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# Census of Great Black-backed Gulls *Larus marinus* breeding in Caithness, Scotland

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## Abstract

Caithness, northern Scotland, has historically been an important breeding area for Great Black-backed Gulls *Larus marinus*, but monitoring at selected colonies shows that numbers have declined substantially over the past 20 years. To investigate this decline in more detail, a survey of the whole of the Caithness coast was undertaken during the 2023 seabird breeding season. The survey found a total of 268 Great Black-backed Gull Apparently Occupied Nests (AON) at 76 colonies. Birds were widely distributed around the coast of Caithness with the most significant numbers being on Stroma (24% of the population) and the coast south of Wick (63%). Colonies were mostly small, with 65% holding just a single breeding pair. The results confirm that a substantial population decline of 74% in the number of AON has taken place since the Seabird Colony Register in 1985–88. Larger colonies have seen a gradual decrease in numbers since the latter half of the 1990s, except for Stroma where numbers were at a minimum in c. 2005 before recovering somewhat. The cause of the Great Black-backed Gull population declines remains unclear. Breeding productivity in 2023 was towards the upper end of the range found elsewhere in Britain (0.64 to 1.45 chicks per breeding pair) and, though lower in some previous years, appears not to have been a significant contributor to the declines. Fish and discards from fisheries are important components of the diet of Caithness Great Black-backed Gulls and so reductions in fish stocks or the availability of discards (based on landings of fish at harbours around the Moray Firth) may, in part, be contributing to their declines. Disturbance by ground predators such as Red Foxes *Vulpes vulpes* is implicated in some recent changes in the numbers of Great Black-backed Gulls breeding on the cliffs south of Wick, and the extinction of several former colonies. We discuss other potential factors contributing to the reduction in numbers and possible methods of halting and reversing the declines of Great Black-backed Gulls.

## Introduction

Seabirds are among the most threatened groups of birds globally, with widespread declines being observed in a broad range of groups and species (Dias *et al.* 2019). Despite their generalist and opportunistic tendencies, several populations of large *Larus* gulls have declined in recent decades (Nager & O'Hanlon 2016; Bond *et al.*

2016). Within the UK, Herring Gulls *L. argentatus* have a Red status in the Birds of Conservation Concern 5, whilst Lesser Black-backed Gulls *L. fuscus* and Great Black-backed Gulls *L. marinus* are Red listed species (Stanbury *et al*. 2024). A recent assessment of Great Black-backed Gull population trends across their breeding range estimated a global decline of 43–48% between 1985 and 2021, therefore arguing that the species should be reclassified as 'Vulnerable' on the IUCN Red List (Langlois *et al*. 2022).

Due to the opportunistic foraging behaviour of gulls, identifying the specific causes of their population declines has been challenging, and it is likely that a range of stressors are involved across the breeding and non-breeding ranges of Great Black-backed Gulls (Lewis, in Burnell *et al*. 2023). These stressors include food availability, especially changes in food associated with landfill and fishery discards (Bicknell *et al*. 2013; Sherley *et al*. 2020), predation of eggs, chicks, and adults at the breeding colonies by mammalian and avian predators (Hipfner *et al*. 2012; White *et al*. 2012), and continued persecution/culling in some locations (Hario & Rintala 2016). Within Britain, declines of Great Black-backed, Lesser Black-backed and Herring Gulls on Canna, northwest Scotland, have been linked with reductions in fish landings at Mallaig, c. 40 km away (Foster *et al*. 2016), although such declines could simply be a return to historical population levels following a brief period of food abundance from discards (Lewis, in Burnell *et al*. 2023). Another area where fish stocks and the availability of discards are likely to be important is the Moray Firth area of northern Scotland which includes fishing ports such as Fraserburgh, Macduff, Buckie and Lossiemouth on its southern side, and Wick and Scrabster on the northern side.

Nationally important numbers of seabirds breed around the Moray Firth, notably on the cliffs of Caithness, and historically it has been an important area for Great Black-backed Gulls. From 1970 until the mid 1990s, Caithness held around 5% of the British breeding population, but numbers have subsequently declined (Mitchell *et al*. 2004; Swann 2016, 2018). Between 2002 and 2022 counts at selected Caithness colonies revealed a decline of 66% (Oksien & Sellers 2023). Subsequently during the 2022 breeding season; it became evident that there had been a large mortality of seabirds breeding all along the east coast of Scotland following an outbreak of Highly Pathogenic Avian Influenza (HPAI) (Cunningham 2022, HPAIG 2023; Tremlett *et al*. 2024). In Caithness this mortality began at the end of May 2022, shortly after the completion of the 2022 seabird monitoring counts.

To evaluate whether previous counts were representative of the Caithness population, and to enable comparisons between prior counts from selected Caithness colonies and other surveys of the whole area, we carried out a full census of the Great Black-backed Gull population breeding in Caithness during the 2023 breeding season. We also sought to document the location and breeding habitat of all breeding Great Black-backed Gull nests in Caithness, partly to provide a firm baseline against which future changes can be judged, and partly as an aid for future counters. To complement the Great Black-backed Gull census, we also recorded productivity from a subset of colonies. Measuring demographic rates alongside

population counts can provide useful data to understand the drivers of population change, even in long-lived species such as seabirds (Cairns 1987). The 2023 survey also provided the opportunity to undertake a preliminary assessment of the impact of the HPAI outbreak on the Caithness Great Black-backed Gull population.

## Methods

Survey work was conducted between 15 May and 6 June 2023, primarily during the incubation phase of the Great Black-backed Gull breeding cycle (Walsh *et al*. 1995). Counts were mostly undertaken from cliff tops, but additional checks of cliffs between Wick (58°26'N, 3°05'W) and Whaligoe (58°20'N, 3°09'W) were made by boat and between the county boundary near Dun Glas (58°08'N, 3°35'W) and Ceann Leathad nam Bo (58°11'N, 3°28'W) (Figure 1). Great Black-backed Gulls can be sensitive to disturbance and so care was taken to make counts from vantage points at a distance from nests (Oksien & Sellers 2023). In some instances, we also included nests that were in blind spots that could not be seen from vantage points from land, but that were identifiable based on the number of individuals observed loafing, as opposed to incubating.

The names used for the colonies were selected based on those shown on the 1:25,000 Ordnance Survey Explorer maps 444, 449, 450 and 451 (Ordnance Survey 2002, 2003 & 2015). Where no suitable name was shown, we used the nearest place name on the map but prefaced it with 'nr' (i.e. near). If additional clarification was needed, we have included this in brackets (e.g. the addition of 'south' or 'north').

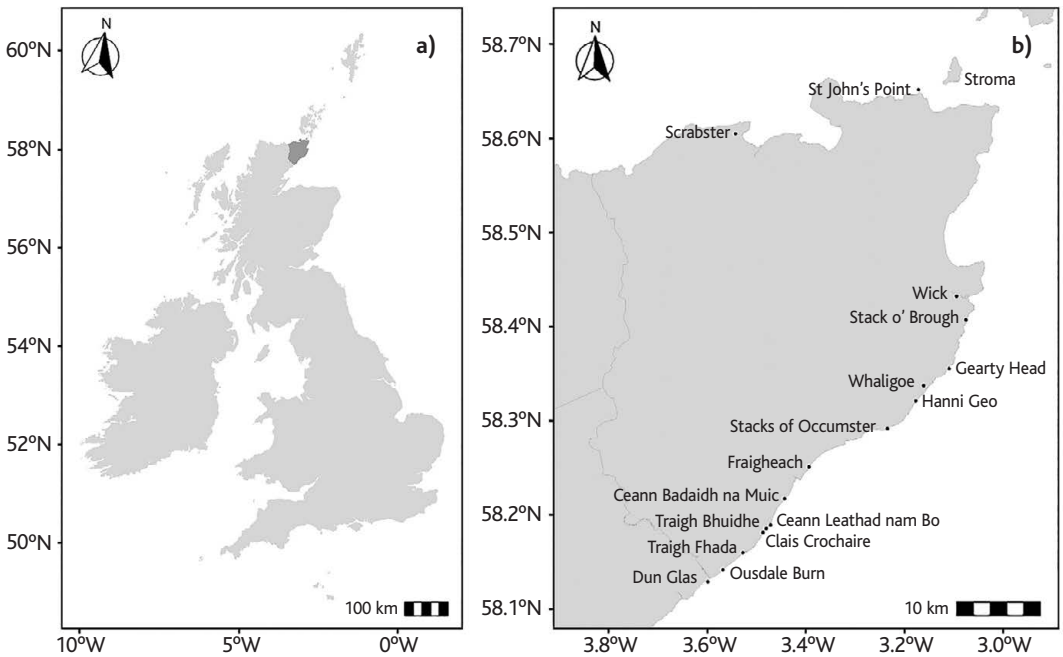


**Figure 1.** Map showing **a)** the location of the study area (Caithness, dark grey) within Britain and Ireland, and **b)** locations in Caithness mentioned in the main text.

Great Black-backed Gulls are colonial birds and often breed in discrete, close-knit groups (nearest neighbour distances typically <20 m) but may also breed in more scattered groups or as isolated pairs (Cramp & Simmons 1983). For the purposes of our analyses, we have taken nests separated by <50 m as belonging to the same colony, and for convenience use the term 'colony' to refer to all such groups regardless of their size (i.e. including isolated pairs). We have taken Stroma (58°40'N, 3°06'W) to comprise a single extensive colony when in practice the birds were located primarily in two main groups: one in the northeast (Ordnance Survey grid reference ND3578), the other to the southwest (ND3476), with the remainder dispersed across the rest of the island (ND3477/78 & ND3576/77; Table A1, see online Supplementary Materials). Larger colonies of Great Black-backed Gulls (>5 Apparently Occupied Nests, AON) typically persist in the same place for long periods and their locations are generally well known (Oksien & Sellers 2023). Although smaller groups, especially those breeding as isolated pairs, can be difficult to detect, Great Black-backed Gulls are conspicuous birds and usually nest in the open.

To aid in the identification of colonies we prepared a detailed list of those known to have been used in the past quarter of a century, based mainly on records kept by the authors between 1985 and 2022, all of which were checked. However, gulls including Great Black-backed Gulls occasionally skip breeding (Pierotti 1979; Kazama *et al*. 2013), so not all colonies with a single pair are occupied every year. It is therefore difficult to know whether a small number of nest sites have been overlooked, although we think that this is unlikely.

Nest sites were classified as either: stacks (nests on the flat top of stacks), rock pillars (similar to stacks, but with space for just a single nest), rocky islets (rocky structures with no distinctive flat top), rocky promontories or ridges (on mainland cliffs), grassy ledges (on mainland cliffs), rock slabs (or similar) at the base of mainland cliffs, beaches (pebbles or rocks below mainland cliffs), buildings, and on the ground away from cliffs (Figures 2 & 3).

To collect productivity data, we revisited a subset of colonies in the final week of June and the first week of July, shortly before the chicks were expected to fledge (7–8 weeks post-hatching, Cramp & Simmons, 1983). Productivity was estimated as the number of large chicks (those typically within c. two weeks of fledging) divided by the total number of AON as determined during the incubation phase (Walsh 1995).

**Figure 2 a–f. (opposite)** Types of sites used by Great Black-backed Gulls *Larus marinus* breeding in Caithness in 2023: (a) rock pillar, St. John's Point (58°39'N, 3°11'W), (b) rocky promontory on mainland cliff, Hanni Geo (58°19'N, 3°10'W), (c) rock slab, Ousdale Burn (58°08'N, 3°33'W), (d) rocky islet, Traigh Bhuidhe (58°11'N, 3°29'W), where, in 2023, a single pair nested next to a small group of Great Cormorants *Phalacrocorax carbo*, (e) isolated beach, Fraigheach (58°15'N, 3°23'W), and (f) stack, Stacks of Occumster (58°18'N, 3°14'W) seen from the south (in 2023 the Great Black-backed Gulls bred on the grassy, southward facing slope of the main stack with others by the Great Cormorant colony just out of sight on the north-eastern side of this same stack, and on two of the three smaller stacks to the west of the main stack). Photos: Robin Sellers.


a)


b)


c)


d)


e)


f)

**Figure 3.** A pair of Great Black-backed Gulls *Larus marinus* on a stack with three well grown chicks, Gearty Head (South) (58°22'N, 3°06'W), 26 June 2022. Photo: Robin Sellers.

The difficulties associated with counting nests on the tops of grass-covered stacks apply equally to the counting of chicks, and we therefore relied on counts of chicks at smaller colonies (1–3 AON). Though these smaller colonies may not be representative of all colonies within Caithness, they provide an indication of productivity that is consistent with previously collected data (Oksien & Sellers 2023). Furthermore, we were also able to include data from two somewhat larger colonies (Clais Crochaire (58°11'N, 3°29'W) and Fraigheach (58°15'N, 3°23'W); Figure 1b), both of which were on beaches where counting chicks from the cliff-top by telescope was straightforward. In total, productivity data were collected from 27 nests at 11 colonies, seven of which comprised a single nest.

To investigate how the population of Great Black-backed Gulls in Caithness has changed over the past half century, we compared the Caithness counts of the whole area from the national seabird censuses in 1969–70 (Operation Seafarer, Cramp *et al*. 1974), 1985–88 (Seabird Colony Register, Lloyd *et al*. 1991) and 2015–21 (Seabirds Count, Burnell *et al*. 2023) with those of the present survey. We did not make comparisons with those from the 1998–2002 census (Seabird 2000, Mitchell *et al*. 2004) in view of the late timing of that survey in Caithness (Oksien & Sellers 2023). To fill in some of the gaps in this dataset, we normalised the population indices (PI) from the 2002–22 monitoring at selected colonies (Oksien & Sellers 2023) to whole area counts by taking a PI of 100 as equivalent to 447 AON. The ratio of these two figures was estimated from the PI of 60 in 2023 (itself based on the PI in 2022 and the percentage change in the sum of the counts at the same colonies in 2023) and the total number of AON found in the present survey.

Information on the tonnage of fish landed at ports around the Moray Firth was taken from the annual Scottish Sea Fisheries Statistics reports (Marine Scotland 2024). Using these data, we calculated Pearson correlation coefficients between the 2002–22 Great Black-backed Gull population indices listed in Oksien & Sellers (2023) and annual landings of wet fish in the Moray Firth using Minitab version 13 (www.minitab.com).

The impact of the 2022 outbreak of HPAI was assessed through surveys of beached birds carried out from 27 June to 2 July 2022. A total of 23 sites between Thurso (58°59'N, 3°52'E) and Dornoch (57°88'N, 4°02'E) were surveyed: 15 mostly short sections of shoreline in Caithness were traversed, totalling 9.3 km, and eight longer sections in East Sutherland, totalling 17.9 km. When possible, all beached birds were identified to species level. No attempt was made to identify the cause of death, but, given how widespread HPAI was in the spring of 2022 (Cunningham *et al*. 2022), it is assumed that this was the cause in most cases. The few birds that were still alive when found showed the convulsions typical of HPAI infection.

## Results

The 2023 survey of breeding Great Black-backed Gulls found a total of 268 AON in Caithness across 76 colonies (taking Stroma to be a single colony, and including the colony at Dun Glas, which is just over the county boundary in East Sutherland, but functionally part of the Caithness population; Table A1, see online Supplementary Materials). Our results suggest that Great Black-backed Gull AON had declined by 74% (1,048 AON to 268 AON) since the Seabird Colony Register in 1985–88 (2.0% per annum from 1986–2023; Figure 4). Colonies were located all around the coast of Caithness, with the main concentration on the east coast south of Wick (74% of colonies, 63% of nests), reflective of the extensive cliffs and the closer spacing of the colonies in comparison with the two areas north of Wick (Figure 5 and Table A2, see online Supplementary Materials).

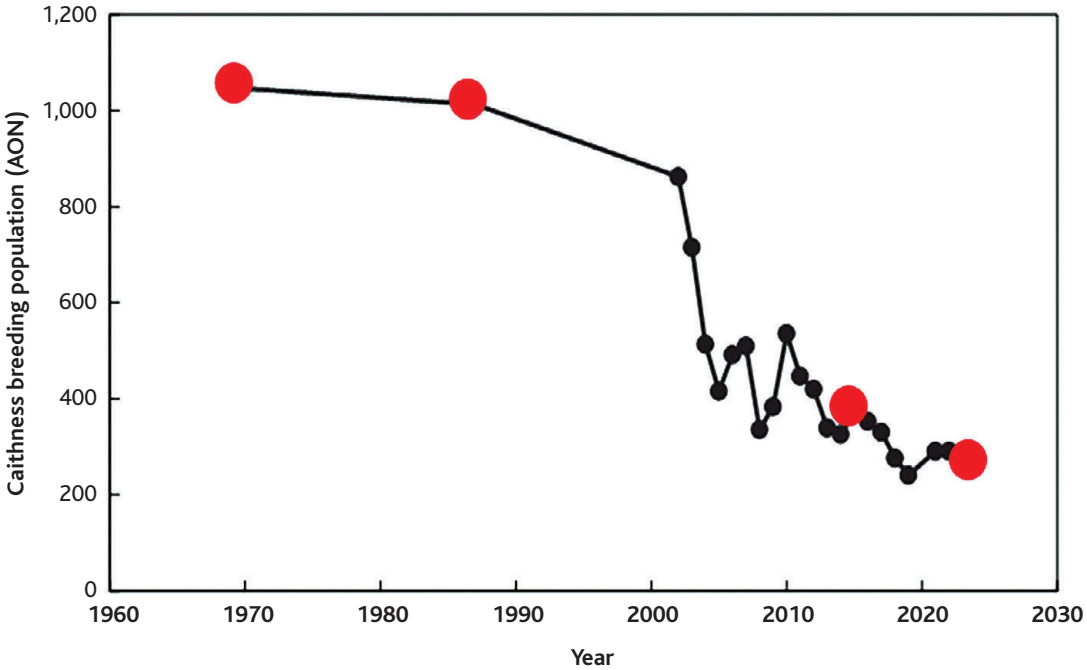


**Figure 4**. Population trend of Great Black-backed Gulls *Larus marinus* breeding in Caithness in 1969–2023. Red dots show the results of surveys of the whole of Caithness, the black dots are from the annual monitoring at selected colonies described by Oksien & Sellers 2023.

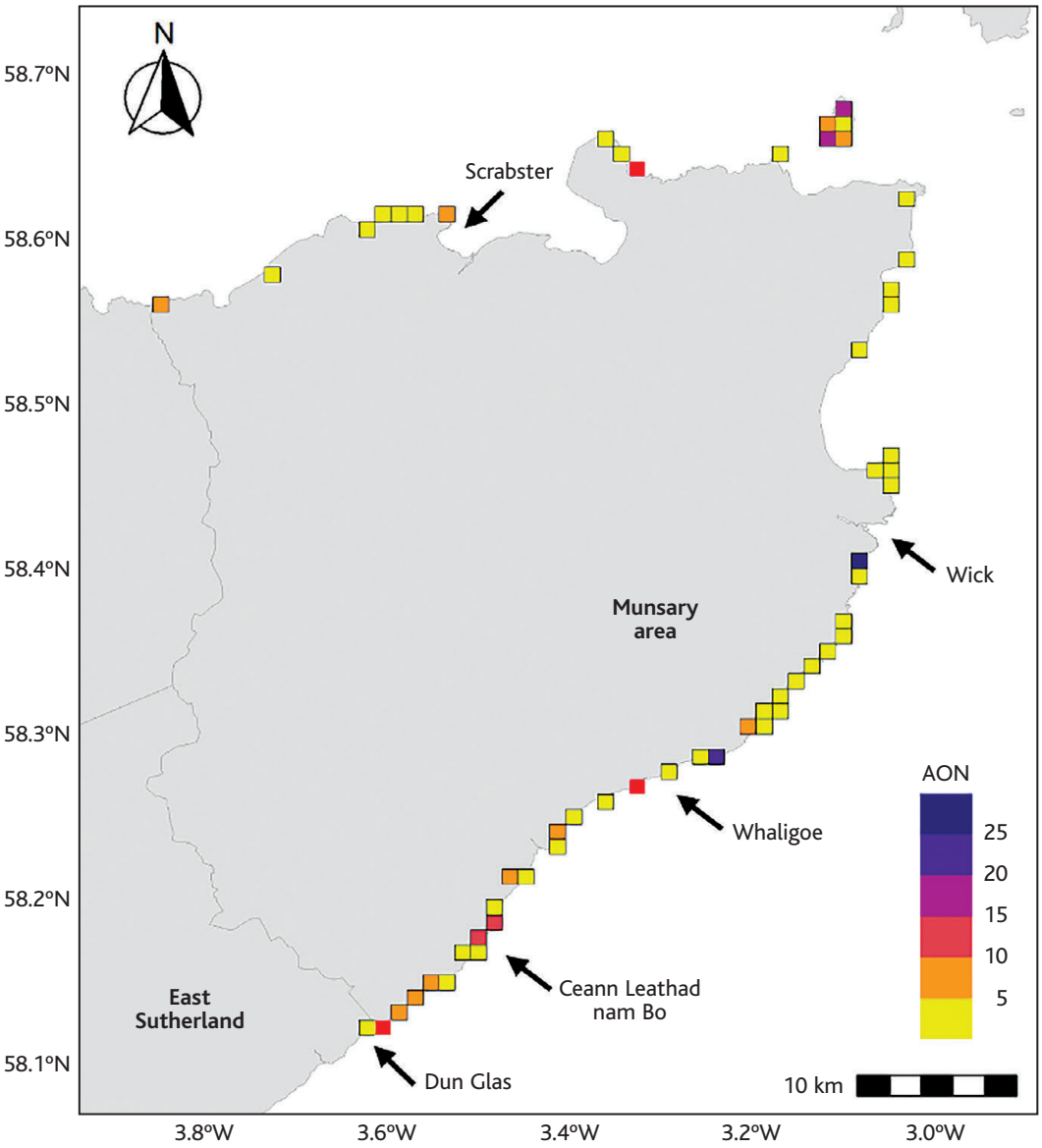


**Figure 5.** Map of the Caithness coast showing the breeding distribution of Great Black-backed Gulls *Larus marinus* in 2023. Red squares are 1 km$^2$ areas in which Great Black-backed Gulls have bred in the recent past but not in 2023.

Great Black-backed Gull colonies varied in size from single isolated pairs up to a maximum of 63 AON, the latter being on Stroma (where there were two main groups of nests and a scattering of individual nests between them). The next largest colony was at the Stack o' Brough (58°25'N, 3°04'W) with 26 AON. The distribution of colony sizes was highly skewed to smaller colonies (Figure 6), with 65% of colonies (18% of the total population) comprising single isolated pairs. Furthermore, 95% of colonies (comprising 55% of AON) held ≤10 AON (Figure 6).

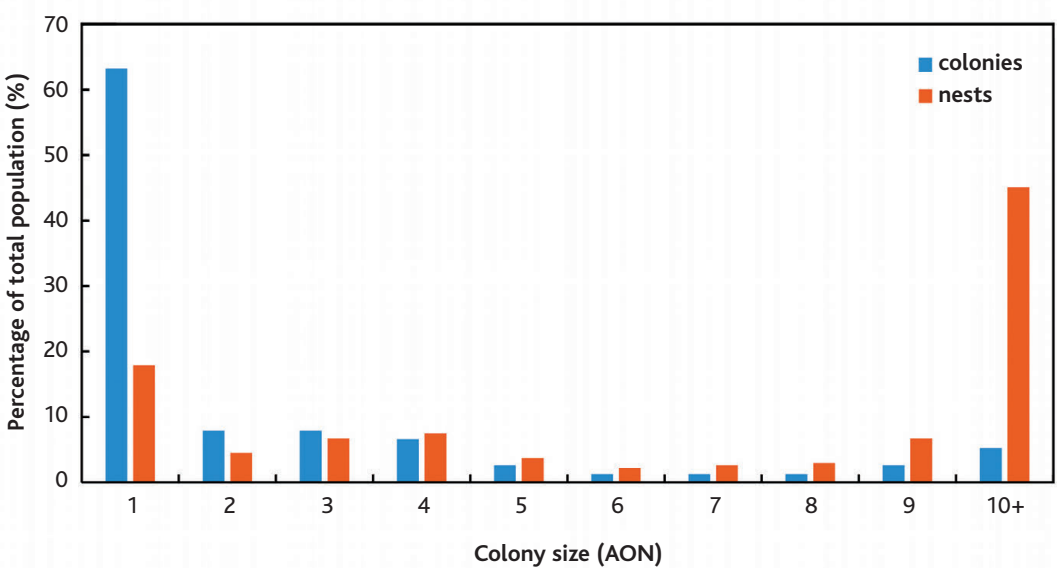


**Figure 6.** Frequency distribution of colony sizes of Great Black-backed Gulls *Larus marinus* breeding in Caithness in 2023.

Island colonies (stacks, rock pillars and rocky islets) and those on mainland cliffs (rock promontories, rock slabs and grassy ledges) accounted for both the majority of colonies used (87% of 76 colonies) and had the mosts nests (86% of 268 AON). Most beach colonies would have been inaccessible to ground predators such as Red Foxes *Vulpes vulpes*, other than at Traigh Fhada (58°09'N, 3°32'W) where there were 2 and 4 AON (entries 68 and 69 in Table A1, see online Supplementary Materials).

### Impact of the 2022 outbreak of HPAI

Based on surveys of seabird corpses washed ashore on beaches between Thurso and Dornoch, densities of dead birds on the east coast averaged c. 25 birds per km. The most common species involved in the wreck were Common Guillemot *Uria aalge* (374 corpses of a total of 631 corpses examined, i.e. 59%), Northern Gannet *Morus bassanus* (15%), Black-legged Kittiwake *Rissa tridactyla* (7%), Herring Gull (6%) and Razorbill *Alca torda* (5%). Only nine Great Black-backed Gull corpses were found (1.4% of all corpses).

Annual monitoring found 96 AON in 2022 at the 21 colonies indicated in Table A1, see online Supplementary Materials (Oksien & Sellers 2023). These same colonies totalled 89 AON in 2023, a reduction of 7.3%, which falls within the limits expected due to annual variation.

### Productivity

Based on results from colonies varying in size between 1 and 11 AON, net productivity in 2023 was 1.3 chicks fledged per nesting attempt, with 8 of 27 nests (30%) failing to produce any chicks. Of the 19 broods producing chicks, five had a single chick, 12 had two chicks, and two had three chicks (mean brood size = 1.8 chicks).

### Fishery landings

The decline in AON of Great Black-backed Gulls in Caithness occurred during a period (1965–2021) when landings of demersal and pelagic fish at ports around the Moray Firth had declined, typically by more than 50% (Figure 7). There have been too few complete surveys of Caithness to test whether there is any statistically significant relationship between these population estimates and landings of fish, but the population indices based on counts at selected colonies made in 2002–22 (Oksien & Sellers 2023) showed a correlation with total landings of wet fish ($r = 0.56$, $P = 0.01$), pelagic fish ($r = 0.52$, $P = 0.02$), but not demersal fish ($r = 0.37$, $P = 0.11$) in the Moray Firth during this period.

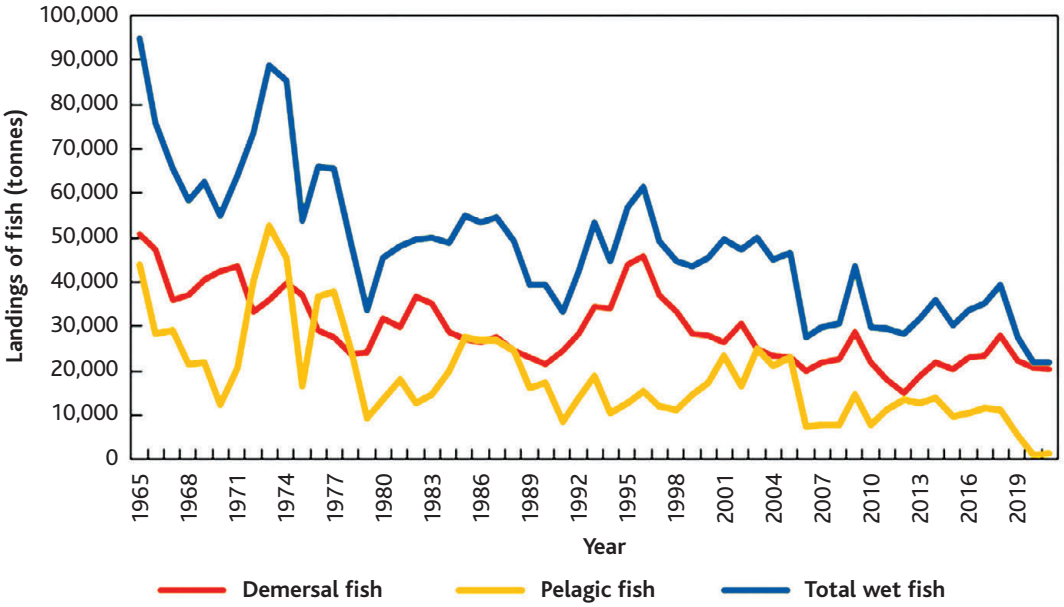


**Figure 7.** Landings of wet fish at ports around the Moray Firth, 1965–2021. Data were extracted from the annual Scottish Sea Fisheries Statistics reports (Marine Scotland 2024).

## Discussion

### Population trends 1970–2023

The first full survey of Great Black-backed Gulls breeding in Caithness was undertaken as part of Operation Seafarer (the national seabird census carried out in 1969–70) and found a total of 1,048 AON (Mitchell *et al.* 2004). The equivalent figure from the next such census, the Seabird Colony Register of 1985–88, was little changed at 1,013 AON (Mitchell *et al.* 2004), but by the time of Seabird 2000, the national survey carried out in 1998–2002, the count had decreased to just 211 AON (Mitchell *et al.* 2004, but note that the figure is quoted as 241 AON in Seabirds Count, Lewis, in Burnell *et al.* 2023), apparently indicating that a substantial decline had taken place. However, the Caithness counts included in Seabird 2000 were not obtained under optimum conditions and this figure is thought to be an underestimate (further details in Oksien & Sellers 2023).

Verification that the population had suffered a considerable decline was supported by counts at selected colonies undertaken annually between 2002 and 2022, by a survey organised by Scottish Natural Heritage in 2015–16 (Swann 2016, 2018), and by the present study. Annual monitoring at 21 colonies indicated a decline of 66% between 2002 and 2022 (or 69% between 2002 and 2023 using the data from this study), figures consistent with the decline of 74% between the Seabird Colony Register in 1985–88 and this 2023 survey where a total of 268 AON were recorded (Figure 4). Oksien & Sellers (2023) suggested that the declines probably began in the late 1990s and the present data corroborate this. Great Black-backed Gull populations elsewhere in Britain have also shown substantial declines over the past several decades. Langlois Lopez *et al*. (2022), for instance, report an overall decline of approximately 34% in the UK in the period 1985–2022; the equivalent figure for Caithness is approximately double this. A decline of 63% was recorded in Scotland between the Seabird 2000 census (1998–2002) and the Seabirds Count census (2015–21) (Lewis, in Burnell *et al*. 2023).

The annual monitoring described by Oksien & Sellers (2023) showed no significant difference in the extent of the declines between the north and east Caithness coasts. The figures quoted by Mitchell *et al*. (2004) from 1998 to 2002 compared with the counts from the present survey suggest a more marked decline on the east coast (842 AON to 176 AON, a decrease of 79%) compared to the north coast (171 AON to 92 AON, a decrease of 46%), a statistically significant result ($\chi^2$ = 39.5, 1 df, $P < 0.01$). This difference appears to be due primarily to the way in which the population on Stroma has developed over the past half century or so, reaching a peak of around 130 AON in 1986, then declining to only a few pairs over the next 15 years, followed by an increase over the past 15 years to a figure of 63 AON in 2023 (Table A3, see online Supplementary Materials).

**Cause of population decline**

The productivity of Caithness Great Black-backed Gulls in 2023 (1.30 chicks fledged per nesting attempt) was towards the upper end of the range of 0.64 to 1.45 chicks fledged per breeding pair in Britain between 1991–2019 recorded as part of the Seabird Monitoring Programme (JNCC 2019). Earlier investigations in Caithness in 2006–22 found that brood sizes (as determined during ringing operations) varied between 1.4 and 2.5 chicks per breeding pair, although up to 60% of these nests ultimately failed in 2017 and 2018 (Oksien & Sellers 2023). Great Black-backed Gull productivity does not appear to be a major cause of their declines, but the high failure rates in some recent years are a cause for concern.

Virtually all the breeding colonies monitored in this study were in places inaccessible to ground predators such as Red Foxes, but this was not always the case in the past. Table A1 (see online Supplementary Materials) lists seven colonies which Great Black-backed Gulls have abandoned within the past 30 years. Disturbance due to ground predators is implicated in the loss of birds from these former colonies and has resulted in declines of other seabirds breeding nearby (Supplementary materials Table S1). Impacts, possibly due to ground predators, are

also apparent at certain extant colonies where gull breeding numbers were formerly greater, particularly those at Ceann Badaidh na Muic (58°13'N, 3°26'W) and Traigh Fhada (south) where the limited number of birds remaining are restricted to small portions of the beach to which access by ground predators is unlikely. Other gull nest predators in the area include Eurasian Otter *Lutra lutra*, European Hedgehog *Erinaceus europaeus*, Brown Rat *Rattus norvegicus*, European Pine Martin *Martes martes*, European Polecat *Mustela putorius*, Stoat *M. erminea*, Weasel *M. nivalis*, other gulls *Larus* sp. (but especially Herring Gulls) and crows *Corvus* sp. (Guidos *et al*. 2023). European Mink *Mustela lutreola*, known to be a cause of poor productivity in gulls in the west of Scotland (JNCC 2019), are absent from Caithness.

The size of gull colonies can influence the presence of native carnivores with fewer sightings in larger colonies (Guidos *et al*. 2023), therefore reduced colony sizes in Great Black-backed Gulls may open them up to further mammalian predation, especially where they breed in association with other species, such as Herring Gull which have also experienced declines (Table A1, see online Supplementary Materials). White-tailed Eagles *Haliaeetus albicilla* have recently recolonized Caithness following historic persecution. They are known to prey upon large gulls in Scandinavia and provoke colony abandonment (Hipfner *et al*. 2012) and may be contributing to Great Black-backed Gull declines in western Scotland (Lewis, in Burnell *et al*. 2023). There is no evidence of any such effect in Caithness at present, but this needs to be monitored in the future.

Currently Caithness breeding Great Black-backed Gulls are all coastal nesters, but until c. 2014 they also bred inland (>5 km from the coast), particularly at sites in the Achavanich/Munsary area of the eastern Flow Country (Manson 2016). In 1971, they were described as increasing and spreading inland (Collett 1971), whilst in the 1990s there was a minimum of 15 pairs (Mitchell *et al*. 2004). In the Flow Country there were significant declines in peatland breeding by the species following non-native commercial afforestation (Hancock *et al*. 2009), possibly linked to predation pressures, in an area where there are higher mammalian scat densities near forest edges (Hancock *et al*. 2020). There were no inland breeding records of Great Black-backed Gulls in Caithness during the Seabirds Count census (2015–21; Lewis, in Burnell *et al*. 2023). The non-native afforestation and changes in woodland management, and the mammalian pressures associated with them, may also affect the coastal breeding populations.

The diet of Great Black-backed Gulls in Caithness is not well known, but they likely rely, to some extent, on fish and fishery discards. Indeed, regurgitates from chicks handled during ringing operations mostly consisted of Sandeels *Ammodytes* sp., together with some European Rabbit *Oryctolagus cuniculus* remains, and fishing boats in the Moray Firth are usually accompanied by 5–20 Great Black-backed Gulls (pers. obs. M. Oksien & R. M. Sellers). The decline in Great Black-backed Gull breeding numbers has occurred during a period when landings of fish at ports around the Moray Firth have declined (Figure 7). Oksien & Sellers (2023) noted that the population indices for Great Black-backed Gulls breeding in Caithness were positively

correlated with landings of demersal fish (predominantly Atlantic Cod *Gadus morhua*, Haddock *Melanogrammus aeglefinus*, Saithe *Pollachus virens*, Whiting *Merlangus merlangus* and Monkfish *Lophius piscatorius*) in the Buckie and Fraserburgh Districts but not with those in either Wick or Peterhead. There were, moreover, correlations with landings of pelagic fish (principally Atlantic Herring *Clupea harengus* and Atlantic Mackerel *Scomber sombrus*) in the Fraserburgh and Wick Districts, but not in Peterhead (Oksien & Sellers 2023). The development of the port facilities at Scrabster have resulted in increased landings of fish since 1993, likely attracting landings that would have previously gone to the other ports around the Moray Firth. Although the evidence is incomplete, some impact of declining fish stocks on Great Black-backed Gulls breeding numbers seems likely, mirroring similar observations from the west coast of Scotland (Foster *et al*. 2016) and in Canada (Cotter *et al*. 2012).

The 2022 outbreak of HPAI in the north of Scotland mainly affected Common Guillemots and Northern Gannets, with only a limited number of Great Black-backed Gull corpses being found. Such a finding is consistent with the 7.3% reduction in the Caithness breeding population between 2022 and 2023, which is within the normal range of interannual variation in breeding numbers. Our preliminary conclusion is, therefore, that the outbreak of HPAI in 2022 did not have any significant effect on the Caithness population of Great Black-backed Gulls. However, continued monitoring of the population is desirable to determine whether there are any longer-term effects and what effect, if any, future outbreaks might have. For example, a further outbreak of HPAI appeared to occur in Caithness at the very end of the 2023 breeding season. The only evidence that it might have affected the local Great Black-backed Gulls was the observation of two dead adults at the Little Fraigheach (58°16'N, 3°23'W) colony and a third dead adult bird at the nearby Fraigheach colony when visited on 29 June 2023. Retrieving the corpses was not feasible and so we were unable to confirm the cause of death of these individuals.

**Halting population decline**

As is the case for many of the UK's breeding seabirds, declines in Great Black-backed Gulls at the national level, and as observed in Caithness, are attributed to several potentially interacting pressures (Bolton & Baker, in Burnell *et al*. 2023). Identifying the pressures acting on Great Black-backed Gulls in Caithness is therefore a priority in implementing actions to halt population declines (Langlois Lopez *et al*. 2022). Collecting data and reporting on demographic rates is a first step in identifying the causes of observed declines. These data can be used in integrated population models to identify which mechanisms (i.e. productivity and/or survival of different age classes) have the greatest influence on Great Black-backed Gull population growth to help identify causes of change (Besbeas *et al*. 2002).

Currently, the most significant knowledge gaps regarding Caithness seabirds relate to their survival and diet. If the reduction in numbers is linked to declining fish stocks and/or reductions in the availability of fish discards, then a possible first step in reversing declines might be to designate areas in which commercial fishing is restricted

or prohibited (Davies *et al*. 2021). This should prevent further declines, not only of Great Black-backed Gulls but other declining seabirds in the region (Bolton & Baker, in Burnell *et al*. 2023). However, although Great Black-backed Gulls on the east coast of Caithness are thought to obtain some of their food from the Moray Firth, there is uncertainty as to precisely whereabouts in the firth they go to feed. Large scale movements of birds such as auks, Black-legged Kittiwakes and European Shags *Gulosus aristotelis* take place daily along and parallel to the east coast of Caithness, the birds heading for the waters between Brora and Tarbat Ness (R. M. Sellers, pers. obs.). Some Great Black-backed Gulls feed here, but others appear to venture further out into the Moray Firth (M. Oksien & R. M. Sellers, pers. obs.). Creating a marine nature reserve covering such a large area would be a challenge, but not without precedent. However, given their generalist diets, it is likely that other habitats within the foraging range of their breeding colonies are also important, particularly rocky shores and intertidal areas as well as pastures/agricultural fields (Buckley 1990; Borrmann *et al*. 2019). Ringing recoveries suggest that many Caithness Great Black-backed Gulls winter in the Moray Firth; others move down the east coast of Scotland, a few reaching England, or crossing to the west coast of Scotland (Spina *et al*. 2022). Understanding potential stressors individuals encounter outside the breeding season is also therefore important in understanding drivers of population change (O'Hanlon *et al*. 2023).

The Caithness population of the Great Black-backed Gull has undergone a substantial decline over the past quarter of a century, to a greater extent than exhibited by the UK population. Quite why the population has declined remains to be determined. Key factors may include the availability of food, particularly fish and fishery discards, and pressure from mammalian predators reducing the availability of suitable nesting sites, which is potentially the reason for the breeding failures observed in recent years. Narrowing down the causes of their decline, by collating data on Great Black-backed Gull diet and demographic rates, is required to help identify actions to help try and halt this decline.

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## References

**Besbeas, P., Freeman, S. N., Morgan, B. J. & Catchpole, E. 2002.** Integrating mark-recapture-recovery and census data to estimate animal abundance and demographic parameters. *Biometrics* 58: 540–547. https://doi.org/10.1111/j.0006-341X.2002.00540.x

**Bicknell, A. W., Oro, D., Camphuysen, K. & Voitier, S. C. 2013.** Potential consequences of discard reform for seabird communities. *Journal of Applied Ecology* 50: 649–658. https://doi.org/10.1111/1365-2664.12072

**Bolton, M. & Baker, H. 2023.** Great Black-backed Gull. In: Burnell, D., Perkins, A. J., Newton, S. F., Bolton, M., Tierney, T., & Dunn, T. D. (eds.) *Seabirds Count A Census of Breeding Seabirds in Britain and Ireland (2015–2021)*: 439–466. Lynx Nature Books, Barcelona.

**Bond, A. L., Wilhelm, S. I., Robertson, G. & Avery-Gomm, S. 2016.** Differential declines among nesting habitats of breeding herring gulls (*Larus argentatus*) and great black-backed gulls (*Larus marinus*) in Witless Bay, Newfoundland and Labrador, Canada. *Waterbirds* 39: 143–151. https://doi.org/10.1675/063.039.sp105

**Borrmann, R. M., Phillips, R. A., Clay, T. & Garthe, S. 2019.** High foraging site fidelity and spatial segregation among individual Great Black-backed Gulls. *Journal of Avian Biology* 50: e02156. https://doi.org/10.1111/jav.02156

**Buckley, N. J. 1990.** Diet and feeding ecology of Great Black-backed Gulls (*Larus marinus*) at a southern Irish breeding colony. *Journal of Zoology* 222: 363–373. https://doi.org/10.1111/j.1469-7998.1990.tb04038.x

**Burnell, D., Perkins, A. J., Newton, S. F., Bolton, M., Tierney, T., & Dunn, T. D. 2023.** *Seabirds Count A Census of Breeding Seabirds in Britain and Ireland (2015–2021)*. Lynx Nature Books, Barcelona.

**Cairns, D. K. 1987.** Seabirds as indicators of marine food supplies. *Biological Oceanography* 5: 261–271.

**Collett, P. 1971.** *Caithness Bird Report - 1971*. Scottish Ornithologists' Club. UK.

**Cotter, R. C., Rail, J. F., Boyne, A. W., Robertson, G. J., Weseloh, D. V. C. & Chaulk, K. G. 2012.** Population status, distribution, and trends of gulls and kittiwakes breeding in eastern Canada, 1998–2007. *Canadian Wildlife Service Occasional Paper* 120. Canadian Wildlife Service, Environment Canada, Ottawa.

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

**Cramp, S. & Simmons, K. E. L. 1983.** *The Birds of the Western Palearctic*, Volume III: 855. Oxford University Press, Oxford.

**Cunningham, E. A., Gamble, A., Hart, T., Humphrys, E. M., Philip, E., Tyler, G. & Wood, M. J. 2022.** The incursion of Highly Pathogenic Avian Influenza (HPAI) into North Atlantic seabird population; an interim report from the 15th International Seabird Group Conference. *Seabird* 34: 67–73. https://doi.org/10.61350/sbj.34.67

**Davies B. F., Holmes L., Rees A., Attrill M. J., Cartwright A. Y., Sheehan E. V. 2021.** Ecosystem approach to fisheries management works-how switching from mobile to static fishing gear improves populations of fished and non-fished species inside a marine-protected area. *Journal of Applied Ecology* 58: 2463–2478. https://doi.org/10.1111/1365-2664.13986

**Dias, M. P., Martin, R., Pearmain, E. J., Burfield, I. J., Small, C., Phillips, R. A., Yates, O., Lascelles, B., Borboroglu, P. G., Croxall, J. P. 2019.** Threats to seabirds: A global assessment. *Biological Conservation* 237: 525–537. https://doi.org/10.1016/j.biocon.2019.06.033

**Foster, S., Swann, R. L. & Furness, R. W. 2016.** Can fishery landings explain long-term population trends in gulls? *Bird Study* 64: 90–97. https://doi.org/10.1080/00063657.2016.1274287

**Guidos, S., van Dijk, J., Systad, G. & Landa, A. 2023.** Colony nesting gulls restrict activity levels of a native top carnivore during the breeding season. *Remote Sensing in Ecology and Conservation* 9: 527–539. https://doi.org/10.1002/rse2.326

**Hancock, M. H., Grant, M. C. & Wilson, J. D. 2009.** Associations between distance top forest and spatial and temporal variation in abundance of key peatland breeding bird species. *Bird Study* 56: 53–64. https://doi.org/10.1080/00063650802648176

**Hancock, M. H., Klein, D. & Cowie, N. R. 2020.** Guild level responses by mammalian predators to afforestation and subsequent restoration in a formerly treeless peatland landscape. *Restoration Ecology* 28: 1113–1123. https://doi.org/10.1111/rec.13167

**Hario, M. & Rintala, J. 2016.** Population trends in Herring Gulls (*Larus argentatus*), Great Black-Backed Gulls (*Larus marinus*) and Lesser Black-Backed Gulls (*Larus fuscus fuscus*) in Finland. *Waterbirds* 39: 10–14. https://doi.org/10.1675/063.039.sp107

**Hipfner, M. J., Blight, L. K., Lowe, R. W., Wilhelm, S. I., Robertson, G. J., Barret, R. T., Anker-Nilssen, T. & Good, T. P. 2012.** Unintended consequences: how the recovery of Sea Eagle *Haliaeetus* spp. populations in the northern hemisphere is affecting seabirds. *Marine Ornithology* 40: 39–52.

**HPAIG 2023.** *Highly pathogenic avian influenza in Great Britain: evaluation and future actions*. (www.gov.uk/government/highly-pathogenic-avian-influenza-in-great-britain-evaluation-and-future-actions). Scientific Advisory Group in Highly Pathogenic Avian Influenza. Accessed February 2024.

**JNCC 2019.** *Seabird Population Trends and Causes of Change: 1986–2019*. (https://jncc.gov.uk/our-work/smp-report-1986-2019/). Joint Nature Conservation Committee. Accessed February 2024.

**Kazama, K., Hirata, K. Yamamoto, T., Hashimoto, H., Takahashi, A., Niizuma, Y., Trathan, P. N. & Watanuki, Y. 2013.** Movements and activities of male Black-tailed Gulls in breeding and sabbatical years. *Journal of Avian Biology* 44: 603–608. https://doi.org/10.1111/j.1600-048X.2013.00103.x

**Langlois Lopez, S., Bond, A. L., O'Hanlon, N. J., Wilson, J. M., Vitz, A., Mostello, C. S., Hamilton, F., Rail, J.-F., Welch, L. Boettcher, R., Wilhelm, S. I., Anker-Nilssen, T., Daunt, F. & Masden, E. 2023.** Global population and conservation status of the Great Black-backed Gull *Larus marinus*. *Bird Conservation International* 33: e23. https://doi.org/10.1017/S0959270922000181

**Lewis, M. 2023.** Great Black-backed Gull. In: Burnell, D., Perkins, A. J., Newton, S. F., Bolton, M., Tierney, T., Dunn, T. D. *Seabirds Count A Census of Breeding Seabirds in Britain and Ireland (2015–2021)*. Lynx Edicions, Barcelona. 267–280.

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

**Manson, S. 2016.** *Caithness Bird Report - 2015*. Scottish Ornithologists' Club. UK.

**Marine Scotland 2024.** *Scottish Sea Fisheries Statistics, Annual Reports*. www.gov.scot/collections/sea-fisheries-statistics). Marine Scotland. Accessed February 2024.

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

**Nager, R. G., & O'Hanlon, N. J. 2016.** Changing numbers of three gull species in the British Isles. *Waterbirds* 39: 15–28. https://doi.org/10.1675/063.039.sp108

**O'Hanlon, N. J., Johnston, D. T., Cook, A. S. C. P., Robinson, R. A., & Humphreys, E. M. 2023.** A crowded ocean: the need for demographic and movement data in seabird conservation. *Ocean and Coastal Management* 244: 106833. https://doi.org/10.1016/j.ocecoaman.2023.106833

**Oksien, M. & Sellers, R. M. 2023.** Decline of Great Black-backed Gulls breeding in Caithness, 2002–2022. *Scottish Birds* 43: 206–211.

**Ordnance Survey 2002.** Helmsdale & Strath of Kildonan, sheet 444, 1:25,000, Ordnance Survey (Explorer Series). Ordnance Survey, Southampton.

**Ordnance Survey 2003.** Strath Halladale & Strathy Point. Sheet 449, 1:25,000, Ordnance Survey (Explorer Series). Ordnance Survey, Southampton.

**Ordnance Survey 2015.** Wick & The Flow Country, sheet 450, 1:25 000. Ordnance Survey (Explorer Series). Ordnance Survey, Southampton.

**Ordnance Survey 2015.** Thurso & John O'Groats, sheet 451, 1:25 000. Ordnance Survey (Explorer Series). Ordnance Survey, Southampton.

**Pierotti, R. 1979.** *Reproductive behaviour and ecology of the herring gull in Newfoundland*. Unpublished PhD Thesis, Dalhousie University, Nova Scotia.

**Sherley, R. B., Ladd-Jones, H., Garthe, S., Stevenson, O. & Votier, S. C. 2020.** Scavenger communities and fisheries waste: North Sea discards support 3 million seabirds, 2 million fewer than in 1990. *Fish and Fisheries* 21: 132–145. https://doi.org/10.1111/faf.12422

**Spina, F., Baillie, S.R., Bairlein, F1, Fiedler, W. & Thorup, K. 2022.** *The Eurasian African Bird Migration Atlas*. (https://migrationatlas.org). Accessed August 2024.

**Stanbury, A., Burns, F., Aebischer, N., Baker, H., Balmer, D., Brown, A., Dunn, T., Lindley, P., Murphy, M., Noble, D., Owens, R. & Quinn, L. 2024.** The status of the UK's breeding seabirds: an addendum to the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds* 117: 471–487.

**Swann, B. 2016.** *Seabird counts at East Caithness Cliffs SPA for marine renewable casework*. Scottish Natural Heritage Commissioned Report 902.

**Swann, B. 2018.** *Seabird counts at North Caithness Cliffs SPA in 2015 and 2016 for Marine Renewables Casework*. Scottish Natural Heritage Research Report 692.

**Tremlett, C. J., Morley, N., & Wilson, L. J. 2024.** *UK seabird colony counts in 2023 following the 2021– 22 outbreak of Highly Pathogenic Avian Influenza*. RSPB Research Report 76. RSPB Centre for Conservation Science, Sandy, Bedfordshire.

**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: A Compilation of Methods for Survey and Monitoring of Breeding Seabirds*. JNCC/RSPB/ITE/Seabird Group, Peterborough.

**White, A. F., Heath, J. P. & Gisborne, B. 2012.** Seasonal timing of bald eagle attendance and influence on activity budgets of glaucous-winged gulls in Barkley Sound, British Columbia. *Waterbirds* 29: 497–500. https://doi.org/10.1675/1524-4695(2006)29 [497:STOBEA]2.0.CO;2

## Supplementary Materials

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