Numbers, distribution and population trends of large gulls breeding in Cumbria, northwest England

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Abstract
This paper reports the results of a survey of large gulls breeding in Cumbria in 2009, together with an assessment of recent population trends. The survey found totals of 15,489 apparently occupied nests (AON) in 43 colonies for Lesser Black-backed Gulls *Larus fuscus*, 4,747 AON in 40 colonies for Herring Gulls *L. argentatus* and 85 AON in seven colonies for Great Black-backed Gulls *L. marinus*. A substantial part of the populations for all three species was concentrated in a few large coastal colonies, but there were many smaller colonies, mostly of roof-nesting birds in coastal towns, as well as a number of generally small colonies inland, chiefly in quarries or on islands in lakes. Since the 1998–2002 Seabird 2000 census, coastal colonies for all three species have shown a marked reduction in breeding numbers, but increases at those in urban areas; the declines far outweighed the increases, however. Despite the overall downward trend in the breeding population in this period the number of colonies increased. The factors responsible for these changes include the food supply, disturbance by man, and, to a lesser extent, disease.

Introduction

Cumbria is an important breeding area for large gulls. In recent decades it has been home to the largest mixed colony of Lesser Black-backed Gulls *Larus fuscus* and Herring Gulls *L. argentatus* in Britain, at South Walney near Barrow-in-Furness, one of the largest such colonies in Europe, and the largest recorded for both species in Britain and Ireland in the 1998–2002 Seabird 2000 census (Mitchell *et al*. 2004). A second mixed colony, at Rockcliffe Marsh near Carlisle, was the fourth largest of both Lesser Black-backed Gulls and Herring Gulls in Britain in 1998–2002, and together these two colonies accounted for 28% of the former and 9% of the latter breeding in Britain and Ireland at the time (rankings and percentages based on the revised counts for Rockcliffe Marsh as outlined in Table 4). In contrast, only limited numbers of Great Black-backed Gulls *L. marinus* were recorded in Cumbria in 1998–2002.

Although the small number of coastal colonies in Cumbria was surveyed for the 1969–70 Operation Seafarer (Cramp *et al*. 1974) and 1985–87 Seabird Colony Register censuses (Lloyd *et al*. 1991), the 1998–2002 census was the first of gulls breeding throughout Cumbria (Mitchell *et al*. 2004). There have subsequently

been marked declines at the South Walney colony (Chadwick & Raven 2004; Mavor *et al*. 2006) as well as the establishment of new colonies and it seemed timely to survey the whole of Cumbria to assess the current size of the population and how numbers have changed since Seabird 2000. This paper describes the results of such a survey carried out in 2009.

Methods

The 2009 survey: The size of the South Walney colony was estimated from counts in 20 x 30 m diameter circular sample quadrats, as described in the Seabird Monitoring Handbook, Census Method 2 (Walsh *et al*. 1995); at all other colonies a complete count of nests was made (Census Method 1). The count unit used throughout was the apparently occupied nest (AON). Surveying gulls breeding on buildings is not always straightforward because some nests are hidden in blind spots; buildings with a series of pitched roofs are a particular difficulty. To compensate we sought to make counts in urban areas from as many vantage points as possible and to ensure no double counting a detailed record was kept of the location of every nest found. Where only part of a particular roof was visible, counts were corrected by dividing the number of AON that could be seen by the fraction of the roof (typically 0.5 to 0.8) that was visible. This approach yielded reasonable estimates in most cases in which it was possible to test it independently by comparing estimates from ground level with complete counts from suitable vantage points above ground level (RMS, unpublished data based in part on counts not associated with this survey). The corrections amounted to < 10% of the colony total in all but two cases (colonies 7e and 21; Table 1); the figures for these are less accurate than the others and are shown preceded by 'c.' in Table 1. In addition to nest location we also recorded the nature of the nest site according to the categories listed in Table 2.

To minimise the number of times that corrections needed to be made and to obtain the most reliable estimates possible, two aerial surveys were carried out, on 10 June from a microlight covering colonies along the coast between Silloth and Whitehaven, and on 19 June from a gyroplane covering the Kingmoor colony group north of Carlisle (Figure 1). In both cases the numbers of breeding gulls were estimated from aerial photographs (Canon EOS 50D digital camera with a 28–105 mm zoom lens). Birds sitting on nests (as opposed to off-duty birds or non-breeders) were fairly easily identified on these, but distinguishing between Herring and Lesser Black-backed Gulls proved much more difficult (cf Durham 2002). We therefore used the photographs to count nests and divided this total according to the ratio of adult Herring Gulls to Lesser Black-backed Gulls present based on field observations.

At four colonies access to part or all of the colony for counting was impossible and aerial surveys were impracticable. For three (17a, 21 and part of 20a; Table 1), a substantial portion of the colony was visible from outside the area with restricted access and counts made from the perimeter were corrected so far as possible for those parts of the colony which were not visible (as above). Only a

small part of a fourth colony, at the Sellafield nuclear complex, could be seen from outside the site boundary and here we based our estimate of breeding numbers on counts of birds in the vicinity in the pre-breeding period, counts during the breeding season at a loafing area at the mouths of the Rivers Ehen and Calder, 400 m from the colony, and the comments of a number of birdwatchers who worked at the site.

Surveys were mainly undertaken in the last week of May and the first two weeks of June, when an adult was usually on the nest incubating or brooding, and hence when nests were most easily detected. Two small colonies (7e, 11a; Table 1) were not discovered until July and, as this was after the optimum counting period, figures for these may be underestimates. Unfortunately the second aerial survey was delayed due to bad weather, and counts at the Kingmoor Park colonies north of Carlisle may also be slightly low, being made after the optimum count period; no corrections were made to allow for this.

All sites at which large gulls have bred in Cumbria in the past fifty years were investigated. We also sought information on newly established colonies via articles in the Cumbria Bird Club's bulletin, and checked all coastal towns and

Table 1. Population estimates (apparently occupied nests) for Lesser Black-backed Gulls *Larus fuscus*, Herring Gulls *L. argentatus* and Great Black-backed Gulls *L. marinus* breeding in Cumbria in 2009. Counts made under sub-optimal conditions or for which substantial corrections have been made to allow for nests in blind spots are indicated by 'c.', and may only be accurate to ± 50%; the figures for Sellafield are rough estimates only and were judged accurate only to a factor of 2–3. Within colony groups (see text), distances to the nearest colony are indicated in brackets.

Colony	Habitat	Lesser Black-backed Gull	Herring Gull	Great Black-backed Gull
Coastal colonies				
1. Rockcliffe Marsh	saltmarsh	3,850	610	8
2. Saltom Bay	seacliff	0	4	0
3. St. Bees Head	seacliff	3	164	0
4. Hodbarrow	shingle	250	12	1
5. South Walney	shingle	9,819	2,797	c. 70
6. Chapel Island	islet in sea	7	0	0
Urban colonies				
7. Kingmoor Park colony group				
7a. Crookdyke [a] (1100 m)	buildings	6	35	0
7b. Heathlands (900 m)	buildings	249	13	0
7c. Low Harker (900 m)	buildings	144	7	0
7d. Kingmoor Park North (600 m)	buildings	40	2	0
7e. Kingmoor Park Central (600 m)	buildings	c. 30	c. 10	0
7f. Kingstown (600 m)	buildings	51	20	0
8. Carlisle	buildings	162	28	0
9. Silloth	building	6	28	0
10. Maryport colony group				
10a. Maryport Town (500 m)	buildings	1	27	0
10b. Glasson & Grasslot	buildings	47	50	0

Table 1 (continued).

Colony	Habitat	Lesser Black-backed Gull	Herring Gull	Great Black-backed Gull
Coastal colonies				
11. Flimby colony group				
11a. Risehow (800 m)	buildings	c. 4	c. 3	0
11b. Flimby	building	0	1	0
12. Workington colony group				
12a. Workington Town (800 m)	buildings	20	98	0
12b. Mossbay (800 m)	ground	4	9	0
12c. Salterbeck (1400 m)	building	5	10	0
13. Lillyhall	building	29	0	0
14. Cleator Moor	buildings	3	25	0
15. Whitehaven colony group				
15a. Whitehaven Town (800 m)	buildings	31	173	2
15b. Moresby Parks (900 m)	building	4	20	0
15c. Hensingham (800 m)	buildings	2	12	0
16. Sellafield	buildings	~150	~150	~2 [b]
17. Haverigg & Millom colony group				
17a. Haverigg Haws (1100 m)	buildings, ground	50	97	1
17b Haverigg Town (900 m)	buildings	0	5	0
17c. Millom (1200 m)	buildings	2	15	0
18. Askam-in-Furness	buildings	16	32	0
19. Barrow (Park Road Ind. Est.)	building	3	0	0
20. Barrow-in-Furness colony group				
20a. Barrow Town (500 m)	buildings, ground	358	200	1
20b. North Scale (600 m)	building	0	1	0
20c. North Walney (600 m)	building	0	1	0
20d. Vickerstown Northeast (500 m)	buildings	2	12	0
20e. Vickerstown West (600 m)	buildings	1	10	0
21. Ulverston	buildings	c. 60	c. 12	0
22. Penrith (Gilwilly Ind. Est.)	building	1	0	0
Non-urban colonies inland				
23. Salterhall Quarry	inland cliff	12	36	0
24. Crummock Water	islet in lake	1	0	0
25. Derwent Water	islet in lake	4	0	0
26. Thirlmere	islet in lake	6	1	0
27. Haweswater	islet in lake	25	4	0
28. Shap Hardendale Quarry	ground	1	0	0
29. Windermere (Hen Holme & Lady Holme)	islets in lake	3	0	0
30. Windermere (Ridding Bay)	islet in lake	1	0	0
31. Kendal Fell Quarry	inland cliff	26	12	0
32. Killington Lake	island in lake	0	1	0
Total nests (AON)		**15,489**	**4,747**	**85**
Total colonies		**43**	**40**	**7**

(a) Formerly RAF Carlisle (Rockcliffe) site and currently Kingmoor Business Park Rockcliffe site; to avoid confusion with the Rockcliffe Marsh colony we have referred to this as 'Crookdyke' (the name of a nearby farm) rather than Rockcliffe.
(b) Breeding by Great Black-backed Gulls at Sellafield was not confirmed in 2009, but they have bred here in the past, and 3 adults at the loafing area at the mouth of the Rivers Ehen and Calder, 400 m southwest of the colony, on 16 May 2009 were presumed to have been breeding here.

villages, and all inland towns, for breeding gulls; full details are given in Sellers & Shackleton (2010). We think it unlikely that any colony of size was overlooked, but isolated nests or small colonies can be difficult to detect and one or two may have escaped our notice. This will have had minimal effect on overall breeding numbers (well within uncertainties associated with the counts) but may mean that the number of colonies is slightly underestimated.

A colony was defined as any nest or group of nests separated by more than 500 m from the nearest nest or group of nests. Some colonies were separated from one another by only 500–1,500 m, and we refer to these as 'colony groups' (Table 1). For present purposes we have treated colonies as being either coastal (in natural sites immediately next to the sea), urban (those in built-up areas including those on buildings close to the sea) or non-urban inland (colonies in natural sites away from the coast). The accuracy of the counts is difficult to assess, but it is inevitable that some nests on buildings will have been overlooked, principally because they were hidden from view. Most counts for built-up areas are therefore likely to be slight underestimates, perhaps by up to 15%.

Productivity in 2009: Productivity estimates were based on observations made between 7 and 9 July, when most chicks were well grown but unable to fly. At those urban colonies where visibility was an issue, we only included broods for which we were satisfied we had detected all chicks present. Being based on observations on a single date, our figures refer only to the number of chicks

Table 2. Characteristics of nest sites used by Lesser Black-backed Gulls *Larus fuscus* and Herring Gulls *L. argentatus* in built-up areas in Cumbria in 2009. [a]

Nest site location	No. nests (%)			
	Lesser Black-backed Gull		Herring Gull	
	n	%	n	%
Chimney stack	51	3.8	259	27.1
In chimney pot	3	0.2	1	0.1
Sloping roof, in open	348	26.1	227	23.7
V between sloping roof and chimney stack	7	0.5	29	3.0
Sloping roof behind vent *etc*.	47	3.5	185	19.4
'V' between two sloping roofs	2	0.2	9	0.9
Flat roof, in open	508	38.2	127	13.3
On flat coping stone or similar	8	0.6	13	1.4
On the ground	315	23.6	58	6.1
Other [b]	3	0.2	4	0.4
Unknown (estimated figures) [c]	39	2.9	44	4.6
Total	1,331		956	

(a) Includes all urban colonies listed in Table 1 except Sellafield.
(b) Lesser Black-backed Gull: 1 AON on floating crane and 2 AON on chemical plant; Herring Gull: 2 nests on floating crane, and 2 AON on chemical plant
(c) Principally nests in blind spots - virtually all were in the open on flat or sloping roofs, or on sloping roofs behind vents *etc*.

Table 3. Productivity estimates for Lesser Black-backed Gulls *Larus fuscus* and Herring Gulls *L. argentatus* breeding in Cumbria in 2009.

Colony	Lesser Black-backed Gull		Herring Gull	
	Mean	n	Mean	n
Coastal colonies				
3. St. Bees Head	-		1.21	19
Colonies in built-up areas				
8. Carlisle	2.32	31	-	
10a. Maryport Town	-		2.00	12
10b. Glasson & Grasslot	2.25	12	-	
12a. Workington Town	1.86	7	2.06	17
15a. Whitehaven Town	-		1.97	32
20a. Barrow Town	2.05	39	2.16	25
Others (combined)	1.86	7	1.83	12
All combined	2.14	96	2.02	98

produced per successful pair; there appeared to be few total nest failures at the roof-nesting colonies in 2009 so our figures will only slightly overestimate breeding success expressed as chicks per breeding pair, but are useful for comparative purposes.

Results

Lesser Black-backed Gull and Herring Gull: The 2009 survey found totals of 15,489 Lesser Black-backed Gull AON and 4,747 Herring Gull AON (Table 1). Despite its relatively long coastline, Cumbria has little suitable natural breeding habitat for gulls along its shores, and only six coastal colonies were recorded, of which four were mixed. That on shingle at South Walney was by far the largest, and though numbers here have declined substantially since the Seabird 2000 census (Lesser Black-backed Gull: 19,487 AON in 1998–2002, 9,819 AON in 2009, -50%; Herring Gull: 10,129 AON in 1998–2002, 2,797 AON in 2009, -72%), it remains one of the largest colonies in Britain. The second largest colony was at Rockcliffe Marsh, a saltmarsh at the eastern end of the Solway Firth close to Carlisle. Here too numbers of both species have declined sharply since Seabird 2000 (Lesser Black-backed Gull: 7,200 AON in 1998–2002, 3,850 AON in 2009, -50%; Herring Gull: 2,400 AON in 1998–2002, 610 AON in 2009, -75%; based on the amended figures described in Table 4). There were two smaller mixed coastal colonies, as well as one solely of Herring Gulls and one just of Lesser Black-backed Gulls.

The 2009 survey found 30 mixed colonies inland, 26 in urban areas, two associated with quarries, and two on islands in lakes. Colonies in built-up areas were widely distributed in the coastal hinterland and nearly all were within 10 km of the sea and many within 3 km (Figures 1 & 2). Although these colonies were separated from one another by at least 500 m, a number were only between 500 m and 1,500 m from the next nearest colony, forming seven 'colony groups' (Table 1).

Nine colonies contained only Lesser Black-backed Gulls; all were small (< 30 AON) and four comprised just a single pair of birds. That in Penrith, colonised in 2008, was the only roof-nesting pair more than 10 km from the coast. There were five colonies consisting only of Herring Gulls, one of four pairs at Saltom Bay near St. Bees Head, and four other isolated pairs.

In built-up areas, most Lesser Black-backed Gulls nested in the open on flat or gently sloping roofs (64% of all nests; where birds had a choice there was a tendency to prefer roofs on which there was some moss or grass), or on the ground (24%; Table 2). Many Herring Gulls also nested on open roofs (56% of all nests) but about a third of these nests were located against roof structures such as vents or standpipes rather than being out in the open. Ground-nesting was less frequent in Herring Gulls (6%) than in Lesser Black-backed Gulls (24%), whereas nesting on chimney stacks was more common in Herring Gulls (27%) than Lesser Black-backed Gulls (4%).

Table 4. Population estimates for large gulls breeding in Cumbria in 1998–2002 (Mitchell *et al*. 2004 as corrected) and 2009 (this study). Some inconsistencies exist between the published 1998–2000 counts (Mitchell *et al*. 2004) and those summarised in Sellers & Shackleton (2010). These concern (a) the Lesser Black-backed Gull *Larus fuscus* and Herring Gull *L. argentatus* figures for Rockcliffe Marsh in 1998–2002 which were inadvertently transposed in the published 1998-2002 counts (the revised figures are shown below), (b) certain urban colonies that were not covered in Seabird 2000 (figures quoted here taken from Sellers & Shackleton (2010) or based on rough estimates where no other data was available; the figures give only a rough indication of the number of birds breeding at the time), and (c) the Great Black-backed Gull *L. marinus* count for South Walney in 1998–2008 which appears to be incorrect (see also footnote c).

		Population size (AON)		
Survey	**Number of colonies** [a]	**Coastal colonies**	**Urban and other inland colonies**	**Total**
Lesser Black-backed Gull				
1998–2002	c. 27 (21)	27,572	c. 1,200 [b]	28,772
2009	43 (29)	13,929	1,560	15,489
% change		- 49%	+ 25%	- 25%
Herring Gull				
1998–2002	c. 27 (22)	19,541	c. 900 [b]	15,641
2009	40 (30)	3,587	1,160	4,747
% change		- 76%	+ 29%	- 70%
Great Black-backed Gull				
1998–2002	9 (4)	120 [c]	8 [b]	128
2009	7 (4)	79	6	85
% change		- 34%	- 25%	- 34%

(a) Figures in brackets are the number of urban colonies; colonies based on 500 m separation criterion (see Methods).
(b) For comparison the Seabird 2000 figures were: Lesser Black-backed Gull 133 AON, Herring Gull 113 AON and Great Black-backed Gull 2 AON.
(c) The Seabird 2000 total for Cumbria was 51 AON (Mitchell *et al.* 2004). Here we have used data for 2000 from the Cumbria Bird Club's records (Sellers & Shackleton 2010): Rockcliffe Marsh 39 AON, Hodbarrow 1 AON, South Walney 80 AON, giving a total for coastal colonies of 120 AON.

Great Black-backed Gull: A total of 85 Great Black-backed Gull AON was found in seven groups, all associated with mixed Herring and Lesser Black-backed Gull colonies (Table 1). The South Walney colony accounted for 82% of the total number of nests, and of the other six colonies, four were on buildings within a few hundred metres of the sea, one was on saltmarsh (Rockcliffe Marsh) and one pair was in the nature reserve at Hodbarrow. Small numbers of Great Black-backed Gulls nesting in large mixed colonies of Lesser Black-backed and Herring Gulls are easily overlooked and it is possible that some were missed, but apart from a pair that bred at Ulverston in 2005, there is no history of the species breeding in any of the other larger roof-nesting colonies in Cumbria.

Productivity: There were no substantial differences between productivity values for Lesser Black-backed Gulls and Herring Gulls in built-up areas, and for the latter the figures were similar to those found at other roof-nesting colonies in northern Scotland (range 1.5–2.5 chicks per successful pair) in 2006–09 (Clark *et al*. 2007; Sellers 2008; Sellers & Oksien 2009). No figures were obtained for Lesser Black-backed Gulls in colonies away from built-up areas, but at St. Bees Head the productivity of Herring Gulls was just 1.2 chicks per successful pair. Figures in the range 1.0–2.0 chicks per successful pair have been found for coastal colonies in the north of Scotland in 2006–09, figures at the upper end of this range mostly referring to cliff-nesting colonies close to towns (Clark *et al* 2007; Sellers 2008; Sellers & Oksien 2009).

Recent population trends: Four coastal colonies (1, 3, 4 and 5; Table 1) have been counted regularly for at least the past 20 years and all have shown a generally downward trend in numbers averaging about 5% p.a. in the recent past (Sellers & Shackleton 2011). No equivalent data for intervening years exist for inland colonies, but this study found these to have grown in size since 1998–2002 (Table 4). However, the declines at coastal colonies far outweighed increases at inland colonies resulting in a net regional reduction in numbers for all three species, most pronounced in Herring Gull, but substantial in both Lesser Black-backed Gull and Great Black-backed Gull (Table 4). Despite this, the overall number of Lesser Black-backed and Herring Gull colonies increased between these two surveys.

Control measures: During the 2009 survey it became clear that measures to control breeding gulls were being undertaken at a number of colonies. We witnessed the collection of nests and eggs on the roof of a building at Glasson & Grasslot, and were advised of control measures in place in 2009 at Sellafield, Hodbarrow, Barrow-in-Furness (in part), Ulverston and Chapel Island, and they have also been undertaken at Haverigg Haws and Haweswater in recent years. Unsurprisingly, the most proactive controls were at industrial sites where nesting could compromise operational safety or human health. In addition, the use of netting or spikes to discourage gulls from nesting was evident in all the long established colonies in built-up areas, including Carlisle, Maryport, Workington, Whitehaven and Barrow-in-Furness.

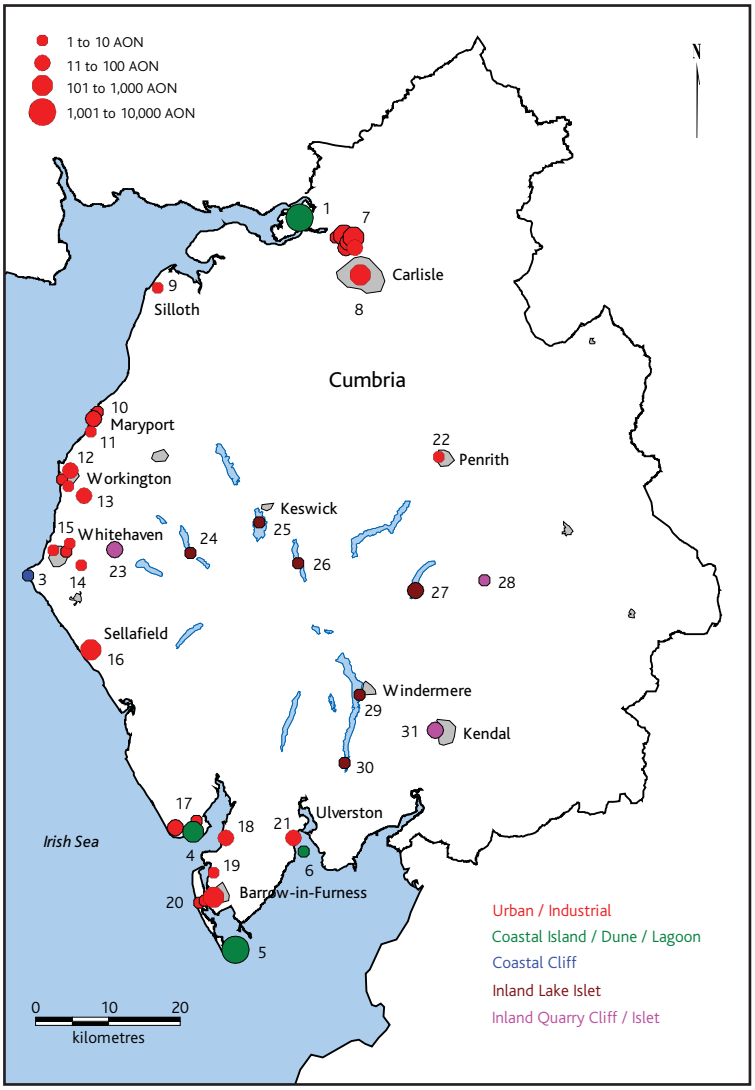

Figure 1. Distribution of Lesser Black-backed Gull *Larus fuscus* colonies in Cumbria in 2009. Colonies are numbered as in Table 1.

Discussion

There have been complex changes to the breeding populations of large gulls in Cumbria over the past 150 years but for much of the twentieth century by far the largest part of the population has bred at coastal sites (Blezard *et al.* 1943; Stott *et al.* 2002; Sellers & Shackleton 2011). The 2009 survey confirmed that most continue to do so, but that a growing proportion (10% of Lesser Black-backed Gulls, 24% of Herring Gulls, 7% of Great Black-backed Gulls) now breeds in an increasing number of urban colonies, mainly on roofs. These inland colonies have grown at c. 10% p.a. since they first began to be established around forty years ago (Sellers & Shackleton 2011), a rate only slightly lower than found in Cumbria's coastal colonies when they were undergoing expansion in the 1950s and 1960s (Harris 1970). By contrast there have been substantial declines in the coastal populations of all three species, for Lesser Black-backed Gull and Herring Gull far outweighing the increases shown by inland nesting birds. Some of the potential causes of these changes are considered below.

There are few cliffs in Cumbria and, if they are to breed in the area and exploit the food resources available, gulls must select sites such as saltmarsh or coastal shingle where predation by ground predators cannot be ruled out, but where, historically at least, it has not been a serious problem in Cumbria, as Brown (1967) noted at South Walney. However, in 2010 predation at this colony is thought to have contributed to low breeding success in both Lesser Black-backed and Herring Gulls;

although not explicitly stated in the original account the predator was presumably Red Fox *Vulpes vulpes* (Raven 2010). Breeding on buildings has freed gulls from attack by ground predators, but has brought them more directly into conflict with man. Although they appear tolerant towards the presence of man, urban gulls retain some sensitivity to disturbance, particularly if it is persistent or accompanied by destruction of their nests and eggs (Calladine *et al*. 2006 and references therein). It appears that this can force birds to seek out new breeding sites less subject to disturbance, such that controlling nests may alleviate problems locally, but in the longer run may simply tend to disperse the population (e.g. Coulson & Coulson 2009). It appears that something of this nature may, in part, have been responsible for the growth in the number of roof-nesting colonies in the last two decades.

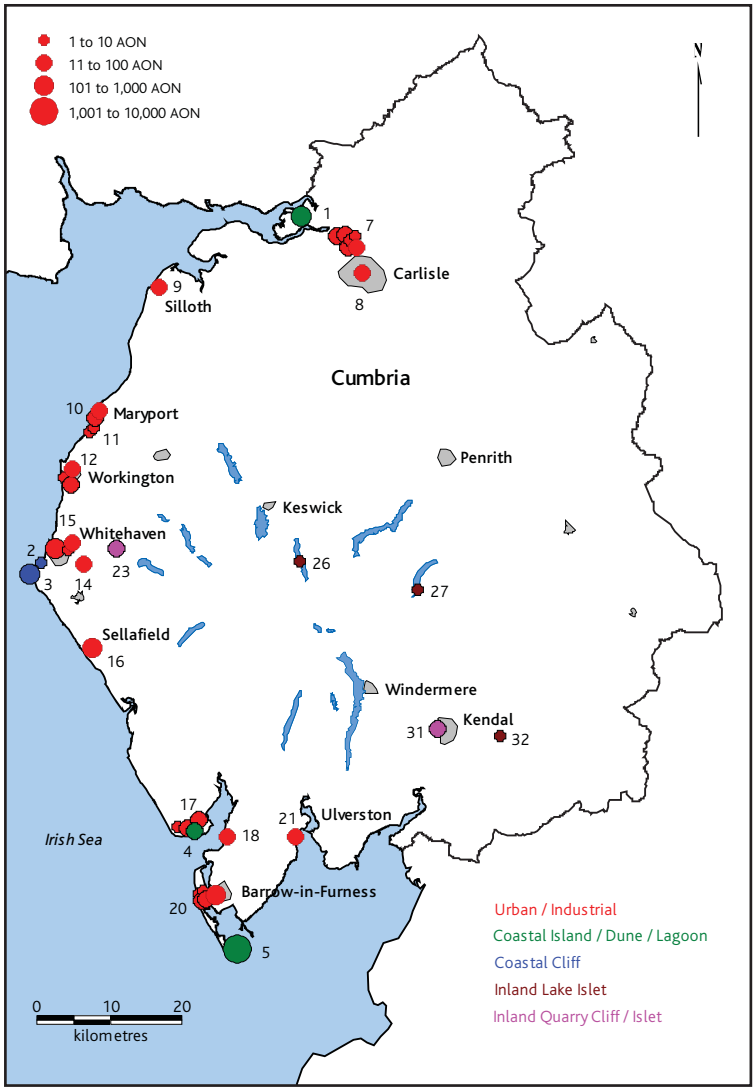

Figure 2. Distribution of Herring Gull *Larus argentatus* colonies in Cumbria in 2009. Colonies are numbered as in Table 1.

A second factor likely to be influencing both distribution and population change is the food supply. The dramatic increases in large gull populations elsewhere in Britain over the past fifty or so years are thought to have been due to a decrease in persecution and an increase in food availability from fisheries discards and refuse tips (Furness *et al*. 1992; Pons 1992; Mitchell *et al*. 2004; Rock 2005). There is little doubt that this helped fuel the increases at South Walney and Rockcliffe Marsh prior to the 1990s, both colonies being close to tips that were used extensively in the breeding season (Verbeek 1977; Kim & Monaghan 2006). However, as gulls came to

be regarded as a nuisance at landfill sites and concerns grew about their potential role as vectors of diseases such as salmonella and botulism, so the management of such sites improved. Elsewhere such reductions in the availability of refuse have coincided with declines in nearby gull populations suggesting strongly that the two are causally linked (e.g. Pons 1992; Mitchell *et al*. 2004). The situation in Cumbria seems to be more complex than this, however. The timing of the declines in Herring Gull and Lesser Black-backed Gull populations differ (Kim & Monaghan 2006; Sellers & Shackleton 2010) and in the case of the former pre-date the closure of the South Walney tip (2001) by at least ten years. By contrast, at Rockcliffe Marsh both species began to decline at about the time the tip at Hespin Wood (6 km away) was enclosed and yet both species appear to be maintaining or increasing their numbers at Kingmoor Park and Carlisle which are respectively about 2 km and 6 km from Hespin Wood (Sellers & Shackleton 2010, 2011).

Fish and particularly fish discards are an important food resource for gulls at South Walney and as landings of Cod *Gadus morrhua* and Whiting *Merlangius merlangus* at Fleetwood (19 km southeast, an important feeding site for South Walney gulls) have been in decline since the mid 1980s a link between the two seems likely (Kim & Monaghan 2006). The role of fish stocks generally around the coasts of Cumbria is more difficult to assess but we suspect that the decline of the St. Bees Head colony is connected with the decline of the Whitehaven fishing fleet and the availability of discards rather than fish stocks *per se*.

The diet of urban gulls in Cumbria remains unclear. Some will exploit discarded 'fast-foods' but the number of birds doing so appears to be limited (RMS pers. obs.; cf Coulson & Coulson 2008). Gulls breeding in Dumfries in southwest Scotland rely heavily on earthworms obtained from nearby agricultural land (Coulson & Coulson 2008) and we suspect this may apply to some Cumbrian roof-nesting birds; certainly those at Sellafield forage in nearby fields throughout the breeding season (RMS pers. obs.).

Productivity at the South Walney and Rockcliffe Marsh colonies has been poor in recent years and appears to have contributed to the recent population declines there (Kim & Monaghan 2006; Sellers & Shackleton 2010, 2011). A number of factors are implicated. Outbreaks of botulism at both colonies have resulted in mortality of adult gulls and chicks, notably at South Walney in 1998–2000 (Mavor *et al*. 2001; Chadwick & Raven 2004; Kim & Monaghan 2006), and at Rockcliffe Marsh in 2003 (Preskett 2003). Flooding was responsible for poor breeding success at Rockcliffe Marsh in 2007 when around 60% of nests were lost (M. Carrier pers. comm.). Productivity at urban colonies in 2009 was similar to that at South Walney in the 1960s (Brown 1967; Kim & Monaghan 2006), and is a key factor in the growing numbers at these colonies.

Not all birds return to their natal colony to breed and movements to new colonies in excess of several hundred kilometres are known to occur (e.g. Parsons & Duncan 1978). As regards Cumbria, Brown (1967) concluded that the rapid

growth of the South Walney colony in the 1960s was due in part to recruitment of birds from outside the county. Although not well documented, some dispersal from South Walney to breed elsewhere is known to occur (based on sightings of colour-ringed birds). Measures to control gull numbers can, as noted above, induce birds to move elsewhere to breed, and, given that such measures have been undertaken at several colonies in the past decade in Cumbria, it would be surprisingly if this had not played some part in the creation of new colonies. The extent to which poor breeding performance, predation or disease affect emigration is less well known but it seems likely that these too may have contributed to the trend towards new colony formation in the recent past.

In summary three factors, the food supply, disturbance by man and to a lesser extent disease, appear to be implicated in recent population changes, with predation and flooding occasionally playing a part in some coastal colonies. All these factors have an influence on key population parameters such as productivity, survival and the balance between immigration and emigration but a good deal more needs to be done before a quantitative understanding of such impacts is achieved.

Acknowledgements

We owe a great debt to the many people who helped with the 2009 survey. In particular we acknowledge the counts from South Walney provided by Mike Douglas of Cumbria Wildlife Trust, from Haweswater by Spike Webb of RSPB, from Hodbarrow and St. Bees by Dave Blackledge and Norman Holton both of RSPB, from Rockcliffe Marsh by Mike Carrier and the North Solway Ringing Group, and from elsewhere by Clive Hartley, Chris Hind, Ken Hindmarch, Andy Langford and Peter Ullrich. We thank also Mike Carrier, Robert Pickett and Peter Ullrich for much useful advice, Roddy Mavor and JNCC, Paul Culley for showing us round MoD Longtown, Paul Campbell at BAe Systems in Barrow, Gary May of HMP Haverigg and June Shields of Sellafield Ltd for information about gulls on their sites and Cumbria Bird Club for their support. For their help with the aerial surveys we thank Chris Jones of Chris Jones Gyroplanes, Andrew Lysser and David Watt.

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