# The Lesser Black-backed Gull *Larus fuscus* in England: how to resolve a conservation conundrum

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## Abstract

Lesser Black-backed Gull *Larus fuscus* 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 decline in breeding birds between 2000 and 2013 (largely because of losses at the same key colonies) and this species is on the *Birds of Conservation Concern* Amber List. Although protected at various sites in the breeding season, the Lesser Black-backed Gull can be taken under three General Licences issued under the Wildlife and Countryside Act 1981, allowing population control in certain circumstances without specific permission or reporting. There are no sites where the Lesser Black-backed Gull is a protected feature outside the breeding season, although numbers surpass the relevant thresholds at certain roosts. This review paper synthesises available information on the Lesser Black-backed Gull in England to help policy makers resolve this apparent legislative contradiction and formulate a clearer conservation policy to guide future practice.

## Introduction

The Lesser Black-backed Gull *Larus fuscus* is traditionally considered to breed around the coasts of northern and western Europe, and winter in southern Europe and northern to central Africa (Cramp & Simmons 1983; Malling Olsen & Larsson 2004). During the twentieth century, this species expanded its breeding and wintering range, moving into new countries and continents (Cramp & Simmons 1983; Malling Olsen & Larsson 2004; Boertmann 2008), and increasingly took advantage of new habitats, including inland and urban areas (e.g. Balmer *et al*. 2013). It is a dietary generalist and is able to subsist off anthropogenic food sources, which, combined with its reputation for being aggressive, noisy and a potential public health hazard, particularly in urban areas, has brought it into conflict with man in various parts of its range, including the UK (Rock 2005), France (Cadiou & Guyot 2012) and the Netherlands (Camphuysen 2013). This conflict has been exacerbated not only by range expansion, but also by an increase in numbers. The global Lesser Black-backed Gull population rose sharply in the twentieth century, although in several areas this trend has since levelled off or reversed


**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 Special Protection Areas (SPAs) are underpinned by several component Sites of Special Scientific Interest. Bowland Fells is currently a potential SPA.

(Wetlands International 2014), and range expansion inland and into urban areas has been accompanied by range contraction at traditional coastal sites, leading to the loss of some formerly important breeding colonies (Camphuysen *et al*. 2010; Balmer *et al*. 2013). The UK is home to 38% of the global breeding population of Lesser Black-backed Gulls and nearly 60% of these birds are found in England (Calladine 2004). England also has an increasing wintering population (Burton *et al*. 2013). As in other countries, the number of Lesser Black-backed Gulls in England rose steeply in the latter half of the twentieth century (Calladine 2004), during which time lethal control of the species began.

In England, the Lesser Black-backed Gull is protected by a suite of national and international legislation, including the Birds Directive 2009 (2009/147/EC) which is transposed into UK law by the Wildlife and Countryside Act 1981 (as amended; WCA 1981) and makes it an offence to kill or injure this species, and destroy its eggs or nests. Lesser Black-backed Gulls are fully protected where they are a notified feature of a Site of Special Scientific Interest (SSSI). They are also a qualifying feature of several Special Protection Areas (SPAs) that make up the European Union's Natura 2000 ecological network of protected sites (Stroud *et al*. 2001). This means that the Lesser Black-backed Gull must be considered in the consenting process for new developments close to its SPAs, for example offshore wind farms (Thaxter *et al*. 2011). Furthermore, it is a qualifying species for various English sites protected by the Ramsar Convention (Figure 1; Wetlands International 2014), while the monitoring of this and other seabird species contributes to the implementation of the European Marine Strategy Framework Directive (2008/56/EC; ICES 2013).

Despite these levels of protection, the Lesser Black-backed Gull can be controlled under three General Licences issued under the WCA 1981, which (consistent with the Birds Directive) allows the killing or taking of birds in certain circumstances, for example in the interests of public health and safety, if not on a protected site. General Licences do not require the user to apply for the licence or report action taken under the licence, e.g. numbers of birds/nests/eggs removed. This is designed to reduce bureaucracy for commonly undertaken activities that are considered to carry a low risk for the conservation or welfare of the species concerned (Natural England 2010). Until 2010, Herring Gulls *L. argentatus* and Great Black-backed Gulls *L. marinus* could also be controlled under a General Licence. These species are closely related to the Lesser Black-backed Gull with overlapping ecological requirements, particularly in the case of the Herring Gull (Collinson *et al*. 2008; Camphuysen 2013). They therefore frequently co-occur with Lesser Black-backed Gulls and are thought to pose similar risks to public health (Rock 2005; Camphuysen 2013). Both species were removed from General Licences because of conservation concerns (Natural England 2010).

The English-breeding Lesser Black-backed Gull population has fallen in recent years, especially at key colonies (Balmer *et al*. 2013; JNCC 2014). This species is also classed as 'Amber' in the most recent *Birds of Conservation Concern* list (Eaton *et al*. 2009). The status of Lesser Black-backed Gull therefore leads to some confusion and

concern, as it can currently be controlled without permission or reporting outside of protected sites, while it is also of conservation interest (at a similar level to species that cannot be controlled in the same way). In addition, although numbers at several winter roosts now surpass the thresholds determined by the Birds Directive (Burton *et al*. 2013), it is not protected outside the breeding season.

As part of a wider consultation on General and Class Licences in February 2014, Natural England proposed moving Lesser Black-backed Gull to a Class Licence, so that anyone wishing to control the species would have to register and report it. This consultation has been completed and is currently in review. This paper contributes to the consultation process, helping policymakers understand the current knowledge of Lesser Black-backed Gull population changes in England and their drivers, and informing future conservation and management measures in balancing the protection and control of the species.

**Classification and distribution:** The Lesser Black-backed Gull is polytypic, with clinal variation in the darkness of its mantle and in size across its breeding range (Cramp & Simmons 1983; Malling Olsen & Larsson 2004). There are currently thought to be three subspecies: *fuscus*, *intermedius* and *graellsii* (Collinson *et al*. 2008). *Graellsii* is generally considered to be the only one to breed in England, although there have been reports of birds ringed in the Netherlands breeding in England, which may be *intermedius* (K. Camphuysen pers. comm.). *Intermedius* regularly occur in England in autumn and winter, but there have been very few records of *fuscus* (BOU 2013). *Intermedius* and *graellsii* are morphologically and behaviourally more similar to one another than to *fuscus*, and some argue they should be a single subspecies (Sangster *et al*. 1999; Liebers & Helbig 2002). Therefore, literature about *intermedius* is used in this review.

**General ecology:** Lesser Black-backed Gulls typically arrive at their nesting sites between late February and early May, lay 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 hatched (Brown 1967; O'Connell 1995; Wanless *et al*. 1996; Rock 2005; Rock & Vaughan 2013) and, provided both members of a pair breed together successfully and survive, they normally return to the same partner at the same nest site each year (O'Connell 1995; Rock 2005; Rock & Vaughan 2013). However, colonies may 'export' individuals if suitable nesting habitat is not available, and birds apparently immigrate to successful colonies (Brown 1967; Greenhalgh *et al*. 1974; Monaghan & Coulson 1977).

Breeding generally starts 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). Sub-adults may visit 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; Calladine & Harris 1997; O'Connell *et al*. 1997; Camphuysen 2013), and a recent study from the Netherlands recorded some birds breeding every other year (Camphuysen 2013). With this cohort of non-breeding adults in addition to sub-adults, it is clear that non-breeding Lesser Black-backed Gulls are common across the breeding range (Balmer *et al*. 2013).

Lesser Black-backed Gulls that reach breeding age typically survive a further ten years, but some individuals can live much longer[1], and several studies have shown adult survival of more than 90% from one year to the next, both for colonies in England and elsewhere (Wanless *et al*. 1996; Camphuysen & Gronert 2012; Rock & Vaughan 2013; Ross-Smith *et al*. 2013). They normally nest colonially (Davis & Dunn 1976), and often in association with other gulls, commonly Herring Gulls (e.g. Tinbergen 1953; Harris 1964; Kim & Monaghan 2006; Camphuysen & Gronert 2012; Ross-Smith *et al*. 2013). At rural colonies Lesser Black-backed Gulls nest on slopes, cliffs and flat ground, although not sheer rock faces, while they often nest on rooftops in urban areas (Harris 1964; Monaghan & Coulson 1977; Ross-Smith *et al*. 2013).

Outside the breeding season, birds move away from colonies and a large part of the English population migrates to southwest Europe and northwest Africa for winter, although in recent decades some individuals have started to remain in England year round (Rock 2002). The habitats occupied in winter are also diverse, and include urban, rural inland and coastal areas (Burton *et al*. 2013).

The Lesser Black-backed Gull's ability to occupy such a wide range of habitats is linked to its generalised diet, which can include marine, terrestrial and freshwater invertebrates, fish, mammals, birds, plant matter and human refuse (Verbeek 1977; Mudge & Ferns 1982; Furness *et al*. 1992; O'Connell 1995; Stanworth 1998; Oro 1996; Kim & Monaghan 2006; Coulson & Coulson 2008; Camphuysen *et al*. 2010; Luczak *et al*. 2012; Mortimer *et al*. 2012). Non-anthropogenic foods can be obtained from foraging on the ground, aerial pursuit, plunge diving and kleptoparasitism around coasts, estuaries and inland (Harris 1965; Ferns 1992), while individuals will predate eggs and chicks of their own species and others at breeding colonies (Brown 1967). Birds both actively hunt and scavenge (Camphuysen *et al*. 2010). They routinely fly 40–80 km from breeding colonies to find food (Camphuysen *et al*. 2010), and can travel over 150 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 in England since the mid twentieth century, when sending waste to landfill tips became the norm, and the Clean Air

[1] 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 killed at Tarnbrook Fell (Bowland) in 2000 (Robinson & Clark 2014).

Act (1956) outlawed burning on site (Rock 2005). These tips have provided Lesser Black-backed Gulls with a predictable, plentiful and constant food supply (Greig *et al*. 1986). Other anthropogenic food sources used by this species include fishing discards at ports and at sea (Harris 1965; Furness *et al*. 1992; Camphuysen 1995; Oro 1996; Perrins & Smith 2000), and foods obtained from agricultural land (including by following ploughs), sewage plants and roadkill (Mudge & Ferns 1982; Oro 1996; Ferns & Mudge 2000; Perrins & Smith 2000; Raven & Coulson 2001; Coulson & Coulson 2008; Camphuysen *et al*. 2010).

### Population trend and its drivers

**Breeding season:** Breeding Lesser Black-backed Gulls in the UK have been counted in three national censuses, Operation Seafarer (1969–1970; Cramp *et al*. 1974), the Seabird Colony Register (1985–1988; Lloyd *et al*. 1991) and Seabird 2000 (1998–2002; Mitchell *et al*. 2004). These all covered 'traditional' coastal colonies, but only Seabird 2000 included a comprehensive survey of inland sites, and this survey also encompassed several urban areas (Calladine 2004). Due to their rooftop nesting habits, urban gulls are often difficult to monitor compared to those in rural locations (Monaghan & Coulson 1977), and as such, the numbers generated by Seabird 2000 for some urban areas might have been an underestimate (Rock 2005; JNCC 2014). Urban nesting sites were also surveyed in 1969, 1976 and 1994, but again numbers reported were likely to have been lower than those actually present (Cramp 1971; Monaghan & Coulson 1977; Raven & Coulson 1997).

Seabird 2000 found 111,960 apparently occupied nests (AON) of Lesser Black-backed Gulls in the UK (63% of the biogeographic breeding population of the *graellsii* subspecies; Calladine 2004)[2]. Of these, 64,208 bred in England, with over two-thirds nesting at only four colonies: South Walney, Cumbria (19,487 AON); Bowland Fells, Lancashire (18,518); Orford Ness, Suffolk (5,500) and the Isles of Scilly, Cornwall (3,603; Calladine 2004). The breeding population at each of these sites corresponded to more than 1% of the biogeographic population, and they (and in some cases, surrounding areas) were classified as SPAs[3] in the 1990s and 2000s[4]. Other sites designated as nationally important for breeding Lesser Black-backed Gulls are protected under the Ramsar Convention (Figure 1). 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, led to this species' 'Amber' status in the most recent *Birds of Conservation Concern* list (Eaton *et al*. 2009). Many of these colonies were established in the early to mid twentieth century and grew rapidly thereafter (e.g. Brown 1967; Greenhalgh *et al*. 1974).

[2] By definition, AON tallies do not properly account for the numbers of non-breeding birds present during the breeding season, including sub-adults prospecting at breeding colonies (e.g. Perrins & Smith 2000) and full adults that do not breed in particular years (e.g. Calladine & Harris 1997). Also, AON tallies may miss some breeding birds and therefore are not likely to correspond to 100% of the true breeding population (Walsh *et al*. 1995).

[3] Many of these SPAs are made up of several component SSSIs, for which Lesser Black-backed Gull is a qualifying species. For instance, South Walney SSSI is part of the Morecambe Bay SPA (Figure 1).

[4] Bowland Fells is currently a potential SPA (pSPA).

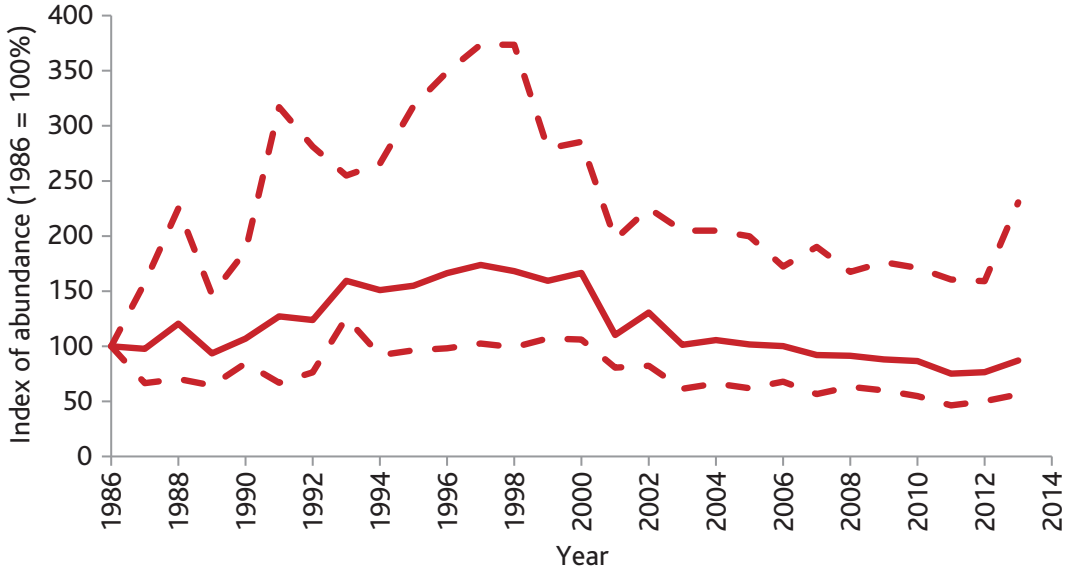


**Figure 2.** Population abundance index (solid line) and 95% CI (dashed lines) for breeding Lesser Black-backed Gulls *Larus fuscus* in the UK, 1986–2013 (JNCC 2014). Data are from both inland and coastal colonies, collected by the Seabird Monitoring Programme.

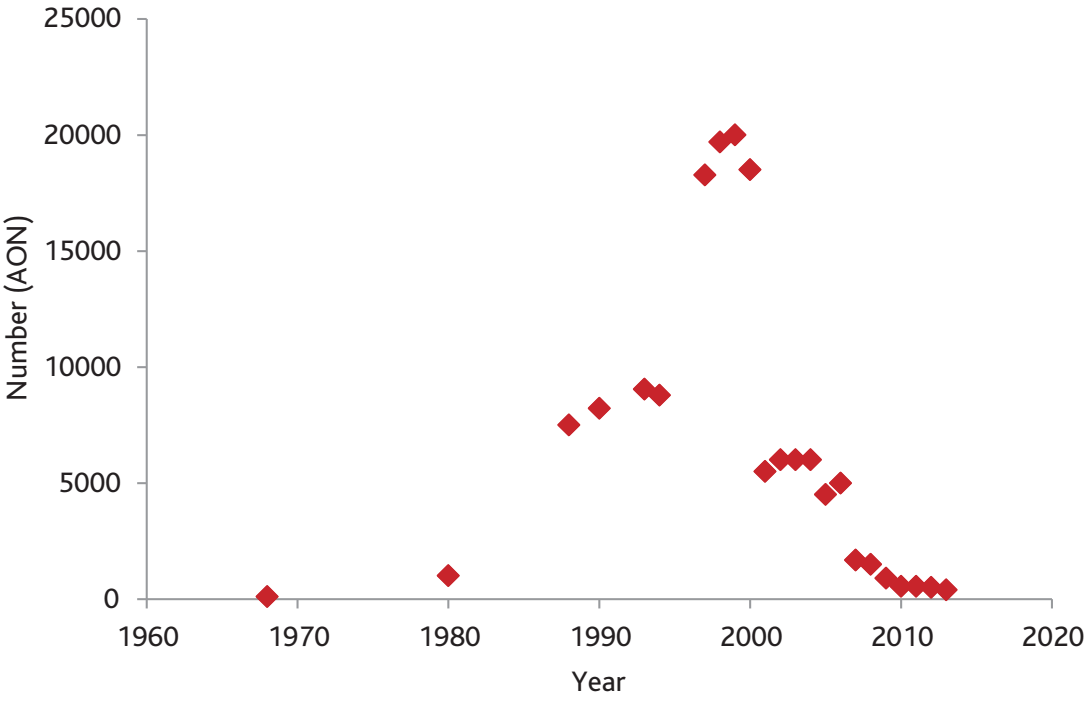


**Figure 3.** Nest counts at the Orford Ness Lesser Black-backed Gull *Larus fuscus* colony between 1968 and 2013 (part of the Alde-Ore Special Protection Area) (Piotrowski 2003; M. Marsh pers. comm.). Note that the years 1997–2000 had very high counts and there is some concern that these figures may be inflated (M. Marsh pers. comm.). The count for 2001 is consistent with Seabird 2000 (Calladine 2004).

The population growth at these key colonies was reflected in the breeding population trend for the UK as a whole, with respective increases of 29% and 40% in AON at coastal colonies between the censuses of 1969–70, 1985–88 and 1998–2002 (JNCC 2014). This trend has reversed since, with a 48% decline between 2000 and 2013 (Figure 2; JNCC 2014)[5], largely influenced by population crashes at the key colonies that held a large proportion of the UK's breeding population, for example Orford Ness (Figure 3), South Walney (Figure 4) and Bowland Fells, where numbers have fallen from 18,518 AON (Calladine 2004) to 3,274 AON in 2012 (Coyle 2012). Colonies have historically both increased and fallen in number rapidly (e.g. Greenhalgh 1974), suggesting that the Lesser Black-backed Gull is able to cope with such fluctuations. However, there are indications that colony reductions in recent years could have been associated with a net loss of birds from the English population, rather than a simple redistribution of birds to other locations (e.g. Sellers & Shackleton 2011).

The rapid growth in English-breeding Lesser Black-backed Gull numbers in the second half of 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 the hunting and egg collecting which had previously depressed the population size (Parslow 1967; Greenhalgh *et al*. 1974; Mudge 1978;

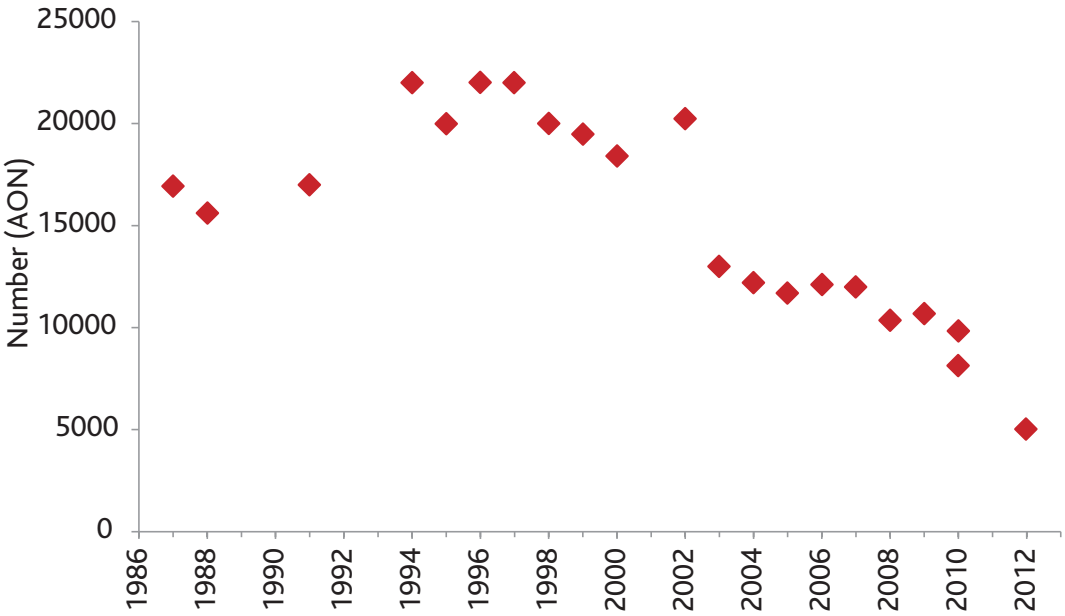


**Figure 4.** Nest counts at the South Walney Lesser Black-backed Gull *Larus fuscus* colony between 1986 and 2013 (part of the Morecambe Bay Special Protection Area; JNCC 2014).

[5] This percentage change is based on a sample of both inland and coastal colonies. For details of the analysis and how missing data are dealt with, see JNCC (2014).

O'Connell 1995; Perrins & Smith 2000; Rock 2005). The ability of Lesser Black-backed Gulls to use a variety of feeding opportunities and adapt to new ones allowed them to exploit new areas (Camphuysen *et al*. 2010), but much of the initial growth was centred at traditional rural breeding colonies, which experienced an influx of breeding adults from elsewhere, along with sustained high productivity and levels of recruitment (Brown 1967; Greenhalgh *et al*. 1974). The colony at Orford Ness was only discovered in 1968 (Piotrowski 2003) (Figure 3), while those 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 also were beginning to expand their breeding range into urban areas (Parslow 1967).

Although numbers rose fast at certain rural colonies, once Lesser Black-backed Gulls became established in towns and cities, population growth in this habitat outpaced that seen at other sites (Monaghan & Coulson 1977). This was accompanied by rapid range expansion as more urban sites were colonised (Monaghan & Coulson 1977; Raven & Coulson 1997). In 1969, seven pairs of Lesser Black-backed Gulls were reported nesting in Gloucester, and a single pair in Hastings (Cramp 1971). By 1976, the number of pairs reported in Gloucester had risen to 80 (Hastings remained at a single pair), and the species had moved into Bath, Bristol, South Shields, Sunderland and Newcastle, with birds observed prospecting in Durham and Barrow-in-Furness (Monaghan & Coulson 1977). In 1994, Lesser Black-backed Gulls were reported breeding in 37 English towns and cities, and prospecting at several others (Raven & Coulson 1997). Seabird 2000 recorded 850 AON in Bristol, a 64% increase since the Seabird Colony Register, and 2,250 AON in Gloucester, a 400% rise (Calladine 2004). This pattern has continued and in England today, there are Lesser Black-backed Gulls breeding in many coastal towns and cities, as well as in heavily urbanised locations further inland, including London and Birmingham (Balmer *et al*. 2013). England's urban population has therefore apparently continued to increase since Seabird 2000, while other inland and coastal colonies have declined. Although some urban population growth has been driven by breeding birds relocating from rural colonies (Monaghan & Coulson 1977; Rock 2005), it is not known whether these contrasting population trends cancel each other out. However, a recent study in Cumbria found that the decrease at traditional colonies like South Walney was greater than urban population growth, so there was still a net shortfall of birds overall in that county (Sellers & Shackleton 2011). The rise in urban-nesting has also occurred elsewhere, including France (Cadiou & Guyot 2012) and the Netherlands (Camphuysen 2013). Indeed, Lesser Black-backed Gulls ringed as chicks in England have been reported breeding in Rotterdam and Zeebrugge (M. Marsh pers. comm.).

Lesser Black-backed Gulls have thrived in towns and cities because they provide ample, largely predator-free, nest sites on residential and commercial rooftops or in relatively undisturbed industrial areas (Monaghan & Coulson 1977; Raven & Coulson 1997; Rock 2005). Birds eat urban food waste, with streetlights even allowing night-time feeding (Rock & Vaughan 2013), although they 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 them to breed earlier in the season (Rock 2005). This combination of plentiful nesting habitat, food and warmth might help explain why some birds in urban areas have been observed breeding successfully at a younger age (three years old) than those elsewhere (Rock 2012).

Probably as a result of plentiful food and low predation pressure, Lesser Black-backed Gull productivity is generally higher in urban than rural areas (Table 1). With a modal clutch size of three eggs, a pair can theoretically more than replace itself in a single breeding attempt. Indeed, there is evidence that levels of breeding success approaching this partially underpin the rapid growth in numbers in urban areas (Table 1). As Lesser Black-backed Gulls are long-lived birds, with a high level of annual survival for adults (Wanless *et al*. 1996; Camphuysen & Gronert 2012; Rock & Vaughan 2013; Ross-Smith *et al*. 2013), and individuals frequently recruit to breed in the colony in which they hatched, it is easy to see how a few pairs can establish a large colony rapidly. Indeed, urban-breeding populations in the UK doubled every three years in the 1970s (Monaghan & Coulson 1977).

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

| Colony | Year(s) | 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[6] | Increasing | Rock 2005 |

*Productivity defined by the number of chicks fledged (Brown 1967; O'Connell 1995; Perrins & Smith 2000; Rock 2005), and by the number of "well-grown" chicks (Sellers & Shackleton 2011).

However, these aspects of Lesser Black-backed Gull breeding ecology also mean that it can take several years of breeding failure before numbers 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). Successive years of poor productivity may partially explain recent declines at some large rural colonies, such as South Walney (Perrins & Smith 2000; Kim & Monaghan 2006; Davis 2013). These decreases are thought to be associated with changes in the management of landfill sites (e.g. closures, bird scaring tactics and covering the tip surface) and fishing practices, including a reduction in fisheries discards (Perrins & Smith 2000; Kim & Monaghan 2006). There are therefore fewer opportunities to feed, 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).

[6] In the early 2000s, large numbers of Lesser Black-backed Gulls breeding on Bristol's rooftops had fledging success of 100%. The exact figure for productivity across the population was not measured, but for broods of three (the modal size), it was common for three chicks to fledge (P. Rock pers. comm.).

Food stress during the breeding season is also thought to promote cannibalism of neighbouring eggs and chicks in adult Lesser Black-backed Gulls (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[7]), compounding population declines at particular colonies, including South Walney and Orford Ness (Perrins & Smith 2000; Sellers & Shackleton 2011; M. Marsh pers. comm.).

Predation, especially by Red Fox *Vulpes vulpes*, has been a key factor driving colony size reduction at several sites, including Rockcliffe Marsh and South Walney (Davis 2013) and Orford Ness (M. Marsh pers. comm.). Small colonies may be more susceptible to predation than larger ones as they lack the benefits of group vigilance and defence, and the dilution effect of being a single prey individual among many (Götmark & Andersson 1984; Beauchamp 2009). This leads to further reductions in colony size, and gradual loss of breeding habitat, when (for example) sites previously used by nesting birds become overgrown and are therefore no longer suitable (VR-S pers. obs.). Declines at English 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 can be a vector, from the water supply[8] (Wanless & Langslow 1983; O'Connell 1995) or to prevent bird strikes near airfields (Niras 2013). Culling has also been carried out in an attempt to protect other species that are thought to be adversely affected by the presence of Lesser Black-backed Gulls. These species might be of conservation concern, e.g. Arctic Tern *Sterna paradisaea* and Common Tern *S. hirundo*, or 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 (because this species can currently be taken under a General Licence), the numbers appear to have been substantial. For example, as many as 90,000 birds

[7] Divorce and subsequent re-pairing with a new partner has been shown to have a negative impact on reproductive success in other gull species (e.g. Mills 1994).

[8] Studies in other gull species, for example the Herring Gull, have shown that the carriage rate of such pathogens is low (e.g. Monaghan *et al*. 1985).

may have been taken at Bowland Fells between 1938 and 1988, with 75,000 being culled systemically between 1978 and 1988 (O'Connell 1995). The methods employed included poisoning, cannon-netting, 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, although some methods (e.g. poisoning and cannon-netting) have not been used for several years. In urban areas, Lesser Black-backed Gulls can be affected by destruction of nesting habitat during redevelopment, and through steps taken to prevent nesting (e.g. scaring, nest removal, egg oiling, netting roofs), although these can be ineffective (Rock 2005; Rock & Vaughan 2013).

Predation, loss of nest sites, disease, food stress and the indirect effects of culling on birds that are not themselves targets, all represent forms of disturbance for breeding Lesser Black-backed Gulls, which may act alone or in combination to affect population dynamics. 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 AON in 2012, was established in the early 2000s following culling at Tarnbrook Fell, also in Bowland Fells (Davis 2013), and Raven & Coulson (1997) suggested that the spread of breeding Lesser Black-backed Gulls into towns in northern England might have been facilitated by culling at Bowland Fells and on the Farne Islands, Northumberland.

**Wintering populations:** In addition to its internationally important breeding population of Lesser Black-backed Gulls, England has become increasingly used by wintering birds, with both gains in numbers present and range (Balmer *et al*. 2013; Burton *et al*. 2013). A decadal census of winter gulls carried out by the British Trust for Ornithology since the 1950s shows that Lesser Black-backed Gulls in the UK have 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, 114,369 of which were in England (Burton *et al*. 2013). There are currently no English (or indeed UK) sites for which non-breeding Lesser Black-backed Gulls are a protected feature (Stroud *et al*. 2001), although numbers at some roosts now surpass the required threshold (Burton *et al*. 2013).

The increase in wintering numbers is partly connected to a change in migratory behaviour, with fewer breeding birds now leaving the country than previously (Baker 1980; Rock 2002; Banks *et al*. 2009). Traditionally, English-breeding *graellsii* migrated to southwest Europe and northwest Africa for the winter, but in recent decades some individuals have begun to remain in England year round, although birds normally disperse away from their breeding colonies (Rock 2002). This is thought to be primarily due to the year-round availability of food (Barnes 1961; Horton *et al*. 1983; Banks *et al*. 2009). Since birds found in England during the winter also breed there, breeding and wintering population trends are likely to be inter-related. Other Lesser Black-backed Gulls found wintering in England are *graellsii*, *intermedius* and *fuscus* that breed in Iceland, Scandinavia, the

Netherlands, Belgium and Germany (Barnes 1952; Barnes 1961; Horton *et al*. 1983; Hallgrimsson *et al*. 2012; BOU 2013). Some of these birds also come from populations that historically migrated further south, but now winter in England (Rock 2002; Camphuysen 2013).

## Discussion

Although several studies have been conducted on English Lesser Black-backed Gulls over a number of decades, this review has shown that many knowledge gaps remain, and these hamper our understanding of how best to manage this species. To make informed conservation decisions, we need to understand population changes across the annual cycle, the drivers of those changes and the effect of control measures, both at a local and wider scale.

The number of breeding Lesser Black-backed Gulls in England is reported to be falling, but this species is not currently monitored systematically in urban areas where it is apparently increasing. It is not even clear from published sources how many urban colonies there are, whether they vary in their population trend and rate of population change, and what proportion of the English Lesser Black-backed Gull breeding population they account for. Such uncertainties make it 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, or even increasing, but birds are simply moving to sites where monitoring is not currently undertaken, both within England and abroad. Analysis from Norway, Sweden, Denmark, Germany, the Netherlands, Belgium and the UK, shows an upward population trend for breeding Lesser Black-backed Gulls for these countries combined (ICES 2011). These data do not distinguish between subspecies, and the number and nature of sites (e.g. urban/rural) from each country is not specified. However, they do indicate that the apparent declines in the English breeding population described in this review could be offset by increases elsewhere (or indeed in urban colonies in England). 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). It is possible that birds from England recruited or relocated to this population, contributing to increases in the Netherlands and declines in England, but amounting to no net loss at the species level. Since Lesser Black-backed Gull breeding colonies can become established rapidly and grow to several thousand pairs in just a few decades, only to decline again just as fast (e.g. Orford Ness (Piotrowski 2003; M Marsh pers. comm.) and Foulshaw Moss (Greenhalgh *et al*. 1974)) it may be that large site-level fluctuations in numbers are a feature of the population dynamics of this species.

Large and rapid colony-level fluctuations in breeding Lesser Black-backed Gull numbers 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). Indeed, birds colour-ringed at the formerly large colony at Orford Ness as both chicks

and adults have subsequently been found breeding in several colonies, some of which are relatively close by (e.g. Felixstowe, Ipswich and Lowestoft), while others are further afield, including Norwich, Greater London, Gloucester, Swindon and Worcester, as well as Rotterdam and Zeebrugge (Rock 2007; M. Marsh pers. comm.).

Clearly, despite studies showing that Lesser Black-backed Gulls are faithful to their nest site and partner once they recruit, these birds can be flexible in their nesting decisions. It is possible that they are sensitive to prevailing conditions, and use this information in choosing whether to remain or relocate to a 'better' breeding site. Breeding birds might continually scout for information on more suitable colonies, even if the one they currently nest at is relatively successful. Some shifts in breeding location might be pre-dated by movements outside the breeding period, during which birds might prospect for better sites and this could be part of the mechanism for between colony movements if it exposes individuals to novel sources of information on alternative breeding sites. Younger birds travel further from their colony than older birds outside the breeding season (Jorge *et al*. 2011; Ross-Smith *et al*. 2014), so may be more likely to find such information and relocate. It would be useful to characterise the conditions under which both sub-adult birds and breeding adults move colonies, how, when and where they gather information on alternative colonies, and where they are moving from and to at any one time. Such movements could be monitored using colour-marking or tracking technology to aid our understanding of this process. In addition, the effect of such moves in terms of the degree to which birds survive and breed successfully subsequently is not known and needs to be established.

Although it is hypothetically possible that some Lesser Black-backed Gulls might choose to 'upgrade' their nest site even when conditions are good, it is likely that an important proportion of movements between and within breeding colonies is influenced by human control and other forms of disturbance. Understanding this is essential for policy makers to assess the potential effects of such factors at different colonies. Disturbance during the breeding season, including mammalian predation and culling, can prompt individuals to abandon a colony (e.g. O'Connell 1995; Davis 2013; Rock & Vaughan 2013). One consequence of this can be an increase in availability of nest sites for new recruits. Recruitment to different (and perhaps newly-established) colonies could result from a lack of available nesting sites at birds' natal colonies. If this is the case, control measures that remove (or provoke emigration of) established breeders could simply free up nest sites for recruits, reducing the efficacy of that control (e.g. O'Connell 1995; Wanless *et al*. 1996). In colonies with culling, birds may recruit to the population at an earlier age than normal (P. Monaghan pers. comm.), and a study at Bowland Fells found that the perturbations 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). Colonies subject to culling may therefore become both source and sink populations (O'Connell 1995), so the effectiveness and broader consequences of any such programme need to be assessed at both the control site and other breeding colonies in the vicinity.

England is now an important region for wintering Lesser Black-backed Gulls, so management of this population is also crucial. Adult birds can be flexible in their choice of breeding sites, but we do not know whether they also 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*. 2012). The increase in English-wintering populations could therefore be due to an upturn in the number of birds that never migrate. It would be useful to understand the mechanisms controlling this process, and ascertain how Lesser Black-backed Gull migratory strategies become fixed. For example, it seems possible that some individuals might explore various wintering destinations before settling in England throughout the year, whereas other birds might never leave the country in the first place. Recent studies have indicated age-related changes in migration (e.g. Marques *et al*. 2010; Jorge *et al*. 2011; Ross-Smith *et al*. 2014), so these could be important. It would also be interesting to elucidate whether Lesser Black-backed Gulls breeding in urban and rural colonies have different migration strategies, as suggested by preliminary analysis of English colour-ringing data (Ross-Smith *et al*. 2014), especially if these strategies relate to different levels of breeding success and/or survival, as this could have big implications for breeding population trends. In addition, it is important to establish whether England (and the UK) is becoming a more common wintering destination for Lesser Black-backed Gulls from elsewhere in Europe, and whether these birds ever start to breed in England.

It is essential to understand the key characteristics of, and differences between, colonies in urban and rural settings, both on the coast and inland, and the contribution each makes to the population as a whole. More extensive annual monitoring in the breeding season is required to achieve this, including nest counts and measures of productivity, at a broader range of colonies, with full coverage every ten years. To understand what is happening on a wide scale, protected sites for which the Lesser Black-backed Gull is a qualifying feature should be monitored, as should a representative range of urban colonies, as smaller, more-recent colonies may show different population trends to larger, better-established ones (Raven & Coulson 1997). Similarly, although the survival rate of adult Lesser Black-backed Gulls is high - around 90% - and productivity varies in different colonies and under different conditions, there have been no large-scale systematic comparisons of these drivers of population change between different colonies or types of colonies, including those in urban and rural environments. Monitoring during the winter is also needed. Winter roosts are currently surveyed every decade, but more frequent visits may be necessary to demonstrate consistent use by Lesser Black-backed Gulls and justify their inclusion as protected features.

Differences between urban and rural Lesser Black-backed Gulls in the number and distance of movements they make, as well as more generally in their ecology, for example timing of breeding, productivity, survival, diet, wintering behaviour and reaction to disturbance, also need further study to fully understand the population dynamics of the species. If there are such differences, they are likely to inform future management decisions and conservation action.

Such research and monitoring could also be implemented elsewhere across the Lesser Black-backed Gull's range, as the conflicts with humans and confusion over conservation status described here for England also apply in various other countries where this species breeds and overwinters. The most obvious places where the recommendations in this paper would be relevant are the other countries in the UK, which have the same or a similar legislative framework, and have experienced the same patterns of Lesser Black-backed Gull population and range change to those in England. Debates over managing Lesser Black-backed Gull populations in light of changes similar to those described here have also taken place in the Netherlands (Camphuysen 2013) and France (Cadiou & Guyot 2012), which are also legally bound by the European Birds Directive. Further work is therefore required to resolve the Lesser Black-backed Gull conservation conundrum and direct future conservation action.

## Recommendations

***Monitoring:***

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

***Analysis of existing datasets:***

- Movements should be studied further to understand the relationship between colonies and the geographic scale on which populations operate more clearly, 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.
  - Analysing winter movement data to understand where birds from different colonies winter and to investigate the mechanism behind the population changes taking place in winter (i.e. northwards movement of wintering area).
  - Collecting and analysing data collected from resightings of colour-marked birds.
  - Carrying out more tracking studies using and collating the results from those in progress.
- Survival rates over time should be analysed to understand their contribution to population change, allowing the production of population models.

***New research:***

- Comparisons of the ecology between geographic areas and types of colony (e.g. urban/rural) 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 this should be put into the wider context of all sub-species of Lesser Black-backed Gull.
- Further detailed tracking studies.

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## 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.

**Beauchamp, G. 2009.** Sleeping gulls monitor the vigilance behaviour of their neighbours. *Biology Letters* 5: 9–11.

**BirdLife International. 2014.** Species factsheet: *Larus fuscus*. Downloaded from http://birdlife.org on 06/01/2014

**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 Black-backed Gulls *Larus argentatus* and *L. fuscus*. *Ibis* 109: 502–515.

**Bukaciński, D., Bukacińska, 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., 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.

**Burton, N. H. K., Musgrove, A. J., Rehfisch, 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.

**Cadiou, B. & Guyot, G. 2012.** *Bilan des recensements des colonies urbaines de goélands du Finistère sud en 2012*. Bretagne-Vivante report.

**Calladine, J. 2004.** Lesser Black-backed Gull *Larus fuscus*. In: Mitchell, P. I., Newton, S. F., Ratcliffe, N. & Dunn, T. E. (eds.) *Seabird populations of Britain and Ireland*: 226–241. Poyser, London.

**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. 2013.** 'A historical ecology of two closely related gull species (Laridae): multiple adaptations to a man made environment.' Ph.D. thesis, University of Groningen.

**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.

**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.

**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. 1971.** Gulls nesting on buildings in Britain and Ireland. *British Birds* 64: 476–487.

**Cramp, S., Bourne, W. R. P. & Saunders, D. 1974.** *The Seabirds of Britain and Ireland*. Collins, London.

**Cramp, S. & Simmons, K. E. L. (eds.) 1983.** *The Birds of the Western Palearctic*. Vol. III. Oxford University Press, 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.

**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. 1992.** *Bird life of coasts and estuaries*. Cambridge University Press, Cambridge.

**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.

**Götmark, F. & Andersson, M. 1984.** Colonial breeding reduces nest predation in the common gull (*Larus canus*). *Animal Behaviour* 32: 485–492.

**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.

**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.

**ICES 2013**. *Report of the Joint ICES/OSPAR Expert Group on Seabirds (WGBIRD), 22–25 October 2013, Copenhagen, Denmark*. ICES CM 2013/ACOM:78.

**JNCC 2014.** *Seabird Population Trends and Causes of Change: 1986–2013 Report*. (http://www.jncc.defra.gov.uk/page-3201). Joint Nature Conservation Committee. Updated August 2014. Accessed 26th August 2014.

**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. 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.

**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.

**Lloyd C., Tasker M. L. & Partridge K. 1991.** *The Status of Seabirds in Britain and Ireland*. Poyser, London.

**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.

**Malling Olsen, K. M. & Larsson, H. 2004.** *Gulls of North America, Europe and Asia*. Princeton University Press, Princeton.

**Marques, P. A. M., Sowter, D. & Jorge, P. E. 2010.** Gulls can change their migratory behavior during lifetime. *Oikos* 119: 946–951.

**Mills, J. A. 1994.** Extra-pair copulations in the Red-billed Gull: females with high-quality, attentive males resist. *Behaviour* 128: 41–64.

**Mitchell, P. I., Newton, S. F., Ratcliffe, N. & Dunn, T. E. (eds.) 2004.** *Seabird Populations of Britain and Ireland*. Poyser, London.

**Monaghan, P. & Coulson, J. C. 1977.** Status of large gulls nesting on buildings. *Bird Study* 24: 89–104.

**Monaghan, P., Shedden, C. B., Ensor, K., Fricker, C. R. & Girdwood R. W. A. 1985.** Salmonella carriage by Herring Gulls in the Clyde Area of Scotland in relation to their feeding ecology. *Journal of Applied Ecology* 22: 669–680.

**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. *BioInvasions 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.

**Natural England 2010.** *Guidance Note on applications for a licence to control gulls*. (http://www.naturalengland.org.uk/Images/gull-licensing_tcm6-18281.pdf) Updated April 2010. Accessed 28th August 2014.

**Niras 2013**. *Paper 10: Implications of the BAES Warton gull control measures*. Niras Consulting Ltd., Cambridge.

**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.

**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.

**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. 2014.** The Online Ringing Report: Bird ringing in Britain & Ireland in 2013. BTO, Thetford (http://www.bto.org/ringing-report). Created on 30th May 2014.

**Rock, P. 2002.** Lesser Black-backed Gull *Larus fuscus*. In: Wernham, C. V., Toms, M. P., Marchant, J. H., Clark, J. A., Siriwardena, G. M. & Baillie, S. R. (eds.) *The Migration Atlas: movements of the birds of Britain and Ireland*: 365–368. Poyser, London.

**Rock, P. 2005.** Urban gulls: problems and solutions. *British Birds* 98: 338–355.

**Rock, P. 2007.** Roof-nesting gulls at the Port of Felixstowe. *Suffolk Birds*: 56 17–21.

**Rock, P. 2012.** 'Roof-Nesting Gulls in Bath. Follow-up survey summarising surveys from 1995.' Report to Bath & North-East Somerset Council.

**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*. *Ringing & Migration* 28: 21–29.

**Ross-Smith, V. H. 2009.** 'Pecking response in Lesser Black-backed Gull chicks *Larus fuscus*.' Ph.D. thesis, University of 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.

**Ross-Smith, V. H., Grantham, M. J., Robinson, R. A. & Clark, J. A. 2014.** *Analysis of Lesser Black-backed Gull data to inform meta-population studies*. BTO Research Report No. 654. Thetford, Norfolk.

**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.

**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., Rehfisch, 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.

**Walsh, P. M., Halley, D. J., Harris, M. P., del Nevo, A., Sim, I. M. W., & Tasker, M. L. 1995.** *Seabird monitoring handbook for Britain and Ireland*. JNCC / RSPB / ITE / Seabird Group, Peterborough.

**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.

**Wetlands International. 2014.** *Waterbird Population Estimates*. http://wpe.wetlands.org