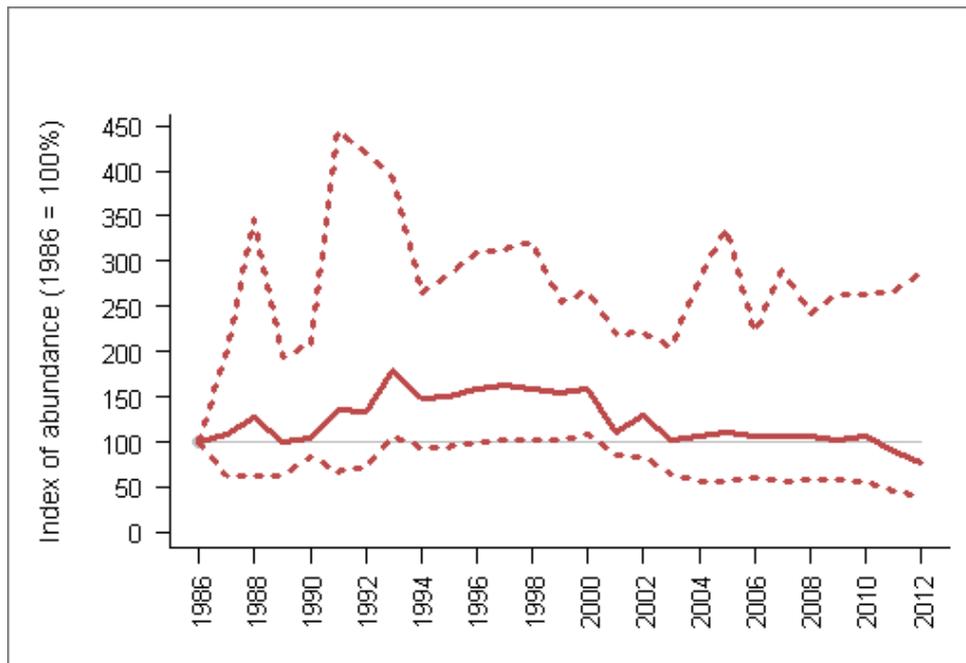
The population growth at these key colonies was reflected in the breeding population trends for England and the UK as a whole; there was a 29% increase in Lesser Black-backed Gull AONs between the censuses of 1969-70 and 1985-88, and a further rise of 40% between 1985-88 and 1998-2002 (Mitchell *et al.* 2004). In more recent years, however, the UK breeding Lesser Black-backed Gull population trend has reversed, with a 32% decline between 2000 and 2011 (Balmer *et al.* 2013), corresponding to a 31% fall in England (JNCC 2012) (Fig 3). This trend is largely influenced by population crashes at the key breeding sites that held a large proportion of the UK's breeding population. At Orford Ness, for example, 20,000 AONs were counted in 1999 (Piotrowski 2003), but only 400 in 2013 (M Marsh *personal communication*) (Fig 4), while similar trends have been observed at other important colonies, such as South Walney (Fig 5) and Bowland Fells where numbers have fallen from 18,518 AONs (Seabird 2000) to 3,274 AONs (Coyle 2012). The concentration of breeding Lesser Black-backed Gulls on a small number of sites, making the whole UK population vulnerable to substantial changes through fluctuations at a single colony, means this species is classed as "Amber" in the most recent *Birds of Conservation Concern* list (Eaton *et al.* 2009). It should, however, be noted that colonies have historically both grown and fallen in numbers rapidly, suggesting that this is not an unusual situation for Lesser Black-backed Gull (e.g. Greenhalgh 1974).

---

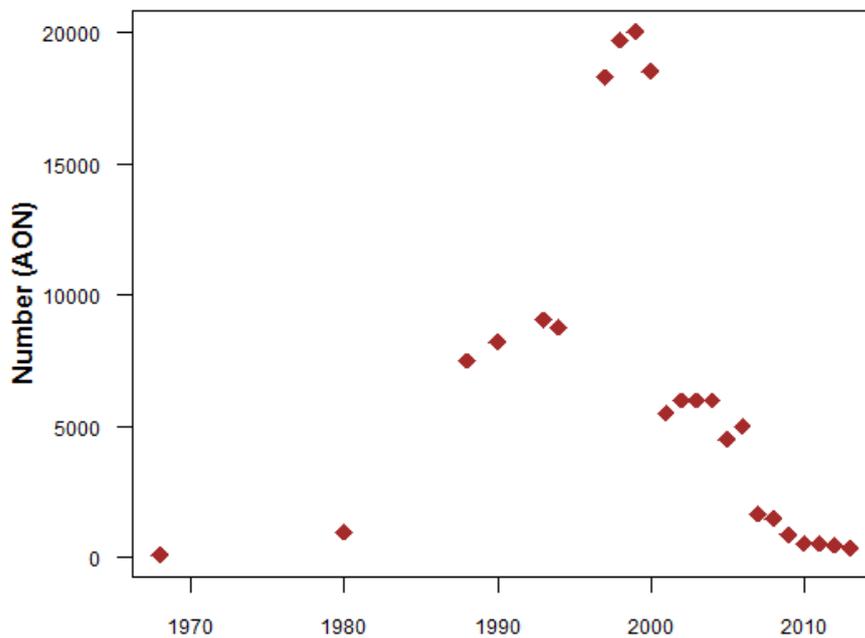
<sup>2</sup> There is also a large number of non-breeding birds present in the UK during the breeding season, many of which are sub-adults prospecting at breeding colonies (e.g. Perrins & Smith 2000).

<sup>3</sup> Many of these SPAs are made up of several component Sites of Special Scientific Interest (SSSIs), for which Lesser Black-backed Gull is a qualifying species. For instance, South Walney is part of the Morecambe Bay SPA.

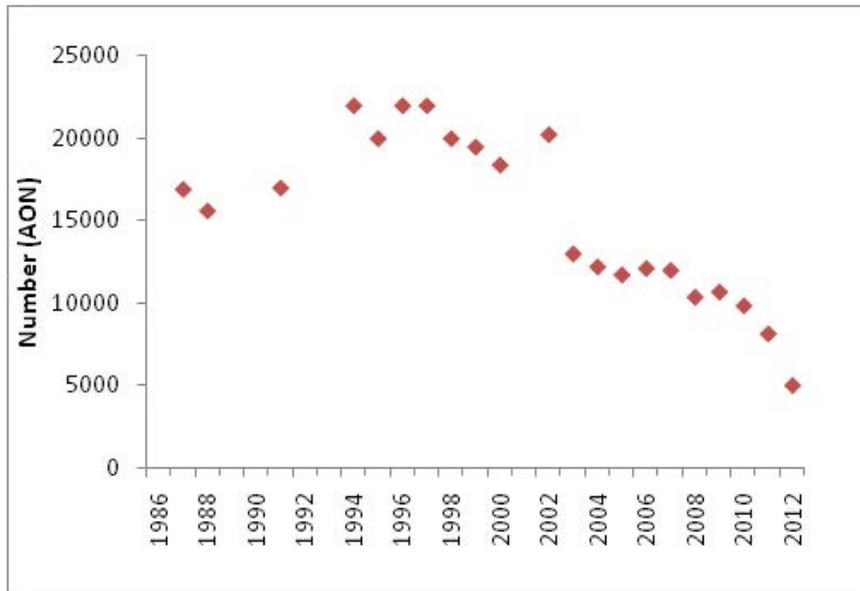
<sup>4</sup> Bowland Fells is currently a potential SPA (pSPA).



**Figure 3. Population abundance index for Lesser Black-backed Gulls in the UK 1986-2012 showing a rise and subsequent fall (JNCC 2012). The solid line is the index and the dotted lines are the 95% confidence limits.**



**Figure 4. Nest counts at the Orford Ness Lesser Black-backed Gull colony between 1968 and 2013 (part of the Alde-Ore SPA) (Piotrowski 2003, M Marsh *personal communication*). Note that four years were surprisingly high and there are some concerns that these figures may be inflated (M Marsh *personal communication*).**



**Figure 5. Nest counts at the South Walney Lesser Black-backed Gull colony between 1986 and 2012 (part of the Morecambe Bay SPA) (JNCC 2012).**

### 1.5.2 Wintering populations

In addition to its internationally important breeding population of Lesser Black-backed Gulls, the UK has become an increasingly important area for wintering birds (Burton *et al.* 2013). Some of these individuals are *graellsii* that breed in the UK and remain year round (although birds normally disperse away from their breeding colonies), while others are *graellsii* and *intermedius* that arrive from Iceland, Scandinavia and the Netherlands for the winter months (Barnes 1952, Barnes 1961, Horton *et al.* 1983, Hallgrimsson *et al.* 2012). A decadal census of winter gulls has been carried out by the BTO since the 1950s and shows how the winter population of Lesser Black-backed Gulls in the UK has risen from a “small number” in the early 1950s (Barnes 1953), estimated at a minimum of 165 birds (Burton *et al.* 2003) to 125,113 individuals in 2003/04 (Burton *et al.* 2013), 114,369 of which were in England (Burton *et al.* 2013). There are currently no sites for which non-breeding Lesser Black-backed Gulls are a protected feature (Stroud *et al.* 2001), although numbers found at some roosts now surpass the required threshold (Burton *et al.* 2013).

## 1.6 Causes of Lesser Black-backed Gull population fluctuations in England

### 1.6.1 Breeding season

The rapid growth in breeding Lesser Black-backed Gull numbers in England in the Twentieth Century is thought to have been driven by a combination of factors. Firstly, legal protection for the species was improved, with restrictions placed on hunting and egg collecting which had depressed population size in the early-Twentieth Century (Parslow 1967, Greenhalgh *et al.* 1974, Mudge 1978, O’Connell 1995, Perrins & Smith 2000, Rock 2005). A more important consideration is the Lesser Black-backed Gull’s diet, in particular its omnivory (O’Connell 1995). In common with many other gull species, Lesser Black-backed Gulls are dietary generalists, capable not only of subsisting on a wide variety of foodstuffs and but also of adapting to take advantage of new feeding opportunities as they become available (Camphuysen *et al.* 2010). A Lesser Black-backed Gull’s diet can include marine, terrestrial and freshwater invertebrates (O’Connell 1995, Stanworth 1995, Coulson & Coulson 2008, Camphuysen *et al.* 2010, Luczak *et al.* 2012, Mortimer *et al.* 2012), fish (Furness *et al.* 1992, Kim & Monaghan 2006; Camphuysen *et al.* 2010), mammals (O’Connell 1995, Camphuysen

*et al.* 2010), birds (Camphuysen *et al.* 2010), plant matter (Oro 1996, Camphuysen *et al.* 2010) and human refuse (Verbeek 1977, Mudge & Ferns 1982, Stanworth 1995, Oro 1996, Camphuysen *et al.* 2010). These birds also routinely travel 40 to 80 km from breeding colonies to find food (Camphuysen *et al.* 2010), and can travel up to 159 km in a single foraging trip (Thaxter *et al.* 2011), making a broad range of potential food sources available to any individual. Human refuse has only been widely available as a food source since the mid-Twentieth Century, when sending waste to landfill became the norm in the UK, and the Clean Air Act (1956) outlawed burning on site (Rock 2005). These tips provided Lesser Black-backed Gulls with a predictable and constant food supply (Greig *et al.* 1986). Other anthropogenic sources of nutrition used by this species include fishing discards at ports (Harris 1965, Oro 1996) and from following boats at sea (Furness *et al.* 1992, Camphuysen 1995, Oro 1996, Perrins & Smith 2000), as well as invertebrates and other foods obtained from agricultural land (Oro 1996, Perrins & Smith 2000, Coulson & Coulson 2008) and sewage plants (Mudge & Ferns 1982, Ferns & Mudge 2000, Raven & Coulson 2001).

Even though the increase in Lesser Black-backed Gull numbers was highly likely due to the availability of food from anthropogenic sources, much of the initial growth was centred at breeding colonies in rural areas. The formerly large colony at Orford Ness was only discovered in 1968 (Piotrowski 2003) (Fig 4), while the colonies at South Walney and Bowland Fells were founded in 1926 and 1938 respectively (Greenhalgh *et al.* 1974). However, by the 1940s English Lesser Black-backed Gulls were beginning to expand their breeding range into urban areas (Parslow 1967).

Towns and cities provide ample, largely predator-free nest sites on rooftops or in relatively undisturbed industrial areas (Monaghan & Coulson 1977, Raven & Coulson 1997, Rock 2005). Birds can eat urban food waste, with streetlights even allowing night-time feeding (Rock & Vaughan 2013), although urban Lesser Black-backed Gulls still consume food from more “natural” sources, for instance earthworms and insects (Coulson & Coulson 2008). Furthermore, temperatures in towns tend to be 2° - 6°C warmer than in the surrounding countryside, allowing earlier breeding (Rock 2005). This combination of plentiful nesting habitat, food and warmth means Lesser Black-backed Gulls in urban areas can commence breeding at a younger age (three years old) than those elsewhere (P Rock *personal communication*). Seabird 2000 recorded 850 AONs in Bristol, a 64% increase since the previous seabird census in 1985-1988, and 2,250 AONs in Gloucester, a 400% rise (Mitchell *et al.* 2004). However, these numbers were likely to be an underestimate (Rock 2005). In England today, there are large Lesser Black-backed Gull breeding colonies in various towns and cities, including Bristol, Bath, Gloucester and Felixstowe, and pairs are now established in London (Balmer *et al.* 2013). There have also been steep rises in urban Lesser Black-backed Gull populations in other countries in recent years, including France (Cadiou & Guyot 2012), Belgium and the Netherlands (W Bouten & K Camphuysen *personal communication*). Indeed, Lesser Black-backed Gulls ringed as chicks in England have been reported breeding in Rotterdam and Zeebrugge (M Marsh *personal communication*).

With plentiful food and lack of predation, Lesser Black-backed Gull productivity is generally high. With a modal clutch size of three eggs, a pair can theoretically more than replace itself in a single breeding attempt if post-fledging mortality is low. Indeed, there is evidence that levels of breeding success approaching this partially underpin Lesser Black-backed Gulls’ rapid growth in numbers in urban areas (Table 1). As Lesser Black-backed Gulls are long-lived birds, with a high level of adult survival from one year to the next (Wanless *et al.* 1996, Camphuysen & Gronert 2012, Ross-Smith *et al.* 2013, Rock & Vaughan 2013), and individuals frequently recruit to breed in the colony in which they themselves hatched (O’Connell 1995,

Wanless *et al.* 1996, Rock & Vaughan 2013), it is easy to see how a few pairs can rapidly establish a large breeding population in the correct conditions (Table 2). Indeed, inland breeding populations doubled every three years in the 1970s even after allowing for potential emigration (Monaghan & Coulson 1977). Moreover, Lesser Black-backed Gulls breeding elsewhere apparently immigrate to successful colonies, a factor which contributed to the very rapid population growth observed at some English colonies, for example South Walney and Bowland Fells, in the Twentieth Century (Brown 1967, Greenhalgh *et al.* 1974).

**Table 1. Productivity estimates of Lesser Black-backed Gulls breeding in the UK.**

Colony	Year	Productivity	Population trend	Reference
South Walney	1962-1965	1.0	Increasing	Brown 1967
Bowland Fells	1993-1994	0.94-1.53	Subject to culling	O'Connell 1995
Ribble Marshes	1993	0.03-1.29	Subject to culling	O'Connell 1995
Skomer	1987-2000	<0.2	Decreasing	Perrins & Smith 2000
Carlisle	2009	2.32	Increasing	Sellers & Shackleton 2011
Barrow Town	2009	2.05	Increasing	Sellers & Shackleton 2011
Bristol	2005	3	Increasing	Rock 2005

**Table 2. Theoretical increase in a Lesser Black-backed Gull colony founded by 10 pairs in year 1, to illustrate how rapidly a colony may be able to grow. Assumes age of breeding as four years, three chicks per pair, 90% adult survival, 50% chick survival to breeding age, no emigration or immigration.**

Year	Pairs	Chicks
1	10	30
2	9	27
3	8	24
4	15	44
5	20	60
6	24	72
7	33	98
8	45	134
9	58	175
10	77	231

However, these aspects of Lesser Black-backed Gull breeding ecology also mean that it can take several years of breeding failure before numbers breeding at colonies start to decline (i.e. in the absence of immigration, population reductions are only apparent once breeding adults die) (Perrins & Smith 2000, Camphuysen & Gronert 2012). Such successive years of past poor productivity may partially explain recent declines at some large traditional colonies, for example South Walney (Perrins & Smith 2000, Kim & Monaghan 2006, Davis 2013) (Fig 5). These decreases are thought to be associated with changes in the management of landfill sites (for example closures, bird scaring tactics and covering the tip surface) and fishing practices, including a reduction in fisheries discards (Kim & Monaghan 2006, Perrins & Smith 2000). These changes mean that fewer opportunities to feed are

available, and adults struggle to sustain themselves well enough to reach breeding condition, failing to produce viable eggs or providing insufficient nourishment for chicks (Camphuysen & Gronert 2012).

Food stress during the breeding season is also thought to promote cannibalism of neighbouring eggs and chicks by breeding adults (Bukaciński *et al.* 1998, Perrins & Smith 2000, Camphuysen & Gronert 2012), increasing the likelihood of breeding failure for many pairs. Birds that have been the victim of intraspecific predation of eggs and chicks have been found to turn to this behaviour themselves, further accelerating breeding failure (Davis & Dunn 1976). Starvation also changes the behaviour of chicks so they beg more loudly and visibly, increasing their vulnerability to predation (Bukaciński *et al.* 1998). Such circumstances combined are thought to encourage adults to emigrate to more successful breeding sites (a move often accompanied by divorce of breeding pairs), compounding population declines at particular colonies, including South Walney and Orford Ness (Perrins & Smith 2000, Sellers & Shackleton 2011, M Marsh *personal communication*).

Predation, especially by Red Fox (*Vulpes vulpes*), has been a key factor driving colony size reduction at several sites, such as Rockcliffe Marsh and South Walney (Davis 2013) and Orford Ness (M Marsh *personal communication*). Small colonies may be more susceptible to predation than larger ones as they lack the benefits of group vigilance and defence, as well as the dilution effect of being a single prey individual among many. This leads to further reductions in size, and gradual loss of suitable habitat, when (for example) sites previously used by nesting birds become overgrown and are therefore no longer suitable (V Ross-Smith *personal observations*).

Declines at English Lesser Black-backed Gull colonies including Steep Holm, South Walney and Rockcliffe Marsh have also been associated with disease, primarily botulism (Rock 2005, Kim & Monaghan 2006, Sellers & Shackleton 2011), which appears to affect birds breeding at rural sites more than those in urban areas (Rock 2005). Breeding population size at some colonies (e.g. Bowland Fells, South Walney, Alde-Ore Estuary) has also been influenced by targeted population control, including culling of breeding adults and destruction of nests (Wanless & Langslow 1983, O'Connell 1995, Rock 2005, Davis 2013). This has sometimes taken place in the interests of public health and safety, for instance to exclude pathogens for which gulls are a vector from the water supply (Wanless & Langslow 1983, O'Connell 1995). However, culling is also carried out in an attempt to protect other species that are thought to be adversely affected by the presence of Lesser Black-backed Gulls, either through predation or exclusion from an area. These species might be of conservation concern (e.g. Arctic Tern *Sterna paradisaea* and Common Tern *Sterna hirundo*), or they might be species for which a particular site is managed (e.g. Red Grouse *Lagopus scoticus*) (Wanless & Langslow 1983, O'Connell 1995, Wanless *et al.* 1996, Sellers & Shackleton 2011). Although there are no figures available for the total numbers of birds culled, as Lesser Black-backed Gull can currently be taken under General Licences as part of the WCA 1981, the numbers controlled appear to have been substantial. For example, as many as 90,000 birds may have been taken at Bowland Fells between 1938 and 1988, with 75,000 being systemically culled between 1978 and 1988 (O'Connell 1995). The methods employed included poisoning, cannon-netting, gas gun, falconry and shooting (O'Connell 1995). The culling programme succeeded in reducing the population from 25,000 pairs in the late-1970s to fewer than 10,000 pairs in the mid-1980s (Carter 2011). It has also continued since. In urban areas, disturbance results from nest site destruction during redevelopment, and through steps taken (e.g. scaring or netting roofs) to prevent occupation by breeding birds. Whatever the cause of disturbance, it can prompt emigration of breeding birds to different breeding areas

(Raven & Coulson 1997, Rock 2005, Sellers & Shackleton 2011, Rock & Vaughan 2013). For example, the Bowland Fells satellite colony at Langden Head, which had 2,228 AONs in 2012, was established in the early-2000s following culling at nearby Tarnbrook Fell (Davis 2013).

### **1.6.2 Winter**

The change in wintering populations of Lesser Black-backed Gulls in England is driven by different, but related, processes to those driving breeding population trends. The increase in numbers of birds found in this country during the winter months is partly connected to a change in migratory behaviour, with fewer breeding birds now leaving the country in winter than previously (Baker 1980, Wernham *et al.* 2002, Banks *et al.* 2009). This change in overwintering behaviour is thought to be primarily due to the year-round availability of food in England (Barnes 1961, Horton *et al.* 1983, Banks *et al.* 2009). Ring-recoveries have shown that some Lesser Black-backed Gulls found in England during the winter also breed there, indicating that breeding and wintering population trends are likely to be inter-related. However, English wintering Lesser Black-backed Gulls also comprise birds that breed in Scandinavia, Iceland, the Netherlands, Belgium and Germany, some of which are of the *fuscus* and *intermedius* subspecies. Breeding population trends are different in these countries to those in England, and breeders from these places are also coming to England instead of migrating further south in some cases, as they would have done historically (Wernham *et al.* 2002, Camphuysen 2013).

## 2 SITE SPECIFIC CHANGES

Data on Lesser Black-backed Gull breeding success are collected by the Seabird Monitoring Programme. These were assessed in R (R Core Team 2013), using packages “maptools” (Bivand & Lewin-Koh 2013), “mapdata” (Brownrigg 2013) and “plotrix” (Lemon 2006). After Cook *et al.* (2014), an “alerts” system was used, quantifying breeding failure at colonies between the year 2000 (the middle point of Seabird 2000), and 2011, the last year for which data were available. However, there were large gaps in data collection, so this assessment could only be made for 2000-2011 (Fig 6). As expected the trends vary widely between colonies, suggesting that they are mainly driven by local factors.

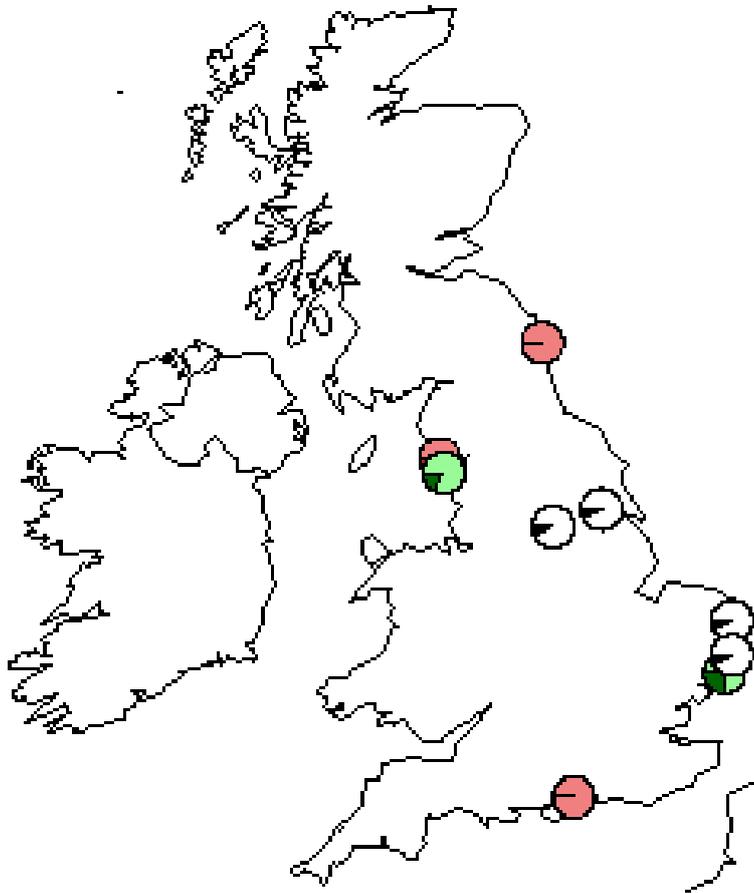


Figure 6. Lesser Black-backed Gull breeding success between 2000 and 2012 at English colonies assessed by the Seabird Monitoring Programme. Each pie chart represents a breeding colony. Green indicates breeding success, red breeding failures and black/white that the colony was not recorded in 2011. Darker segments indicate the proportion of the preceding years in which the target level of breeding success (more than 0.1 chicks per nest, Cook *et al.* 2014) was not achieved.



### 3 ANALYSIS OF THE MOVEMENTS OF LESSER BLACK-BACKED GULL IN ENGLAND USING RING-RECOVERIES

#### 3.1 Introduction

This analysis uses ring-recoveries (recoveries) to investigate the movements of Lesser Black-backed Gulls from different breeding areas. The metal rings are uniquely numbered and also carry an address and, increasingly, a web address ([www.ring.ac](http://www.ring.ac)). Many Lesser Black-backed Gulls also carry colour rings to enable them to be re-identified without being recaptured. Birds are largely ringed by volunteers, working in their own time. A recovery is any subsequent report of a ringed bird.

In this report we distinguish between recoveries when the bird was found dead (or injured) ('dead recoveries') and those recaptured and resighted<sup>5</sup>, as the geographical distribution of ringers and of resighters is concentrated at certain localities. It should be noted that when birds were recaptured or resighted by ringers within 40 km of the site of ringing, these recoveries have not historically been added to the database. In addition, multiple resightings of an individual bird at a site within a winter were only submitted in summarised form (i.e. one or a few sightings per winter). Both of these types of record have been added to the central database more recently. Thus, our analyses concentrate first on the birds found dead, for which there are fewer spatial biases in recovery likelihood. To select individuals of known breeding origin, we have restricted the analyses to birds ringed while nestlings (pulli) and older birds ringed in the breeding season (defined here as April to July). At recovery, birds are divided into those that were immature and those which had reached breeding age (five or *more* years old). Those found in the breeding season and those found outside the breeding season (defined here as October to February) are treated separately. The periods chosen reflect the availability of data. Records were discarded from the analyses if the finding location was not clear (accuracy of finding location of >20 minutes of latitude/longitude), but those of birds possibly moved by water were not excluded, as they were very few in number and are unlikely to have moved far before being found, as this is not a pelagic species. The recovery distance was calculated according to the loxodrome method (i.e the path following a constant bearing, du Feu *et al.* 2012).

#### 3.2 Recoveries

The BTO ring recovery database holds 23,907 recovery records of Lesser Black-backed Gulls ringed in England either while pulli or adults in the breeding season (April-July), and found since 1980 (Table 3).

**Table 3. Number of recoveries of Lesser Black-backed Gulls in the BTO ring recovery database ringed in England, divided by age at ringing. Only birds ringed while pulli or in the breeding season (April-July) are included.**

Ringed while:	Dead recoveries	Resightings/recaptures
Pulli	2,589	17,548
Immatures (1-4 years) in breeding season	388	1,782
Adults (age 5+ years) in breeding season	242	1,358

<sup>5</sup> Recoveries are separated using EURING 2000+ code. Those with finding condition 7, 79, 8 and 89 refer to birds resighted or recaptured.

### 3.2.1 Birds ringed while pulli

#### 3.2.1.1 Recoveries of birds found dead or injured

Ringling effort for Lesser Black-backed Gull across the country is not uniform, with 88% of the dead recoveries relating to pulli ringed at five large sites across the country: Bowland Fells (pSPA, SSSI), Bristol, Orford Ness (NNR, SPA, SSSI), Ribble Estuary (including Banks Marsh) (NNR, SPA, SSSI) and South Walney (SPA, SSSI) (Fig 1). The number of recoveries of birds found dead or injured from each of these sites is shown in Table 4, broken down by distance band from the ringing site.

**Table 4. Percentage of dead recoveries by distance moved of birds ringed while pulli at five main English sites. Distance bands shown are in km. Note the high percentage recovered in the vicinity of Bowland Fells where extensive culling has taken place.**

	0-20	21-50	51-100	101-200	201-500	501+
South Walney (n=1,161)	48.0	22.7	10.1	4.7	4.0	10.0
Bowland (n=361)	86.7	3.0	2.2	3.3	1.4	3.0
Ribble (n=158)	42.2	29.8	7.0	5.0	3.8	12.0
Bristol (n=205)	57.6	8.3	6.8	4.4	7.3	15.6
Orford Ness (n=396)	29.6	12.6	12.6	20.5	8.0	16.7

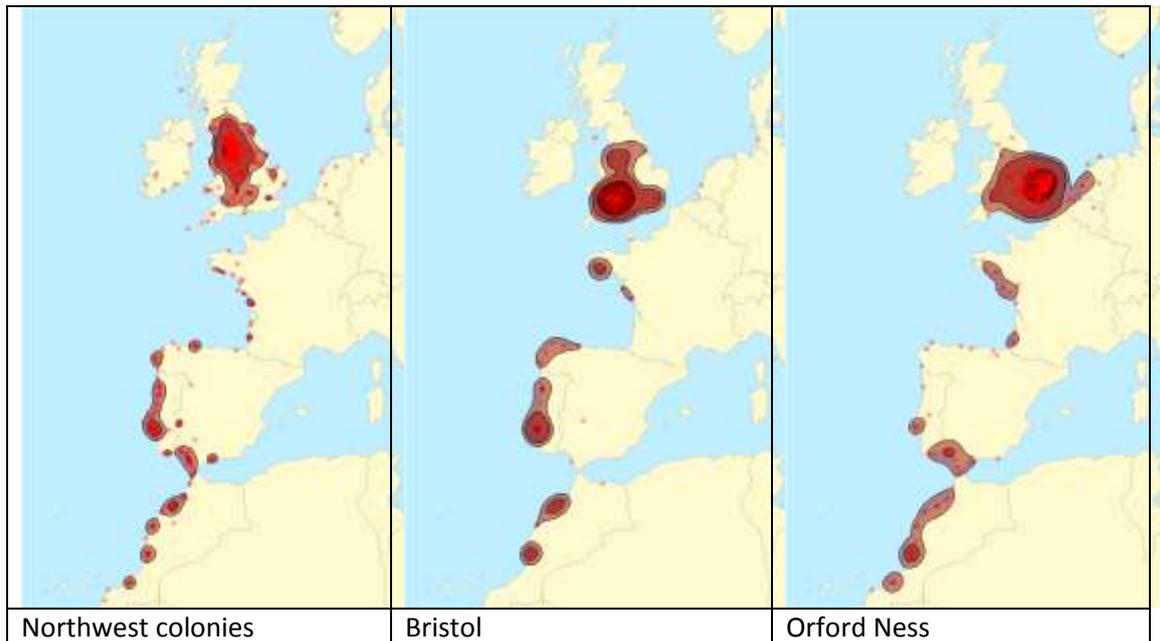
$$\chi^2 = 429, df = 20, p < 0.001$$

As would be expected with a species showing natal philopatry, a high proportion of the recoveries are in the closest distance band, with more in this category at Bowland Fells than the other sites. There are differences in the likelihood of birds being found dead (or intentionally taken) between the sites. The higher number of recoveries at Bowland Fells reflects the extensive culling programme of adult Lesser Black-backed Gulls at this site since the 1970s, initially to protect a public water supply, but also to protect grouse shooting interests ([www.naturalengland.org.uk/ourwork/regulation/wildlife/species/lesserblackbackedgullsfeature.aspx](http://www.naturalengland.org.uk/ourwork/regulation/wildlife/species/lesserblackbackedgullsfeature.aspx)). A large number of these culled birds were ringed (identified in the dataset by EURING coding referring to birds intentionally taken for nature conservation, public safety or scientific investigation) and these have been excluded from some of the analyses below.

There are also differences in the geographical spread of recoveries between the sites, with local movements radiating out from the ringing site. Ribble and South Walney have more recoveries in the 21-50 km category and Orford Ness has fewer in the 0-20 category, but more in the categories over 100 km. There is regular interchange between the three main sites in the northwest (Bowland Fells, Ribble Estuary and South Walney), so in the analyses these are merged into a single geographic unit.

Most recoveries from the different sites/area are within the same broad geographic region, with the distribution of recoveries outside of the UK being similar (Fig 7). There are no obvious differences between the pattern in more distant finding locations, with birds from all colonies found along the coast of the Bay of Biscay into Portugal and northwest Morocco. The only possible differences are the proportionally smaller number of recoveries of Orford Ness birds in Portugal: 1.8% of recoveries of Orford Ness birds are in Portugal, compared to

5.5% of birds from Bristol and 2.8% of birds from northwest colonies, although there may have been some observer bias over time.



**Figure 7. Kernel maps of dead recoveries of birds ringed as pulli from three English sites/areas. Smoothed kernels enclose 50% (darkest), 75% and 90% (lightest) of recoveries (local (<= 20 minutes) movements and culled birds excluded). Dots are actual site of recoveries.**

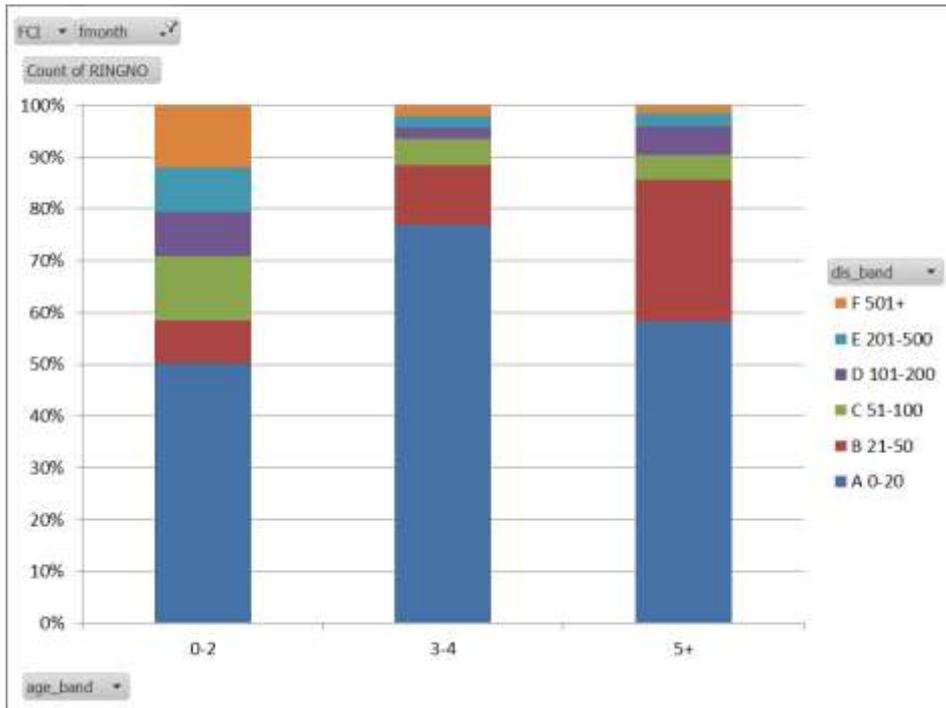
### ***Differences by age***

Immature Lesser Black-backed Gulls are likely to move further than adults as they wander as pre-breeders (Wernham *et al.* 2002, Marques *et al.* 2010, Jorge *et al.* 2011). Using the recoveries from the five main ringing sites, divided by age classes: juvenile (first- and second-year birds, found up to two years after ringing), sub-adult (found three to four years after ringing) or adult (found five or more years after ringing), we explore these differences. Any analysis of movements is confounded by the season, so here we present separately age differences in movements in both seasons: breeding (April-July) and winter (October to February).

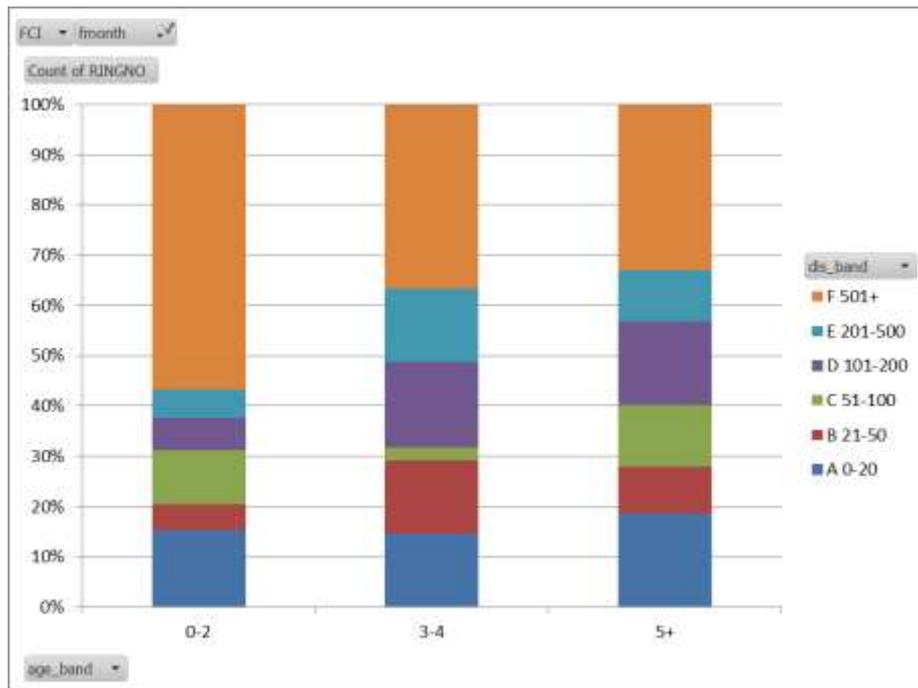
Figure 8 confirms that juvenile birds are more likely to be found further (> 50 km) from their natal site in the breeding season than either sub-adults or adults ( $X^2 = 176$ ,  $df = 10$ ,  $p < 0.001$ ). Adults will be more tied to breeding sites over the summer months and some immatures will also return to breeding colonies to prospect for nest sites before recruiting.

The same pattern of movements is also seen outside the breeding season (October to February), with juvenile birds more likely to be found further from their natal site ( $X^2 = 26.4$ ,  $df = 10$ ,  $p = 0.003$ ) (Fig 9). The difference appears less pronounced than in the breeding season, but this is unsurprising as it is likely that many adults will spend winter in the same broad geographic area as other age classes. This finding agrees with those from recent studies that analysed Lesser Black-backed Gull ringing data from northwest England, and showed that older birds made shorter distance migratory movements than younger birds, choosing wintering grounds that were closer to their breeding colonies (Marques *et al.* 2010, Jorge *et al.* 2011).

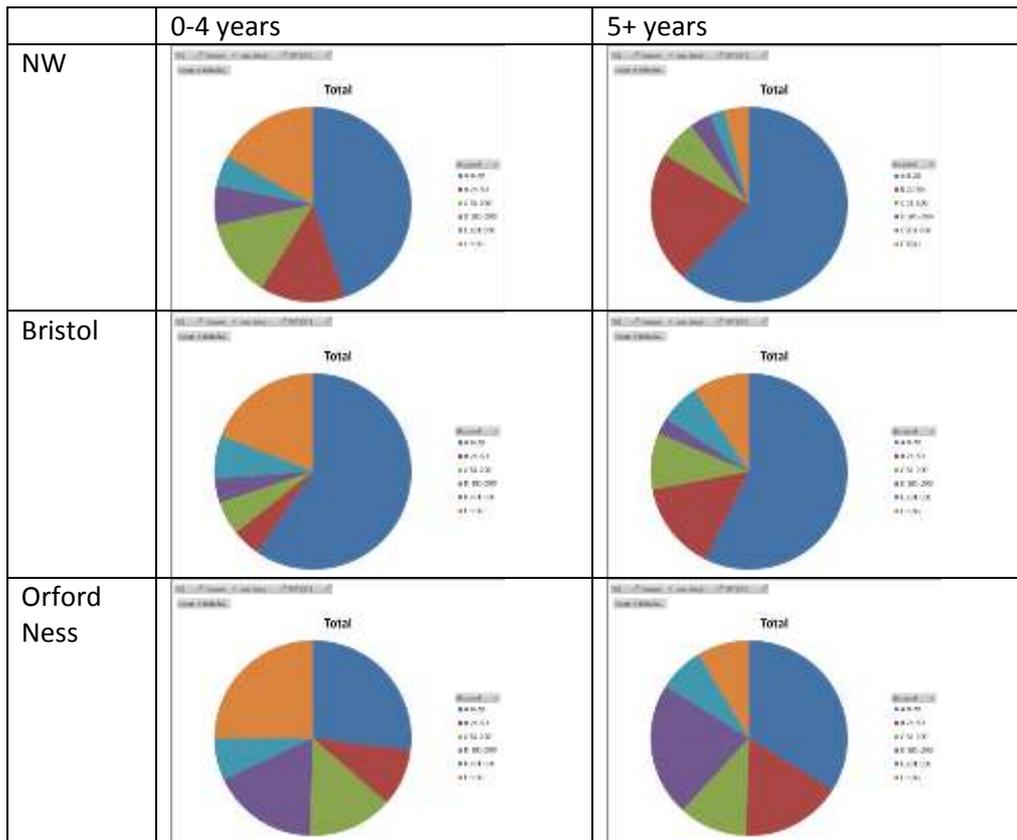
To allow us to more broadly look at regional differences in relation to age class, Figures 10 and 11 use data from the merged northwest sites with age class broken down into those of breeding age (> 5 years) and those not. The breakdown is very similar between the northwest colonies and birds from Bristol, but the small number of short-distance movements of birds from Orford Ness doesn't appear to be dictated by age, with adults and non-adults showing a similar pattern of movements. This is likely to be due to, at least some, of these birds, moving to the Continent. Removing the effect of local recoveries (0-20 km), the pattern is still apparent, with Orford Ness birds making proportionally more medium-distance (51-200 km) movements.



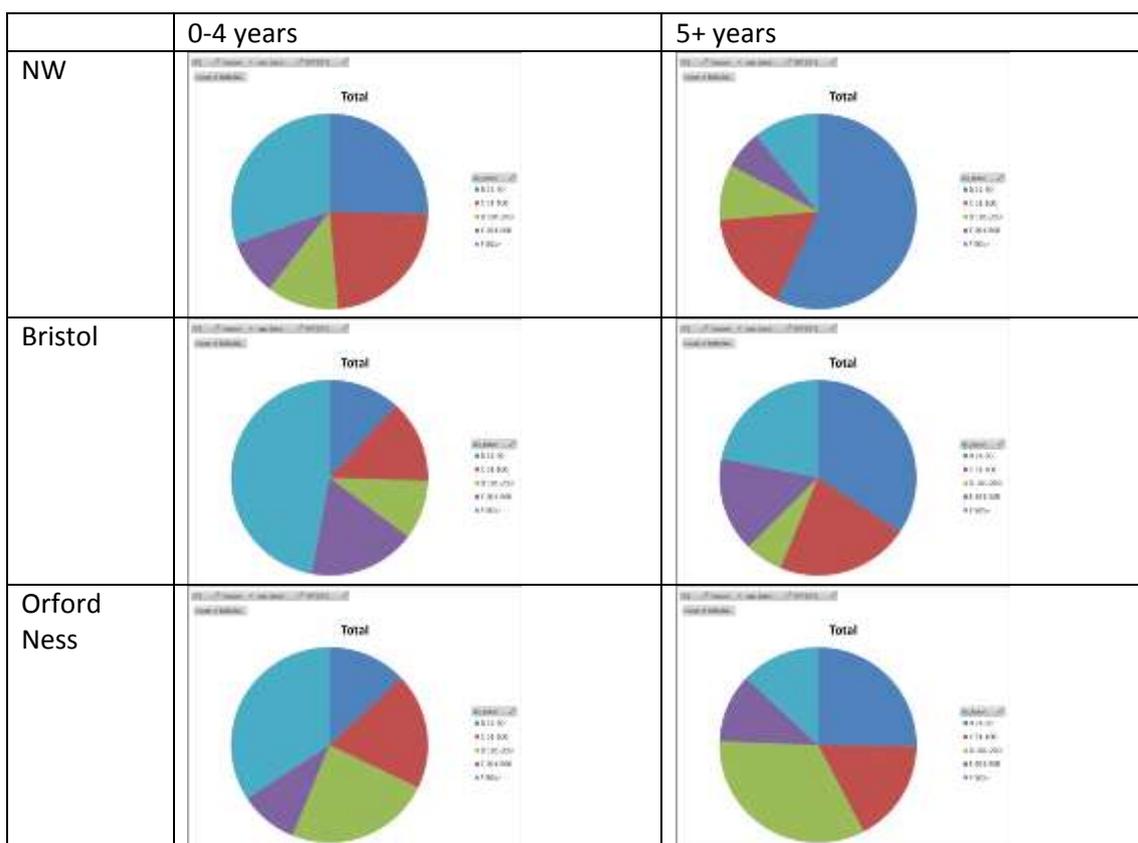
**Figure 8. Proportion of dead recoveries in the breeding season (April-July) of birds ringed while pulli in various distance bands, grouped by age (years since ringing). Culled birds are excluded.**



**Figure 9. Proportion of dead recoveries outside the breeding season (October to February) of birds ringed while pulli in various distance bands, grouped by age (years since ringing). Culled birds are excluded.**



**Figure 10. Proportion of dead recoveries of birds ringed while pulli in various distance bands, grouped by 'site' ringed and age (years since ringing). Culled birds are excluded.**



**Figure 11. Proportion of dead recoveries of birds ringed as pulli in various distance bands, grouped by age (years since ringing). Local movements ( $\leq 20$ km) and culled birds are excluded.**

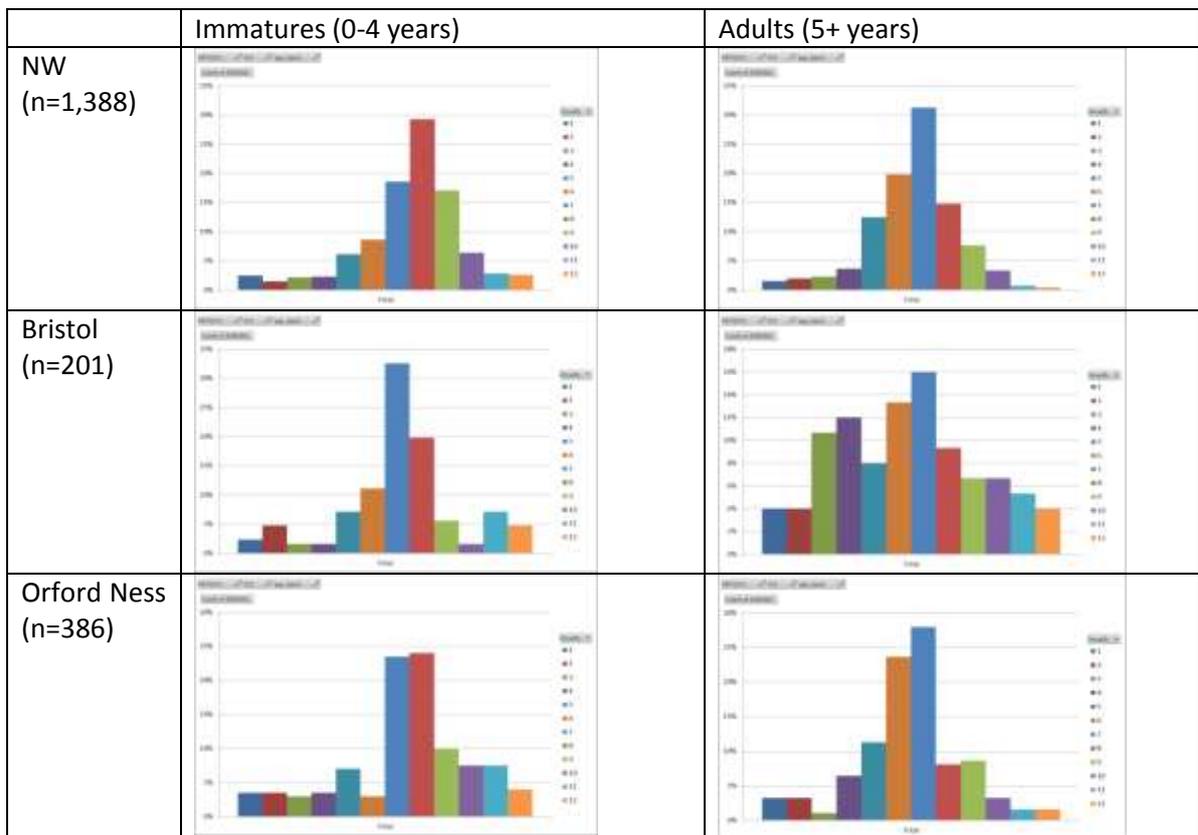
### ***Differences by season***

There are also differences in patterns of movements between the seasons. Unlike resightings of colour-ringed birds, most dead recoveries of birds ringed while pulli (excluding those culled and local ( $\leq 20$  km) recoveries) are in England (849 (76%)), and of these 73% (624) were found in the breeding season (Fig 12). However, this figure does include birds found dead soon after fledging at the ringing site. There are several likely biases with the seasonal pattern of recoveries, including the fact that birds are more likely to be found during fieldwork in the colony. However, excluding recoveries of birds local to the ringing site (0-20 km) has little effect on the general pattern, nor does excluding birds found less than a year after ringing. Figure 13 shows the differences between the three areas/sites in the breeding season and winter.

The observed patterns are again broadly similar between northwest birds and those ringed in Bristol, but the pattern of Orford Ness birds making fewer short-distance movements again doesn't appear to be explained by season, possibly suggesting movement to the Continent. Data from an ongoing study using GPS to track adult Lesser Black-backed Gulls breeding at Orford Ness show that a number of individuals routinely visited locations more than 20 km from the colony during the breeding season. Indeed, the mean foraging range for these birds was almost 40 km (Thaxter *et al.* 2012). It is possible that this reflects the availability of food.

Movements of adult (breeding) birds are of most interest as they provide information on philopatry, and variations between seasons across the areas/sites. Figure 14 shows that birds from Bristol and the northwest recovered when they have reached breeding age are more likely to be found close (0-50 km) to their natal colony in subsequent breeding seasons (as adults) than birds ringed at Orford Ness ( $\chi^2 = 95.2$ ,  $df = 10$ ,  $p < 0.001$ ).

The pattern of birds from Orford Ness being less likely to remain local to their natal site is also seen in the winter, with 75% of birds being found >100 km from their natal colony, compared to 50% of birds from Bristol and 5% from the northwest colonies. The seasonal difference in distances moved is apparent for birds from the northwest and Orford Ness, but birds from Bristol are more likely to be found relatively local (<100 km) to the ringing site in winter.



**Figure 12. Proportion of dead recoveries by month for birds ringed while pulli from the main English areas/sites. Culled birds are excluded.**

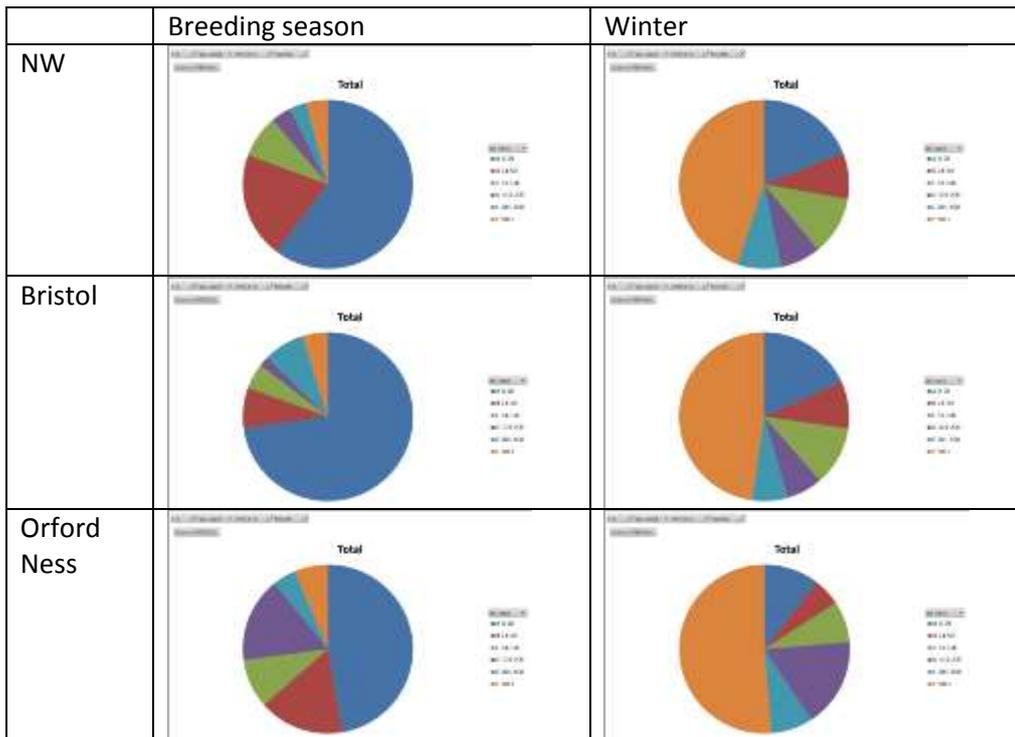


Figure 13. Proportion of dead recoveries by season (breeding season is April-July, winter is October-February) of birds ringed as pulli in various distance bands, from the three main English areas/sites (culled birds excluded).

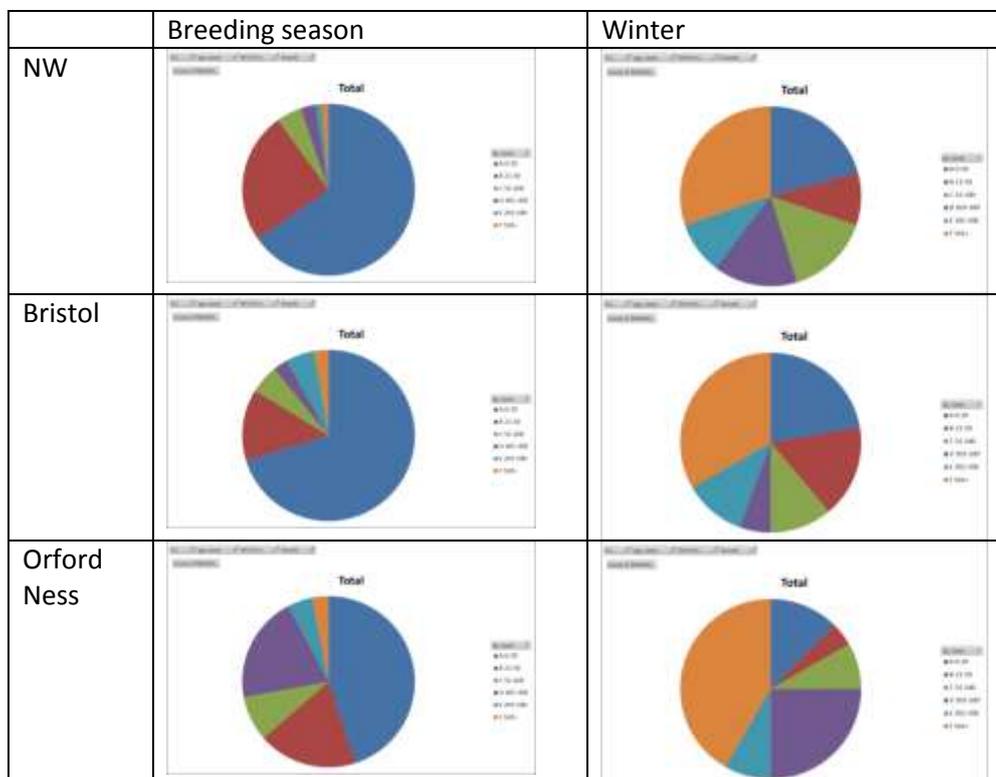


Figure 14. Proportion of dead recoveries of adults (found 5+ years after ringing) by season (breeding season is April-July, winter is October-February) of birds ringed as pulli at the three main English areas/sites (culled birds excluded).

### 3.2.1.2 Movements between sites

Considering the ringing and refinding effort at the five main English 'sites', there are surprisingly few exchanges between the sites in the northwest and elsewhere (Table 5). Whilst there are 35 recorded movements of individuals between the three sites in the northwest (excluding culled birds), there is just a single movement between the regions, of a bird ringed at South Walney and found at Orford Ness.

**Table 5. Number of movements of birds ringed while pulli between (and within) the five main English ringing sites.**

Ringling site below, finding site right	South Walney	Bowland	Ribble	Bristol	Orford Ness
South Walney	383	18	9		1
Bowland		90			
Ribble	4	4	5		
Bristol				43	
Orford Ness					57

### 3.2.1.3 Culled birds

The summer culling of adult birds (alongside destruction of nests) at Bowland Fells, provides a good opportunity to look at the origins of some of these birds. An estimated 90,000 birds were killed in this area between 1938 and 1988, with the majority (75,000) dying during systematic culling between 1978 and 1988 (O'Connell 1995). The methods employed included poisoning, cannon-netting, gas gun, falconry and shooting (Wanless & Langslow 1983, O'Connell 1995). The culling programme succeeded in reducing the population from 25,000 pairs in the late-1970s to fewer than 10,000 pairs in the mid-1980s (Carter 2011). Culling and nest destruction continued beyond 1988 and culling increased in the early 2000s with the use of stupefying drugs. Numbers of ringed birds reported over the period are rather sporadic (Table 6) and may reflect either changes in the numbers of birds culled or changes in the reporting of ringed birds by those carrying out the cull.

**Table 6. Numbers of ringed birds reported by year during culling in Bowland.**

Cull year	No. ringed birds reported from cull
1995	6
1996	11
1997	12
1998	13
1999	5
2000	57
2001	111
2002	57
2009 <sup>6</sup>	9
TOTAL	281

Of these 281 birds coded as being culled (EURING finding circumstance coded 13, 14, 15, 23 and 24), most birds (73%) unsurprisingly originated from Bowland Fells. However, there were also numerous recoveries of individuals ringed at other sites in the region (Table 7). As the culls were carried out in the breeding season, a large proportion of birds culled were adults, with birds from Orford Ness aged 8-10 years and the bird from Bristol being eight years old. These recoveries suggest significant interchange of breeding birds between the group of sites in the northwest, although movement has been shown to follow culling (Raven & Coulson 1997, Rock 2005, Sellers & Shackleton 2011, Davis 2013, Rock & Vaughan 2013).

**Table 7. Numbers of bird from five main ringing sites found during culling in Bowland (ringed as pulli).**

Ringing site (distance from Bowland)	No. culled birds
Bowland (0 km)	204
South Walney (39 km)	63
Ribble (41 km)	9
Orford Ness (351 km)	4
Bristol (285 km)	1

#### **3.2.1.4 Resightings**

The use of uniquely identifiable colour-rings on pulli, which can be read at distance in the field, has generated 17,548 resightings of Lesser Black-backed Gull ringed in England over the period considered. As for birds found dead (above), a majority of these resightings are of birds ringed at five main sites (Table 8).

---

<sup>6</sup> Although birds were culled in other years in the 2000s, no reports of ringed birds were received. It is likely that ringed birds were killed, but were not reported.

**Table 8. Percentage of resightings by distance moved of birds ringed while pulli at five main English sites. Distance bands shown are in km.**

	0-10	11-50	51-100	101-200	201-500	501+
South Walney (n=2,426)	<1	4	4	5	34	53
Bowland (n=1,141)	<1	6	3	4	35	52
Ribble (n=1,574)	1	6	0	4	32	57
Bristol (n=4,750)	<1	35	10	2	3	49
Orford Ness (n=4,127)	0	16	8	21	12	43

$$\chi^2 = 4,158, df = 20, p < 0.001$$

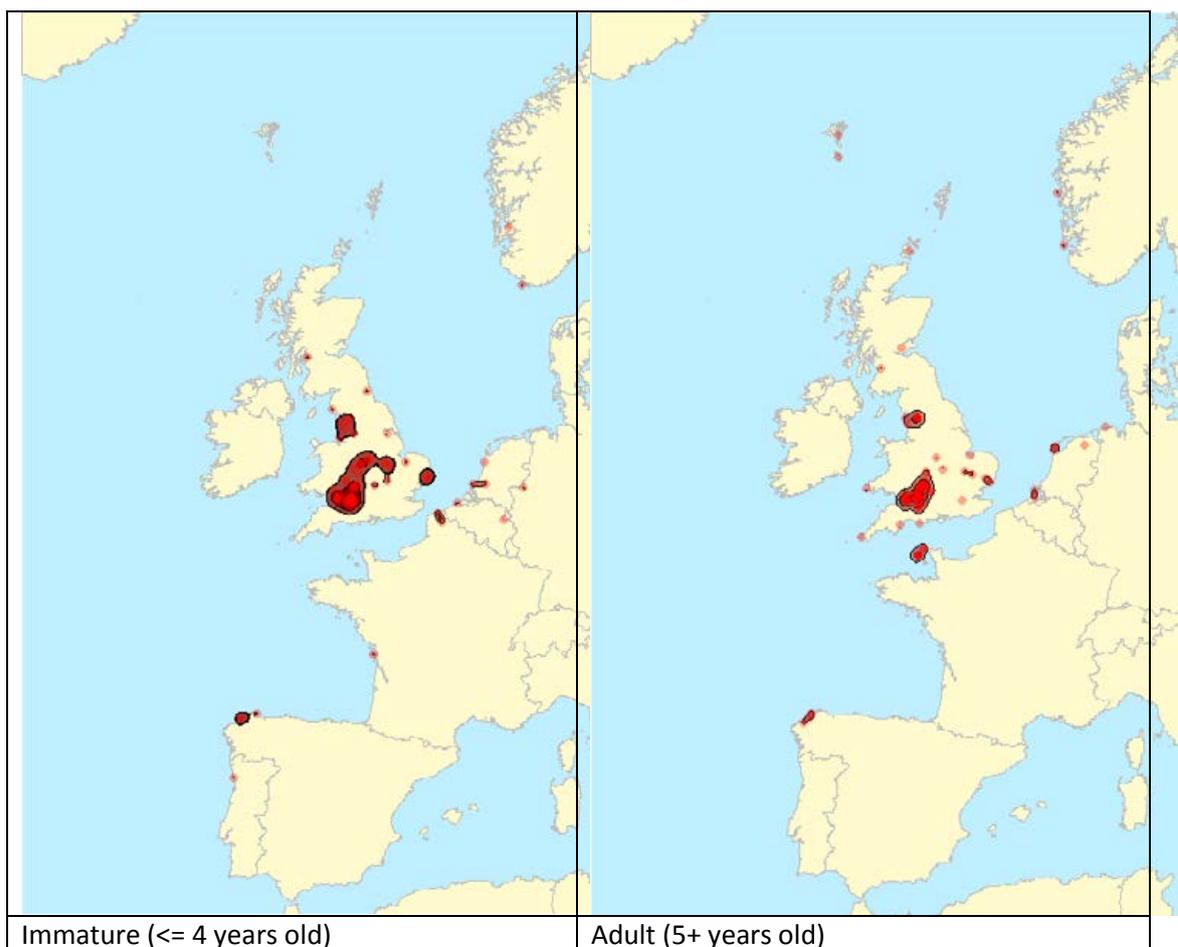
Resightings of colour-ringed birds are treated slightly differently to 'dead recoveries' in the BTO database. Local resightings of birds have not always been routinely collated when submitted by ringers, but have been processed if they were reported by members of public. In this context, 'local' was considered to be  $\leq 40$ km. These data show that northwest sites all have fewer recoveries in the categories 200 km or less (and more over 200 km), Bristol (where the density of human population is higher) has more under 100 km (and especially 11-50 km) and Orford has more in the 101-200 km band. As for 'dead recoveries', there are likely to be differences in the pattern of movements dependent on age class and season.

Considering the three northwest sites, there are clearly proportionally fewer medium-distance (11-100 km) resightings from this region than from the other two regions. However, this may well be a function of observer effort, with a small number of regular observers generating large numbers of resightings from a single location. For example, there are 2,195 individual resightings from Gloucester Landfill (Table 9).

The resightings at Gloucester Landfill are unsurprisingly dominated by birds ringed in Bristol, but there are consistently high numbers of birds from all three sites in the northwest. Despite being a similar distance from Gloucester Landfill, there are relatively few resightings of birds ringed at Orford Ness (Fig 15). As the distance from colonies other than Bristol is likely to be too far to represent feeding movements in the breeding season, the birds seen at the landfill site in the breeding season may have moved breeding area. This requires further investigation, but may suggest that the west of the country is acting as a functional region. Note that 26% of resightings of Bristol birds are at Gloucester Landfill, in the 11-50 km distance band, 16% of resightings of birds ringed in the northwest region are also there, but in the 201-500 km distance band.

**Table 9. Number of resightings at Gloucester Landfill of colour-ringed pulli from the main five English sites.**

Site	Distance from Gloucester Landfill (km)	No. of resightings (% of all resightings from site)	No. breeding season resightings (April-July)
Bristol	47	1,219 (26%)	447
Ribble	210	247 (16%)	59
Bowland	242	185 (16%)	18
South Walney	253	394 (16%)	94
Orford Ness	265	150 (4%)	46



**Figure 15. Kernel maps of resightings of birds ringed in the breeding season (April-July) at Gloucester Landfill and resighted in the breeding season elsewhere. Smoothed kernels enclose 50% (lightest), 75% and 90% of recoveries (darkest) (local  $\leq 40$  km) movements excluded). Dots are actual site of recoveries.**

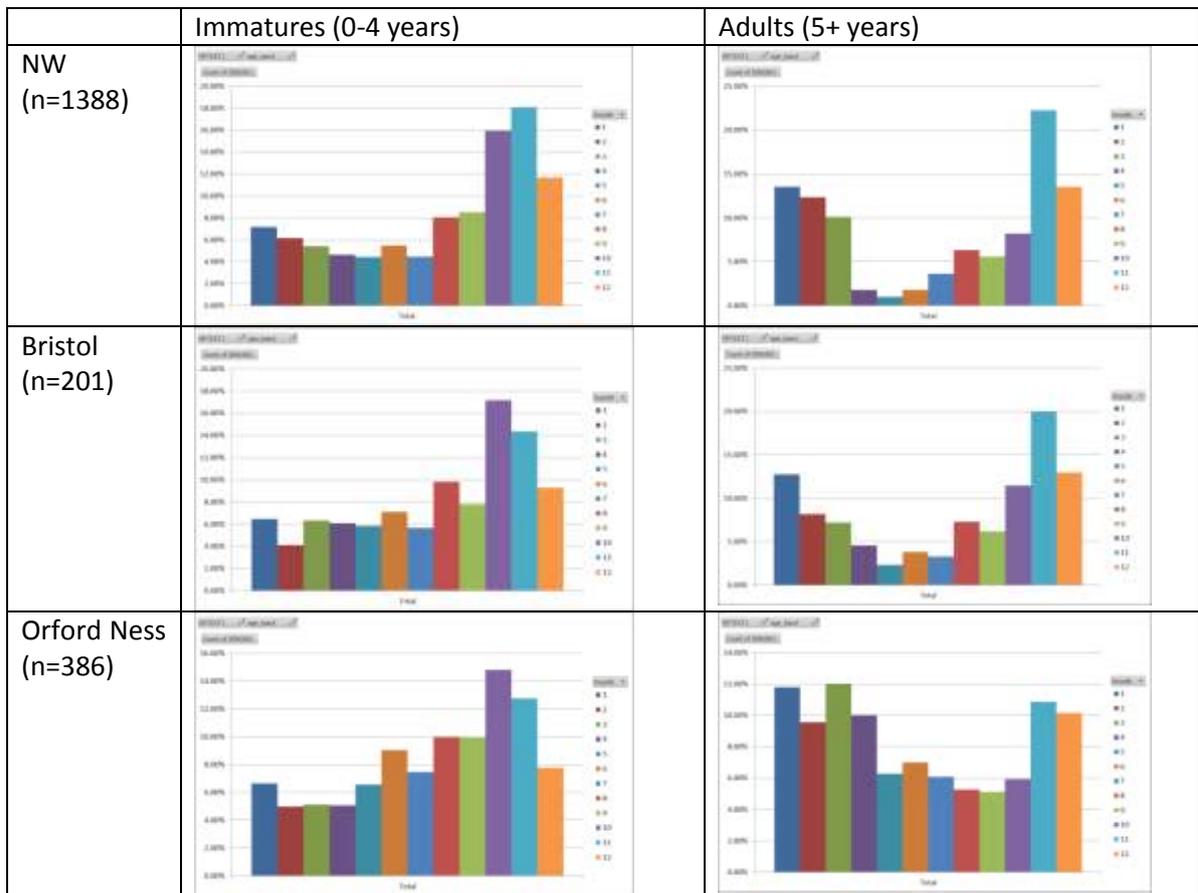
Away from wintering sites, there are very few resightings of colour-ringed birds between the five main colonies, with just a single movement of a bird from Ribble to Bristol (251 km) and four relatively local resightings of birds from Ribble to South Walney (44 km).

There is more observer effort focussed on resighting birds in the winter and this is apparent in the numbers of resightings per month (Fig 16), with most resightings consistently coming from the early winter (October to November).

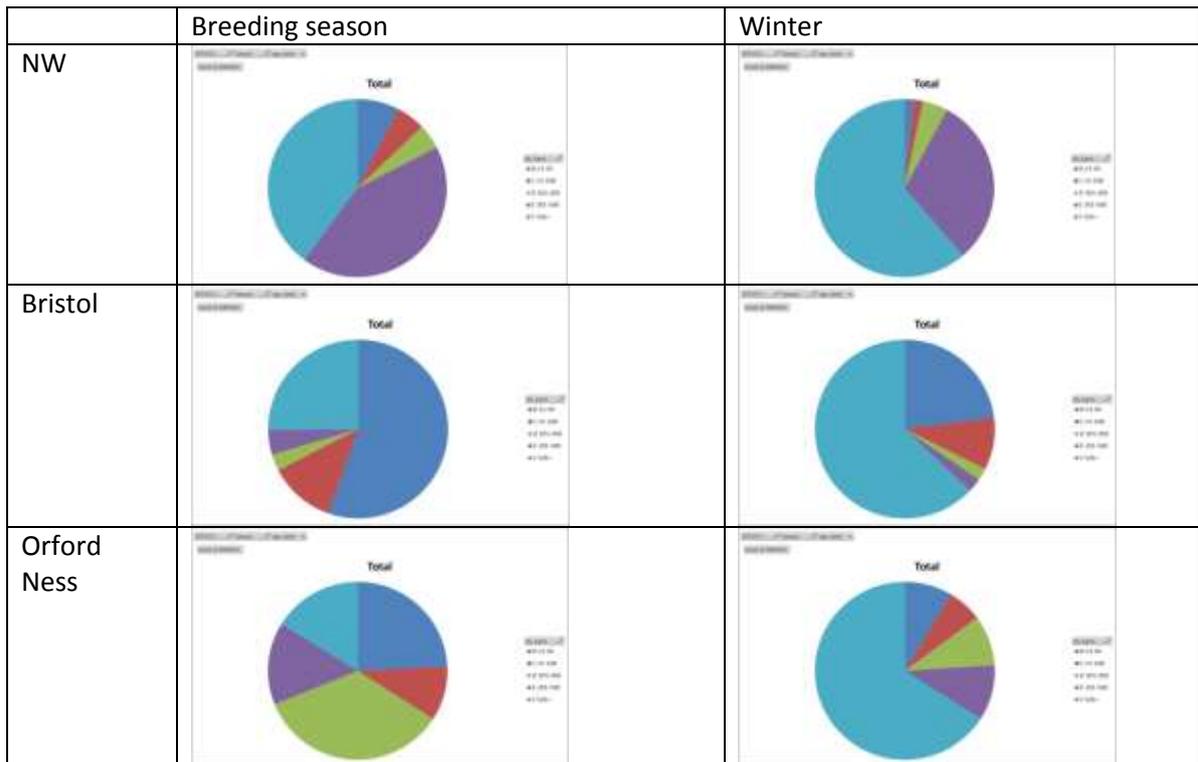
During the breeding season, adults from the northwest colonies are more likely to be resighted further from their natal colony than birds from either of the other sites (Fig 17). Figure 18 shows that these birds are moving south from the colonies and may be utilising landfill sites further south. This is in contrast to birds from Bristol which appear to be more sedentary in the breeding season. The preponderance of birds from Orford Ness being resighted in the 101-200 km distance band may reflect the fact that birds are regularly resighted across the North Sea in the Benelux countries.

A similar pattern of movements is also seen in immatures, with more birds from Bristol resighted closer to their natal colony than other sites (Fig 19). Immatures from the

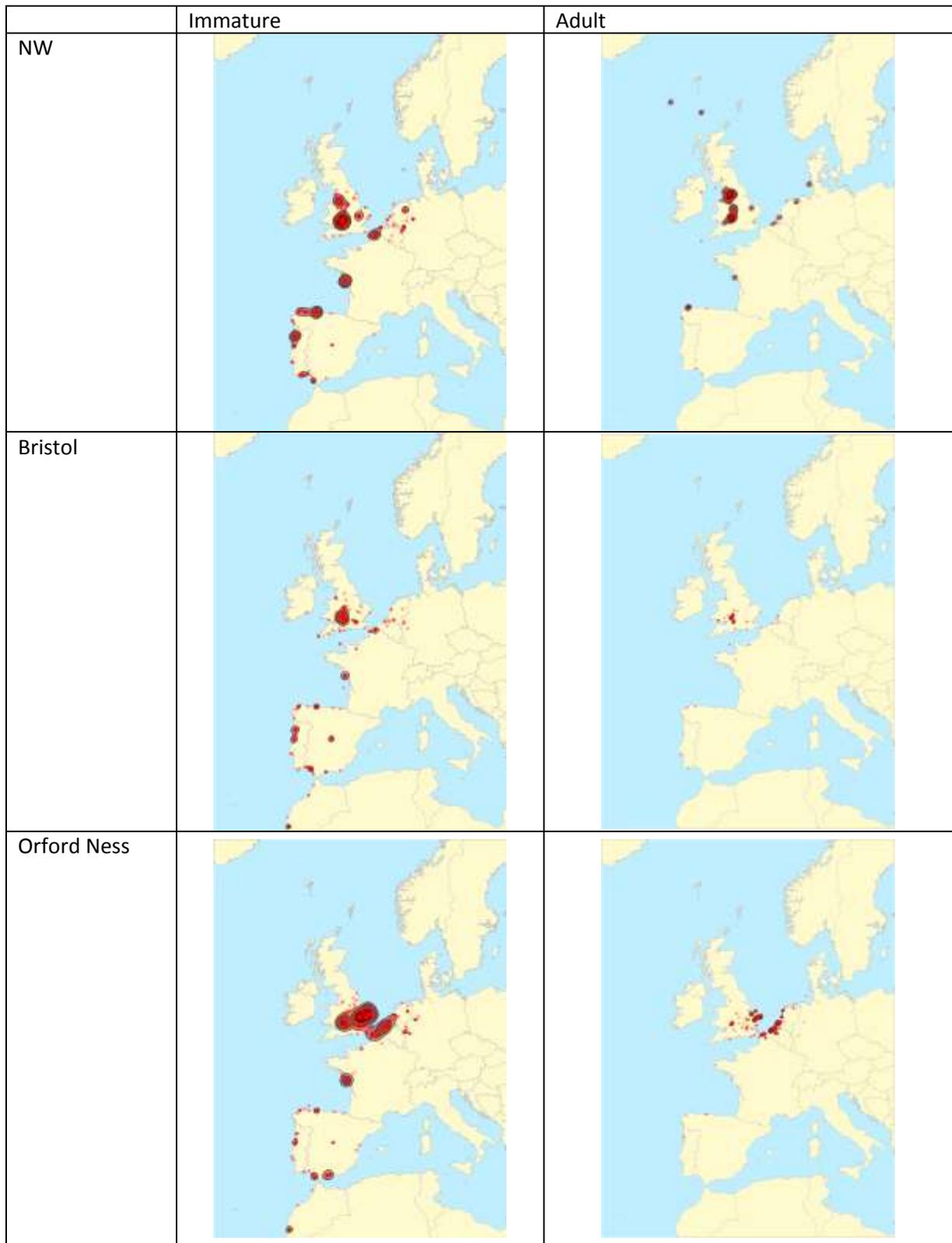
northwest are also more likely to be resighted at greater distances. As for adults, immature birds from Orford Ness are also making regular use of the Benelux countries in the breeding season and there may well be some breeding interchange between these areas.



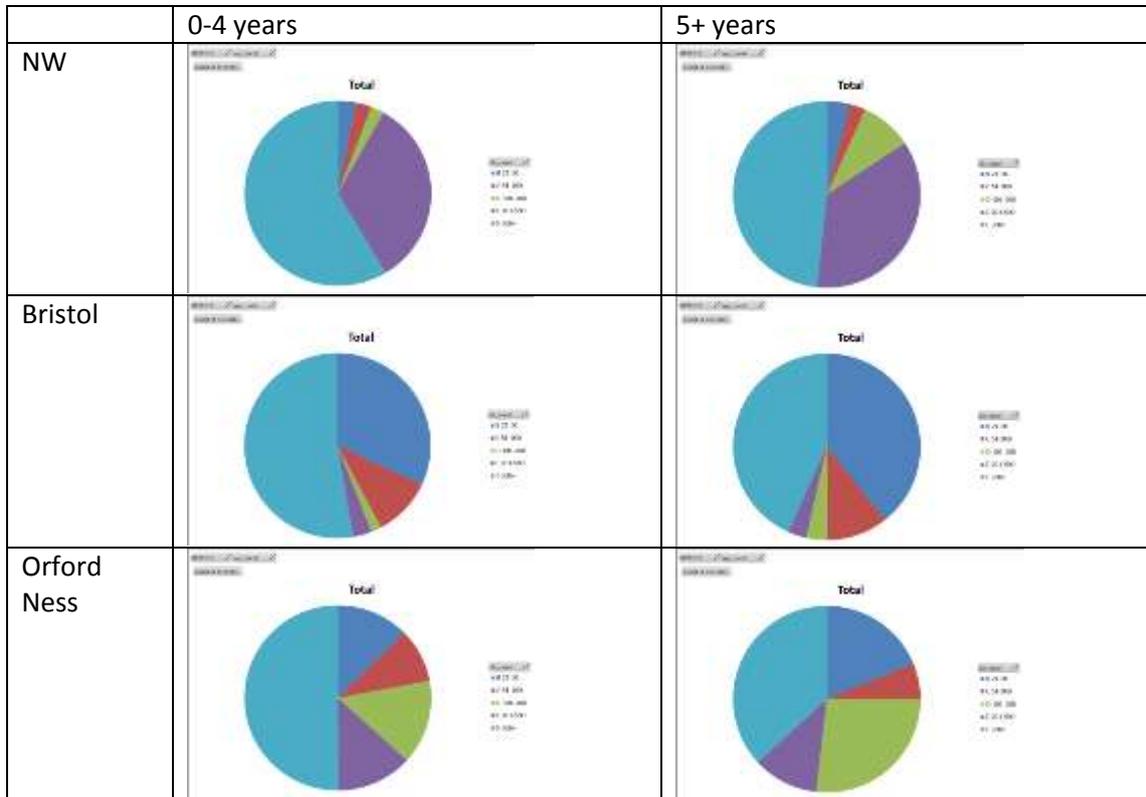
**Figure 16. Percentage of resightings by month for birds ringed as pulli from the five main English sites (all recoveries included).**



**Figure 17. Proportion of resightings of birds ringed as pulli and resighted as adults (found 5+ years after ringing) in various distance bands, from three main English areas/sites (local movements ( $\leq 40$  km) excluded).**



**Figure 18.** Kernel maps of resightings in the breeding season (April-July) of birds ringed as pulli from three English areas/sites. Smoothed kernels enclose 50%, 75% and 90% of recoveries (local ( $\leq 40$  km) movements and culled birds excluded). Dots are actual site of recoveries.



**Figure 19. Proportion of resightings of birds ringed as pulli in various distance bands, from three main English areas/sites (local movements ( $\leq 40$  km) excluded).**

### 3.2.2 Birds ringed while adults

Of birds ringed as adults, there are 3,157 records of birds ringed in Britain recovered in the breeding season (April-July). Of these, 173 are recorded as being in a colony (EURING status code C), of which 43 are on Flat Holm Island, and 173 as nesting (EURING status code N). Many records that undoubtedly refer to breeding birds, coming from the summer at known breeding sites, are not coded as such but can be assumed to be breeding birds. Of these birds, 2,647 were ringed in England, with the only sites generating a significant number of recoveries being three of the main English sites for ringing of pulli (Table 10). The recovery totals for the other two main English sites (Ribble and Bristol) are also listed in Table 10, but are very low, or zero.

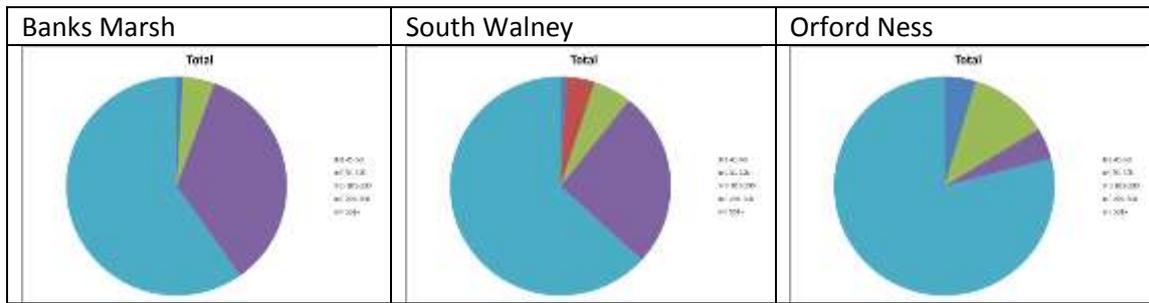
**Table 10. Numbers of recoveries/resightings of birds ringed as adults at five main English sites.**

	No. recoveries	Dead	Alive
South Walney	398	70	328
Bowland	4	3	1
Ribble	114	7	107
Bristol	0		
Orford Ness	51	12	39

As there are relatively few records of dead birds, these have been treated alongside records of live resightings. Using the same distance bands as for pulli, movements from the three main areas/sites are shown in Table 11 ( $\chi^2 = 32.3$ ,  $df = 3$ ,  $p < 0.001$ ) with the proportions shown in Figure 20. There is a tendency for more of the recoveries of birds ringed on the Ribble to be over 200 km from the ringing site, those from South Walney to be over 100 km and those at Orford to be over 500 km.

**Table 11. Percentage of recoveries/resightings by distance moved of birds ringed while adults at three main English areas/sites. Distance bands shown are in km.**

	0-40	41-50	51-100	101-200	201-500	501+
South Walney (n=398)	15.1	0.8	3.5	4.8	22.1	53.7
Ribble(n=114)	6.1	0.9	0	4.4	32.5	56.1
Orford Ness (n=51)	17.3	3.9	0	9.6	3.9	65.4



**Figure 20. Proportion of resightings of birds ringed as adults in various distance bands, from five main English sites (local movements (<= 40 km) excluded).**

### 3.2.3 Birds ringed abroad

There are records of 223 birds ringed as pulli abroad and found in the UK in the breeding season (April-July), 216 of which were in England (Table 12).

**Table 12. Number of recoveries by age band of foreign-ringed birds (ringed as pulli) found in England in the breeding season.**

	0-2	3-4	5+
<b>Norway</b>	65	23	10
<b>France</b>	12	12	1
<b>Denmark</b>	20	2	1
<b>Netherlands</b>	16	4	4
<b>Iceland</b>	8	1	3
<b>Channel Islands</b>	6	4	3
<b>Germany</b>	9	3	
<b>Belgium</b>	2	4	2
<b>Finland</b>		1	

A majority (68%) of these records are recaptures of ringed birds or field sightings of colour-ringed birds, primarily from non-breeding areas in the UK. The only records from breeding sites were 20 birds found at Orford Ness, although 17 of these were birds of non-breeding age (8 being 0-2 years old and 9 being 3-4 years old). Of the three birds of breeding age, these had been ringed in Netherlands (2) and Belgium.

### 3.2.4 Preliminary conclusions

There appears to be some evidence for two metapopulations of Lesser Black-backed Gull occurring in England, with differences in movements being apparent between the west and east of the country. There is also a suggestion of differences between the rural and urban populations in the east, which may be a result of the very different habitat being exploited. Amongst those Lesser Black-backed Gulls culled at Bowland Fells, were birds ringed at both South Walney and the Ribble, suggesting that these colonies might function at least partly as a unit, although this could be a result of the perturbations caused by culling. If we consider the three possible populations (northwest colonies, Bristol and Orford Ness) urban birds from Bristol are more likely to be sedentary, and more interestingly this happens at all times of year. This contrasts with birds from the northwest, where there are more medium-distance

movements and also birds possibly moving further (to feed as well perhaps, or colonising new urban colonies) in the breeding season. These birds are also wandering more widely at all times of year. Orford Ness birds seem to be much more tied to a Continental pattern of movements, with birds regularly resighted across the North Sea.

## 4 DISCUSSION

Although several studies have been conducted on English Lesser Black-backed Gulls over a number of decades, it is clear that many knowledge gaps remain, and these hamper our understanding of how best to manage this species. This lack of understanding is well illustrated by the apparent contradiction between this species' position on the *Birds of Conservation Concern Amber List* (Eaton *et al.* 2009), and its appearance on three General Licences issued in accordance with the WCA 1981, allowing lethal control, although this is currently under review by Natural England.

One of the most important knowledge gaps relates to how breeding Lesser Black-backed Gulls move between colonies. Until these movements are properly understood, it is difficult to ascertain whether decreases in breeding numbers at particular sites translate into species-level population declines, or whether the overall breeding population is stable but simply dispersing elsewhere (both within England and abroad). The review of the literature carried out for this report revealed instances where colonies have rapidly become established and grown to several thousand pairs, only to decline again just as rapidly, sometimes in the space of just a few decades (e.g. Orford Ness (Piotrowski 2003, M Marsh *personal communication*) and Foulshaw Moss (Greenhalgh *et al.* 1974)).

These population fluctuations cannot be explained by breeding success and adult survival alone (Brown 1967, O'Connell 1995, Sellers & Shackleton 2011), and therefore must be influenced by immigration and emigration of adults (both recruits and established breeders) during population growth and decline respectively. Indeed, ringing data from the formerly large colony at Orford Ness show birds ringed there have subsequently been found breeding in several colonies, some of which are relatively close to Orford Ness (e.g. Felixstowe, Ipswich and Lowestoft), but others are further afield, including Norwich, Greater London, Gloucester, Swindon and Worcester, as well as Rotterdam and Zeebrugge (M Marsh *personal communication*). This report has shown that immature birds migrate further from their colony than older birds. This may be part of the mechanism for between colony movement.

This report has shown, however, that Lesser Black-backed Gulls breeding in the east and west of England may belong to different meta-populations and this might influence the number and distance of movements likely to occur. Taken together, these strands of evidence suggest that while Lesser Black-backed Gulls might generally be faithful to their nest site and partner once they recruit, they are also quite sensitive to prevailing conditions and are adaptable, so they may move to a 'better' site. The degree to which they survive such moves and breed successfully is not known and needs to be established.

The extent to which these movements are influenced by disturbance is not fully known, but an understanding of this is essential for policy makers to decide which colonies should be the focus of protection or control. Reports have indicated that perturbations during the breeding season, whether these be due to "natural" causes, such as mammalian predation, or human-induced, for example culling, can prompt individual birds to abandon a colony (e.g. O'Connell 1995, Davis 2013, Rock & Vaughan 2013). However, perhaps breeding Lesser Black-backed Gulls continually scout for information on more suitable colonies, even if the one they currently nest at is relatively successful. It would be useful to characterise the conditions under which breeding adults decide to move colonies, how, when and where they gather information on alternative colonies, and where exactly they are moving from and to at any one time. For example, some shifts in breeding location might be pre-dated by movements

outside the breeding period, during which birds might prospect for better sites. Such movements could be monitored to aid our understanding of this process.

There is evidence that once colonies reach a certain size, density dependent effects such as increased levels of intraspecific predation act to curb further population growth (e.g. Davis & Dunn 1976), so perhaps control is neither necessary nor effective in some areas. However, given that Lesser Black-backed Gulls prey upon other species of conservation concern (Wanless *et al.* 1996), or can alter the delicate ecology of some areas through their presence (Ross-Smith 2009), and that they are perceived as a nuisance and a possible threat to public health in urban areas (e.g. Ferns & Mudge 2000, Rock 2005), further research into the effects of control and optimal measures is needed. In addition, control measures in the northwest of England appear to have contributed to the pattern of movements in that area reported here (e.g. Davis 2013) and may have important implications for the efficacy/effect of that policy (below). Culled sites may become both source and sink populations with both emigration and immigration taking place (O'Connell 1995), such that the effects of control need to be carefully monitored and the measures implemented must be appropriate not only for the colony concerned, but also in light of breeding Lesser Black-backed Gull populations in the vicinity.

It is also important to ascertain where new recruits are choosing to breed. Lesser Black-backed Gulls are thought to be philopatric (O'Connell 1995, Rock & Vaughan 2013), but ring-recoveries and observations have shown that they will recruit to different colonies (Section 3.2, O'Connell 1995, Wanless *et al.* 1996, M Marsh & K Camphuysen *personal communication*). Recruitment to different (and perhaps newly-established) colonies could be a result of lack of available nesting sites at birds' natal colonies. If this is the case, control measures that provoke emigration of established breeders could simply free up nest sites for recruits, reducing the efficacy of the control (e.g. O'Connell 1995, Wanless *et al.* 1996). In colonies with culling, birds will recruit to the population at an earlier age than normal (P Monaghan *personal communication*), and a study at Bowland Fells found that the disturbance caused by culling prompted both immigration and emigration of breeding adults, but that the immigrants outnumbered the emigrants by an estimated 2.3 to 1 (O'Connell 1995).

Further research could also be undertaken into the factors influencing English wintering populations of Lesser Black-backed Gulls as fewer birds are apparently now migrating out of the country (Wernham *et al.* 2002). Adult birds clearly exhibit flexibility in their choice of breeding sites, but are they also able to change their wintering locations in response to prevailing conditions? Recent tagging work at Orford Ness has indicated that adult Lesser Black-backed Gulls behave the same way each winter, regardless of conditions. Individuals that migrate out of England (and the UK) do so at the same time and following the same route each year, whereas those that remain in England disperse to the same wintering sites year on year (Thaxter *et al.* 2013). Does this mean that the increase in English wintering populations is due to birds that never migrate, and if so, is this tendency increasing? Or does an individual's migratory tendency become fixed over the first years of its life, and if so, under what conditions might an individual that has explored alternative wintering destinations decide to remain in England? Recent studies have indicated age-related changes to migration (e.g. Jorge *et al.* 2011), so this latter mechanism might be operating. It would also be interesting to compare the movements of Lesser Black-backed Gulls from this eastern colony with those from colonies in the west of the country, and this will start to be addressed by BTO work tracking these gulls in 2014.

More information on the movements of Lesser Black-backed Gulls could be gleaned from colour-marking studies. Although much of these data are held in the BTO database, much is also held by the individual ringers carrying out the work, in particular the more local movements which were not formerly added to the BTO database. These data would need to be obtained from the individuals who hold them. This would also add to our knowledge of immigration and emigration from colonies.

Studies have shown that the survival rate of adult Lesser Black-backed Gulls is high – around 90%. However, there have been no comparisons between areas of the country. This could be carried out using BTO recovery data along with ringing data to provide cohort size. The ringing data for this species have been computerised, but require cleaning before these analyses can take place. This would allow the creation of demographic models for different areas to further understand the differences between colonies and regions.

It is also important to find out whether birds that remain in England for winter have different levels of breeding success and/or survival to those that migrate, because if (as the literature suggests) Lesser Black-backed Gulls are becoming less migratory, this could have big implications for English breeding populations. It would also be interesting to find out whether England (and the UK) is becoming a more common wintering destination for Lesser Black-backed Gulls from elsewhere in Europe, and the extent to which these birds begin to breed in England, as this would also influence breeding numbers. Ringing information has shown birds hatched in the Netherlands breeding in England (K Camphuysen *personal communication*), but did they winter here first? This could be addressed by comparing movements over time and over a wide geographical area using ring- recoveries generated by schemes across Europe.

Differences between the ecology and movements of Lesser Black-backed Gulls breeding in eastern and western, urban and rural and declining and increasing colonies should be studied to further understand population changes. This report and other work suggests that the birds breeding in the east and west of England might be from different meta-populations, with eastern birds being part of the same meta-population as those from the Netherlands (K Camphuysen & J Shamoun-Baranes *personal communication*), although ringing data show that birds from colonies in eastern England do breed in the west (M Marsh *personal communication*). Similarly, urban and rural Lesser Black-backed Gulls could form distinct populations (P Rock *personal communication*), with some literature suggesting an urban meta-population for the Severn Estuary region, spanning England and Wales (Rock 2005, Rock & Vaughan 2013). This report suggests a difference between the west and east of England both in migratory and foraging movements, although there appear to be some differences between the northwest and southwest. Detailed studies of movements of birds from geographically separate colonies encompassing a range of habitats, both in the breeding and non-breeding season, using tracking devices, such as that at Orford Ness (Thaxter *et al.* 2013) and those planned by BTO for 2014, should be undertaken. In conjunction, in depth studies of the ecology of these colonies (including rural and urban) should be carried out, looking at timing of breeding, productivity, diet *etc* to provide information to inform future conservation action.

Research could be carried out to ascertain whether the apparent geographic split we are seeing between eastern and western colonies of English Lesser Black-backed Gulls has a genetic basis. This would also improve our understanding of the relationship between

*intermedius* and *graellsii* and the extent of mixing between subspecies, and how this varies across the country. Ringing data do show birds that have hatched in England, and are presumably *graellsii*, breeding in continental Europe (M Marsh *personal communication*), and vice versa (*intermedius* breeding in England) (K Camphuysen *personal communication*).

At this wider geographic scale, it is also important to elucidate the extent to which English Lesser Black-backed Gull population fluctuations could be buffered or otherwise affected by population trends elsewhere. Recent work incorporating data from Norway, Sweden, Denmark, Germany, the Netherlands, Belgium and the UK, shows an upward trend for breeding Lesser Black-backed Gulls for these countries combined (ICES 2011). These data do not split Lesser Black-backed Gull by subspecies, and the number and nature of sites (e.g. urban/rural) reported from each country is not specified. However, they do show how the apparent declines in the English breeding population described in this report could be offset by increases elsewhere. For example, the breeding population in the Netherlands rose through much of the Twentieth Century, as it did in England, but this increase continued for longer, with numbers peaking in about 2005 (Camphuysen 2013). Although these Dutch Lesser Black-backed Gulls are likely to be primarily of the *intermedius* subspecies, it is possible that birds from eastern England have recruited or relocated into this breeding population, as demonstrated by ringing data, contributing to what would be reported as increases in the Netherlands and declines in England, but amounting to no overall loss in numbers at the species level.

All monitoring and research must take into account the adaptability and omnivory of the Lesser Black-backed Gull. This species' ability to breed successfully at new sites, which entails discovering and exploiting new food sources, indicates that both as individuals and at a species level, Lesser Black-backed Gulls are flexible in their behaviour and able to modify their ecological niche. This suggests they should be relatively resilient to environmental change. Monitoring therefore has to be regular and capture rapid population movements and their drivers in both urban and rural environments.

The adaptability of the species should also be considered in any plans for future control of the species and concerns about developments which might affect it. Local factors such as predation levels, colony density *etc* will change the effect of control and should be taken into account when control is suggested. For example, although culling apparently worked effectively at the Bowland Fells colony, in a different colony with a higher density of breeding birds, culling may simply allow young birds to recruit to that breeding population earlier and so may maintain, but not reduce colony size. This may be particularly relevant to urban colonies where there is public pressure for control.

One main way in which the Lesser Black-backed Gulls' conservation status could be clarified would be through better monitoring at all breeding colonies, including both counts of pairs and nests, and assessment of productivity. This species' place on the Amber List is confusing to some, especially when it is apparently thriving in urban areas. The Seabird Monitoring Programme currently assesses Lesser Black-backed Gull productivity at only a few English sites (Figure 6), which do not include the Isles of Scilly SPA or any urban colonies (JNCC 2012). Moreover, the data collected only cover a small number of years (late-2000s onwards), and years have been missed even at sites where monitoring does take place (JNCC 2012).

We recommend more extensive annual monitoring in the breeding season, including both nest counts and measures of productivity, at a broader range of colonies, with full coverage

every 10 years. This monitoring should take place at every protected site for which Lesser Black-backed Gull is a qualifying feature, and should cover representative urban colonies (for instance large, well-established colonies in big cities such as Bristol, and smaller colonies in towns and cities of various sizes, for instance London and Chippenham), as the smaller, more-recent colonies may well show different population trends. The latest English population estimates for the Lesser Black-backed Gull are taken from Seabird 2000 (Mitchell *et al.* 2004), which included a relatively small number of urban sites (Rock 2005). To fully understand population change in Lesser Black-backed Gulls it is vital that decadal monitoring takes urban areas into account to try to understand their contribution to the numbers of breeding Lesser Black-backed Gulls in England and the rest of the British Isles. It is also essential to understand the ecological differences between urban and rural colonies and the implications of these. If monitoring is undertaken, the extent to which urban population growth is compensating for declines at more “traditional”, rural colonies will be better understood, and conservation and control measures can be devised and targeted accordingly.



## **5 RECOMMENDATIONS**

To further understand the ecology and movements of Lesser Black-backed Gulls and therefore allow a conservation strategy to be established, we recommend:

### **1 Monitoring**

- The regular counts of seabird colonies be extended to more fully cover urban-breeding gulls.
- A full count of urban-breeding gulls should be carried out urgently.
- Regular monitoring should include wider collection of productivity data.

### **2 Analysis of existing data sets**

- Movements should be studied further to try to understand more clearly the relationship between colonies and the geographic scale on which populations operate, both within England, and in the wider context, and how this might be changing (including comparison of types of colony - urban/rural, declining/increasing) by:
  - Analysing movement data across Britain & Ireland to look for movements into/out of England.
  - Analysing movement data on a European scale covering the sub-species occurring in Europe using data available from the EURING databank.
  - Analysing winter movement data to understand where birds from different colonies winter and to investigate the mechanism behind the population changes taking place in wintering area (northwards movement of wintering area).
  - Collecting and analysing data collected from resightings of colour-marked birds. Some of these data (particularly for short-distance <40 km movements) are only held by individual ringers who have organised the projects.
  - Carrying out more tracking studies using e.g. GPS tags (e.g. Thaxter *et al.* 2013) and collating the results from those in progress (BTO will be carrying out studies on several sites, including Walney, in 2014) (see also below).
- Survival rates over time and geographically should be analysed to understand their contribution to population change, using BTO recoveries. Ringing data have been computerised, but require cleaning to allow this work. This would allow the production of population models, despite some data not being available.

### **3 New research**

- Comparisons of the ecology between geographic areas and types of colony (urban/rural, declining/increasing) should be carried out to help to further understand the potential effects and effectiveness of culling.
- Genetic studies should be carried out to further inform the relationships between colonies and areas and this should be put into the wider context of all sub-species of Lesser Black-backed Gull.
- Further detailed tracking studies.

To underpin the suggested work, consideration of what constitutes favourable conservation status for this species should be undertaken to inform a conservation strategy and allow future decisions about forms of control at particular sites to be placed in a wider context.

## 6 REFERENCES

- Baker, R.R. 1980. The significance of the Lesser Black-backed Gull to models of bird migration. *Bird Study* **27**, 41-50.
- Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. & Fuller, R.J. 2013. *Bird Atlas 2007-11: the breeding and wintering birds of Britain and Ireland*. BTO Books, Thetford.
- Banks, A.N., Burton, N.H.K., Calladine, J.R. & Austin, G.E. 2009. Indexing winter gull numbers in Great Britain using data from the 1953 to 2004 Winter Gull Roost Surveys. *Bird Study* **56**, 103-109.
- Barnes, J.A.G. 1952. The status of the Lesser Black-backed Gull. *British Birds* **45**, 3-17.
- Barnes, J.A.G. 1953. The migrations of the Lesser Black-backed Gull. *British Birds* **46**, 238-251.
- Barnes, J.A.G. 1961. The winter status of the Lesser Black-backed Gull, 1959–60. *Bird Study* **8**, 127-147.
- BirdLife International. 2014. Species factsheet: *Larus fuscus*. Downloaded from <http://birdlife.org> on 06/01/2014
- Bivand, R. & Lewin-Koh, N. 2014. Maptools: Tools for reading and handling spatial objects. R package version 0.8-29. <http://CRAN.R-project.org/package=maptools>
- Boertmann, D. 2008. The Lesser Black-backed Gull, *Larus fuscus*, in Greenland. *Arctic* **61**, 129-133.
- Bolton, M., Houston, D. & Monaghan, P. 1992. Nutritional constraints on egg formation in the lesser black-backed gull: an experimental study. *Journal of Animal Ecology* **61**, 521-532.
- British Ornithologists' Union (BOU). 2013. The British List: a checklist of birds of Britain. 8th ed. *Ibis* **155**, 635–676.
- Brown, R.G.B. 1967. Breeding success and population growth in a colony of Herring and Lesser Back-backed Gulls *Larus argentatus* and *L. fuscus*. *Ibis* **109**, 502-515.
- Brownrigg, R. 2013. mapdata: Extra Map Databases. R package version 2.2-2. <http://CRAN.R-project.org/package=mapdata>
- Bukacinski, D., Bukacinska, M. & Spaans, A. L. 1998. Experimental evidence for the relationship between food supply, parental effort and chick survival in the Lesser Black-backed Gull *Larus fuscus*. *Ibis* **140**, 422-430.
- Burton, N.H.K., Musgrove, A.J., Rehfish, M.M., Sutcliffe, A. & Waters, R. 2003. Numbers of wintering gulls in the United Kingdom, Channel Islands and Isle of Man: a review of the 1993 and previous Winter Gull Roost Surveys. *British Birds* **96**, 376-401.
- Burton, N.H.K., Banks, A.N., Calladine, J.R. & Austin, G.E. 2013. The importance of the United Kingdom for wintering gulls: population estimates and conservation requirements. *Bird Study* **60**, 87-101.
- Bustnes, J.O., Moe, B., Helberg, M., Phillips, R.A. 2013. Rapid long-distance migration in Norwegian Lesser Black-backed Gulls *Larus fuscus fuscus* along their eastern flyway. *Ibis* **155**, 402–406
- Cadiou, B. & Guyot, G. 2012. *Bilan des recensements des colonies urbaines de goélands du Finistère sud en 2012*. Bretagne-Vivante report.
- Calladine, J. & Harris, M.P. 1997. Intermittent breeding in the Herring Gull *Larus argentatus* and the Lesser Black-backed Gull *Larus fuscus*. *Ibis*, **139**, 259-263.
- Camphuysen, C.J. 1995. Herring Gull *Larus argentatus* and Lesser Black-backed Gull *L. fuscus* feeding at fishing vessels in the breeding season: competitive scavenging versus efficient flying. *Ardea* **83**, 365-380.
- Camphuysen, C.J. de Boer, P., Bouten, W., Gronert, A. & Shamoun-Baranes, J. 2010. Mammalian prey in Laridae: increased predation pressure on mammal populations expected. *Lutra* **53**, 5-20.

- Camphuysen, C.J. & Gronert, A. 2012. Apparent survival and fecundity of sympatric Lesser Black-backed Gulls and Herring Gulls with contrasting population trends. *Ardea* **100**, 113-122.
- Camphuysen, C.J. 2013. A historical ecology of two closely related gull species (Laridae): multiple adaptations to a man-made environment. Ph.D. thesis, University of Groningen, Groningen.
- Carter, I. 2011. *The potential impacts of licensed control of large gulls in England on conservation status and Special Protection Areas (SPAs)*. Natural England document.
- Collinson, J.M., Parkin, D.T., Knox, A.G., Sangster, G. & Svensson, L. 2008. Species boundaries in the Herring and Lesser Black-backed Gull complex. *British Birds*, **101**, 340-363.
- Cook, A.S.C.P., Dadam, D., Mitchell, I., Ross-Smith, V.H., & Robinson, R.A. 2014. Indicators of seabird reproductive performance demonstrate the impact of commercial fisheries on seabird populations in the North Sea. *Ecological Indicators* **38**, 1-11.
- Coulson, J.C. & Coulson, B.A. 2008. Lesser Black-backed Gulls *Larus fuscus* nesting in an inland urban colony: the importance of earthworms (Lumbricidae) in their diet. *Bird Study* **55**, 297-303.
- Coyle, S.P. 2012. *The Tarnbrook Fell Gullery Report 2012 and Langden Head Gullery Report 2012*. Unpublished Natural England report.
- Cramp, S. & Simmons, K.E.L. (Eds.) 1983. *The birds of the Western Palearctic. Vol. III*. Oxford University Press, Oxford.
- Davis, J.W.F. 1973. Aspects of the breeding ecology and feeding of certain gulls. Ph.D. thesis, University of Oxford, Oxford.
- Davis, J.W.F. & Dunn, E.K. 1976. Intraspecific predation and colonial breeding in Lesser Black-Backed Gulls *Larus fuscus*. *Ibis* **118**, 65-77.
- Davis, S. 2013. *Large gull research 2012: Population trend and productivity of large gull colonies in relation to mammalian predator presence across northern England and Wales*. RSPB report.
- du Feu, C.R., Clark, J.A., Fiedler, W. and Baillie, S.R. 2012. EURING Exchange Code 2000 v115 (based on Speek, G., Clark, J.A., Rohde, Z., Wassenaar, R.D. & Van Noordwijk, A.J. 2000. EURING Exchange Code 2000)
- Eaton, M.A., Brown, A.F., Noble, D.G., Musgrove, A.J., Hearn, R.D., Aebischer, N.J., Gibbons, D.W., Evans, A. & Gregory, R.D. 2009. Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. *British Birds* **102**, 296-341.
- Ferns, P.N. & Mudge, G.P. 2000. Abundance, diet and *Salmonella* contamination of gulls feeding at sewage outfalls. *Water Research*, **34**, 2653-2660.
- Furness, R.W., Ensor, K. & Hudson, A.V. 1992. The use of fishery waste by gull populations around the British Isles. *Ardea* **80**, 105-113.
- Greenhalgh, M.E., Elkins, N., Williams, M.R., Soilleki, M., Eades R.A. & Mould, J.E.M. 1974. The Pennine gullery. *Bird Study* **21**, 146-158.
- Greig, S.A., Coulson, J.C. & Monaghan, P. 1986. A comparison of foraging at refuse tips by three species of gull (Laridae). *Journal of Zoology* **210**, 459-472.
- Hallgrimsson, G.T., Gunnarsson, H.V., Torfason, O., Buijs, R.-J., Camphuysen, C.J. 2012. Migration pattern of Icelandic Lesser Black-backed Gulls *Larus fuscus graellsii*: indications of a leap-frog system. *Journal of Ornithology* **153**, 603-609.
- Hario, M. 1994. Reproductive performance of the nominate Lesser Black-backed Gull under the pressure of Herring Gull predation. *Ornis Fennica* **71**, 1-10.
- Hario, M., Hirvi, J.P., Hollmen, T. & Rudbäck, E. 2004. Organochlorine concentrations in diseased vs. healthy gull chicks from the northern Baltic. *Environmental Pollution* **127**, 411-423.

- Hario, M. & Nuutinen, J.M.J. 2011. Varying chick mortality in an organochlorine- “strained” population of the nominate Lesser Black-backed Gull *Larus f. fuscus* in the Baltic Sea. *Ornis Fennica* **88**, 1-13.
- Harris, M.P. 1964. Aspects of the breeding biology of the gulls *Larus argentatus*, *L. fuscus* and *L. marinus*. *Ibis* **106**, 432-456.
- Harris, M.P. 1965. The food of some *Larus* gulls. *Ibis* **107**, 43-53.
- Horton, N., Brough, T. & Rochard, J.B.A. 1983. The importance of refuse tips to gulls wintering in an inland Area of south-east England. *Journal of Applied Ecology* **20**, 751-765.
- Hosey, G.R. & Goodridge, F. 1980. Establishment of territories in two species of gull on Walney Island, Cumbria. *Bird Study* **27**, 73-80.
- ICES. 2011. *Report of the Working Group on Seabird Ecology (WGSE), 1–4 November 2011, Madeira, Portugal*. ICES CM 2011/SSGEF:07. 87 pp.
- JNCC. 2012. *Seabird population Trends and Causes of Change: 2012 Report*. <http://jncc.defra.gov.uk>.
- Jorge, P.E., Sowter, D. & Marques, P.A.M. 2011. Differential annual movement patterns in a migratory species: effects of experience and sexual maturation. *PLoS ONE* **6**, e22433.
- Kim, S.Y. & Monaghan, P. 2005. Interacting effects of nest shelter and breeder quality on behaviour and breeding performance of herring gulls. *Animal Behaviour* **69**, 301-306.
- Kim, S.Y. & Monaghan, P. 2006. Interspecific differences in foraging preferences, breeding performance and demography in herring (*Larus argentatus*) and lesser black-backed gulls (*Larus fuscus*) at a mixed colony. *Journal of Zoology* **270**, 664-671.
- Klaassen, R.H.G., Ens, B.J., Shamoun-Baranes, J., Exo, K.-M. & Bairlein, F. 2012. Migration strategy of a flight generalist, the Lesser Black-backed Gull *Larus fuscus*. *Behavioral Ecology* **23**, 58–68
- Kylin, H. Louette, M. Herroelen, P. & Bouwman, H. 2010 Nominate Lesser Black-backed Gulls (*Larus fuscus fuscus*) winter in the Congo basin. *Ornis Fennica* **87**, 106-113.
- Kylin, H., Bouwman, H., & Louette, M. 2011. Distributions of the subspecies of Lesser Black-backed Gulls *Larus fuscus* in sub-Saharan Africa. *Bird Study* **58**, 186-192.
- Lemon, J. 2006. Plotrix: a package in the red light district of R. *R-News* **6**, 8-12.
- Liebers, D. & Helbig, A. J. 2002. Phylogeography and colonization history of Lesser Black-backed Gulls (*Larus fuscus*) as revealed by mtDNA sequences. *Journal of Evolutionary Biology*, **15**, 1021-1033.
- Luczak, C., Beaugrand, G., Lindley, J.A., Dewarumez, J.-M., Dubois, P.J. & Kirby, R.R. 2012. North Sea ecosystem change from swimming crabs to seagulls. *Biology Letters* **8**, 821–824
- MacRoberts, M.H. & MacRoberts, B.R. 1972. The relationship between laying date and incubation period in Herring and Lesser Black-backed Gulls. *Ibis* **114**, 93-97.
- Marques, P.A.M., Sowter, D. & Jorge, P.E. 2010. Gulls can change their migratory behavior during lifetime *Oikos* **119**, 946–951.
- Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E. 2004. *Seabird populations of Britain and Ireland. Results of Seabird 2000 (census 1998 – 2002)*. T. & A. D. Poyser, London.
- Monaghan, P. & Coulson, J. C. 1977. Status of large gulls nesting on buildings. *Bird Study* **24**, 89-104.
- Mortimer, K., Rowson, R., Mackie, A.S.Y., Clark, P.F., Maslen, C., Smith, A.S. & Harrowe, C. 2012. Steep Holm Island, Bristol Channel, UK: evidence of *Larus fuscus* Linnaeus, 1758 (Lesser Black-backed Gull) feeding on the invasive Signal Crayfish, *Pacifastacus leniusculus* Dana, 1852. *BiolInvasions Records* **1**, 201-208.
- Mudge, G.P. 1978. Ecological studies of Herring Gulls (*Larus argentatus* Pont.) and other Larini, in an urban environment. Ph.D. thesis, University of Wales, Cardiff.

- Mudge, G.P. & Ferns, P.N. 1982. The feeding ecology of five species of gulls (Aves: Larini) in the inner Bristol Channel. *Journal of Zoology* **197**, 497-510.
- O'Connell, M.J. 1995. An ecological approach to the management of gulls, in particular the Lesser Black-backed Gull *Larus fuscus* (L. 1758). Ph.D. thesis, Durham University, Durham.
- O'Connell, M.J., Coulson, J.C., Raven, S. & Joyce, S. 1997. Nonbreeding and nests without eggs in the Lesser Black-backed Gull *Larus fuscus*. *Ibis* **139**, 252-258.
- Olsen, K.M. & Larsson, H. 2004. *Gulls of North America, Europe and Asia*. Princeton University Press, Princeton.
- Oro, D. 1996. Effects of trawler discard availability on egg laying and breeding success in the lesser black-backed gull *Larus fuscus* in the western Mediterranean. *Marine Ecology Progress Series* **132**, 43-46.
- Parslow, J.L.F. 1967. Changes in status among breeding birds in Britain & Ireland: part 3. *British Birds* **60**, 177-202.
- Perrins, C.M., & Smith, S.B. 2000. The breeding *Larus* gulls on Skomer Island National Nature Reserve, Pembrokeshire. *Atlantic Seabirds* **2**, 195-210.
- Piotrowski, S. 2003. *The Birds of Suffolk*. Christopher Helm, London.
- R Core Team. 2013. *R: a language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna.
- Raven, S.J. & Coulson, J.C. 1997. The distribution and abundance of *Larus* gulls nesting on buildings in Britain and Ireland. *Bird Study* **44**, 13-34.
- Raven, S.J. & Coulson, J.C. 2001. Effects of cleaning a tidal river of sewage on gull numbers: a before and-after study of the River Tyne, northeast England. *Bird Study* **48**, 48-58.
- Robinson, R.A. & Clark, J.A. 2013. The Online Ringing Report: Bird ringing in Britain & Ireland in 2012 BTO, Thetford (<http://www.bto.org/ringing-report>, created on 15-August-2013)
- Rock, P. 2005. Urban gulls: problems and solutions. *British Birds* **98**, 338-355.
- Rock, P. & Vaughan, I.P. 2013. Long-term estimates of adult survival rates of urban Herring Gulls *Larus argentatus* and Lesser Black-backed Gulls *Larus fuscus*. *Ringling & Migration* **28**, 21-29.
- Ross-Smith, V.H. 2009. Pecking response in Lesser Black-backed Gull chicks *Larus fuscus*. Ph.D. thesis, Cardiff University, Cardiff.
- Ross-Smith, V.H., Conway, G.J., Facey, R.J., Bailey, B.H., Lipton, M., Whitfield, S.A. & Ferns, P.J. 2013. Population size, ecology and movements of gulls breeding on Flat Holm Island. *Birds in Wales* **10**, 7-21.
- Sangster, G., Hazevoet, C.J., van den Berg, A.B. 1999 Dutch avifaunal list: Species concepts, taxonomic instability, and taxonomic changes in 1977-1998. *Ardea* **87**, 139-166.
- Sellers, R.M. & Shackleton, D. 2011. Numbers, distribution and population trends of large gulls breeding in Cumbria, northwest England. *Seabird* **24**, 90-102.
- Snow, D.W. & Perrins, C.M. 1998. *The Birds of the Western Palearctic. Concise Edition*. Oxford University press, Oxford.
- Stanworth, A.J. 1998. Egg production and diet in the Lesser Black-backed Gull. Ph.D. thesis, University of Wales, Cardiff.
- Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, P., McLean, I., Baker, H. & Whitehead, S. (eds). 2001. The UK SPA network: its scope and contents. JNCC, Peterborough.
- Thaxter, C.B., Ross-Smith, V.H., Clark, N.A., Conway, G.J., Rehfish, M.M., Bouten, W. & Burton, N.H.K. 2011. *Measuring the interaction between marine features of Special Protection Areas with offshore wind farm development zones through telemetry: first breeding season report*. BTO Research Report No. 590. Thetford, Norfolk.

- Thaxter, C.B., Ross-Smith, V.H., Clark, N.A., Conway, G.J., Wade, H., Masden, E.A., Rehfisch, M.M., Bouten, W. & Burton, N.H.K. 2012. *Measuring the interaction between marine features of Special Protection Areas with offshore wind farm development zones through telemetry: second year report*. BTO Research Report No. 610. Thetford, Norfolk.
- Tinbergen, N. 1953. *The Herring Gull's world: a study of the social behaviour of birds*. Collins Clear-Type Press, London.
- Tinbergen, N. 1959. Comparative studies of the behaviour of gulls (Laridae): a progress report. *Behaviour* **15**, 1-69.
- Verbeek, N.A.M. 1977. Comparative feeding ecology of Herring Gulls *Larus argentatus* and Lesser Black-backed Gulls *Larus fuscus*. *Ardea* **65**, 25-42.
- Wanless, S. & Langslow, D.R. 1983. The effects of culling on the Abbeystead and Mallowdale gullery. *Bird Study* **30**, 17-23.
- Wanless, S., Harris, M.P., Calladine, J. & Rothery, P. 1996. Modelling responses of Herring Gull and Lesser Black-backed Gull populations to reduction of reproductive output: implications for control measures. *Journal of Applied Ecology* **33**, 1420-1432.
- Wernham, C.V., Toms M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. & Baillie, S.R. (eds). 2002. *The Migration Atlas: movements of the birds of Britain and Ireland*. T. & A.D. Poyser, London.
- Wetlands International. 2014. *Waterbird Population Estimates*. <http://wpe.wetlands.org>.



## **7 ACKNOWLEDGEMENTS**

This report would not have been possible without the work of many ringers, particularly Mike Marsh, Peter Rock, and David Sowter, who generated much of the recovery data on which the analyses are based. Peter and Mike were additionally on hand to give extra information and advice when needed. Helpful information was also provided by Kees Camphuysen and Bernard Cadiou. Thanks also to BTO colleagues Niall Burton and Aonghais Cook for their valuable input, Jane Waters and Sandra Sparkes for formatting the report and Penny Mitchell for all her work on the tender document. Finally, Alex Banks, Chris Gibson and Tim Frayling at Natural England provided many helpful comments at all stages of this work.

The BTO Ringing Scheme is funded by a partnership of the British Trust for Ornithology, the Joint Nature Conservation Committee (on behalf of: Natural England, Natural Resources Wales and Scottish Natural Heritage and the Department of the Environment Northern Ireland), The National Parks and Wildlife Service (Ireland) and the ringers themselves.