

Predator exclusion fencing improves productivity at a mixed colony of Herring Gulls *Larus argentatus*, Lesser Black-backed Gulls *L. fuscus* and Great Black-backed Gulls *L. marinus*

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Abstract

A large multi-species gull colony at South Walney in Cumbria, northwest England, has suffered declines over the past 20 years, and from 2016 to 2020 no gull chicks fledged despite up to 4,000 pairs of adults attempting to breed each year. The primary cause of nest failure was predation. In an attempt to reverse this decline, a predator exclusion fence was erected around the remnant gull colony in March 2021, and population and productivity surveys were carried out over the 2021 and 2022 breeding seasons. In 2021, 53, 27 and 40 chicks fledged from 263 Herring Gull, 186 Lesser Black-backed and 38 Great Black-backed Gull nests, respectively, resulting in reproductive success rates of 0.20, 0.15, and 1.05 fledglings per nest. Following the fence erection, in 2022 numbers of nesting birds increased by 151% overall to 575 Herring Gull nests, 553 Lesser Black-backed Gull nests and 28 Great Black-backed Gull nests, with reproductive success rates of 0.4, 0.61 and 1.21 respectively.

Introduction

Herring Gulls *Larus argentatus*, Lesser Black-backed Gulls *L. fuscus*, and Great Black-backed Gulls *L. marinus* are familiar birds of the coast but are in decline across much of Britain and Ireland.

The Herring Gull population within the United Kingdom was estimated as 130,230 Apparently Occupied Nests (AON) in the Seabird 2000 census (Mitchell *et al.* 2004), a decline of 13% from the 149,197 AON found in the Seabird Colony Register (1985–88) (Lloyd *et al.* 1991), which was itself a decline of 48% from the 285,929 AON found in Operation Seafarer (1979–70) (Cramp *et al.* 1974).

Lesser Black-backed Gull populations within the United Kingdom showed an increase of 40% in breeding numbers, from 62,321 AON in the Seabird Colony Register (Lloyd *et al.* 1991) to 87,413 AON in Seabird 2000 (Mitchell *et al.* 2004). Since 2000, however, there has been evidence of significant declines at natural colonies for this species, including a 98% decline at Orford Ness in southern England between 2001 and 2013, a 46% decline at Skomer, in Wales, between 2000 and 2018, and a 56% decline at neighbouring Skokholm in the same time period, and, at South Walney, a decline of 91% from 19,487 AON in 2000 to 1,981 AON in 2018 (JNCC 2021).

Great Black-backed Gulls showed a small decline in breeding numbers, from 17,415 AON in the Seabird Colony Register (Lloyd *et al.* 1991) to 16,735 AON in Seabird 2000 (Mitchell *et al.* 2004). Most birds recorded nested in Scotland; of the 16,735 AON in Seabird 2000, 1,466 AON were in England (Mitchell *et al.* 2004), with over 50% of the English population nesting on the Isles of Scilly (JNCC 2021).

There are many potential causes of poor breeding success and population declines at gull colonies, including reduction in food sources through closure of landfills (Pons 1992), changes to fisheries discards (Oro *et al.* 2004), cannibalism (Brown 1967; Camphuysen & Gronert 2010), human disturbance (Robert & Ralph 1975), and predation (Southern *et al.* 1985; Ellis *et al.* 2007). Native predators, such as Red Fox *Vulpes vulpes* (hereafter Fox), can have a serious impact where their populations have increased due to human activities. For example, predator numbers can increase due to additional food source in the form of increased waste or introduced game birds (Delcourt *et al.* 2022), thereby further exacerbating population declines amongst their prey species. The productivity of Lesser Black-backed and Herring Gull has therefore been shown to decline as Fox sightings increased (Davis *et al.* 2018).

Predator exclusion fencing has been shown to reduce predation of adult birds, nests, chicks and eggs by mammals in many studies, summarised by literature reviews and meta-analyses (Côté & Sutherland, 1997; Smith *et al.* 2011; Laidlaw 2021). For example, nest success of Piping Plovers *Charadrius relodius* was 106% higher when mammalian predators were excluded using 1.1 m tall

fencing (Ivan & Murphy, 2005). Furthermore, Minsky (1980) found that excluding Foxes from a colony of Least Terns *Sterna albifrons* with an electric fence led to an increase in productivity compared to those nests outside the exclusion area, as did Spear *et al.* (2007), who showed that the daily survival rate of Least Terns increased when an electric fence was erected at nesting sites. A 180 cm high fence with a foot apron and overhang created an effective barrier to feral Cats *Felis catus* and Foxes, while an electric wire offset further improved the fence efficacy (Moseby & Read, 2006). Robley *et al.* (2007) also found a fence height of 1.8 m to be most effective to exclude Foxes and feral Cats; they did not, however, find an electric wire addition to the fence to be necessary.

Removal or exclusion of predators is, therefore, an intervention achievable by conservation land managers to improve the breeding success of ground-nesting bird species.

South Walney Nature Reserve comprises the southern end of Walney Island, off the coast of Barrow-in-Furness in Cumbria. It has been managed by Cumbria Wildlife Trust since 1963, and forms part of the South Walney and Piel Flats Site of Special Scientific Interest (SSSI). A colony of Herring Gulls and Lesser Black-backed Gulls inhabit the reserve, as well as smaller numbers of Great Black-backed Gulls, and this gull colony forms a feature of the SSSI and the Morecambe Bay & Duddon Estuary Special Protection Area Special Protection Area.

The colony has experienced several years of low or zero productivity and declines in nesting pairs from 22,750 Herring Gull AON and 18,615 Lesser Black-backed Gull AON in 1974, to 3,218 Herring Gull and 9,489 Lesser Black-backed Gull AON in 2005, down to just 489 AON of Herring Gull and 420 of Lesser Black-backed Gull AON in 2020. Great Black-backed Gull numbers have also fallen, from a peak of 120 AON in 1998 to 49 AON in 2020 (Cumbria Wildlife Trust, unpublished data). With predation believed to be the main cause of this decline, a permanent predator fence was installed in the winter of 2020/21. This paper assesses the impact on gull productivity in the two years following the installation of this fence.

Methods

South Walney is located in northwest England at the edge of Morecambe Bay ($54^{\circ}03' \text{ N } 3^{\circ}12' \text{ W}$; Figure 1). The main gull colony at South Walney lies at the tip of the reserve in an area called The Spit which is dominated by coarse shingle substrates with sparse vegetation (Figures 1 & 2). This habitat contrasts with that of the rest of the reserve, where sandy substrates dominate.

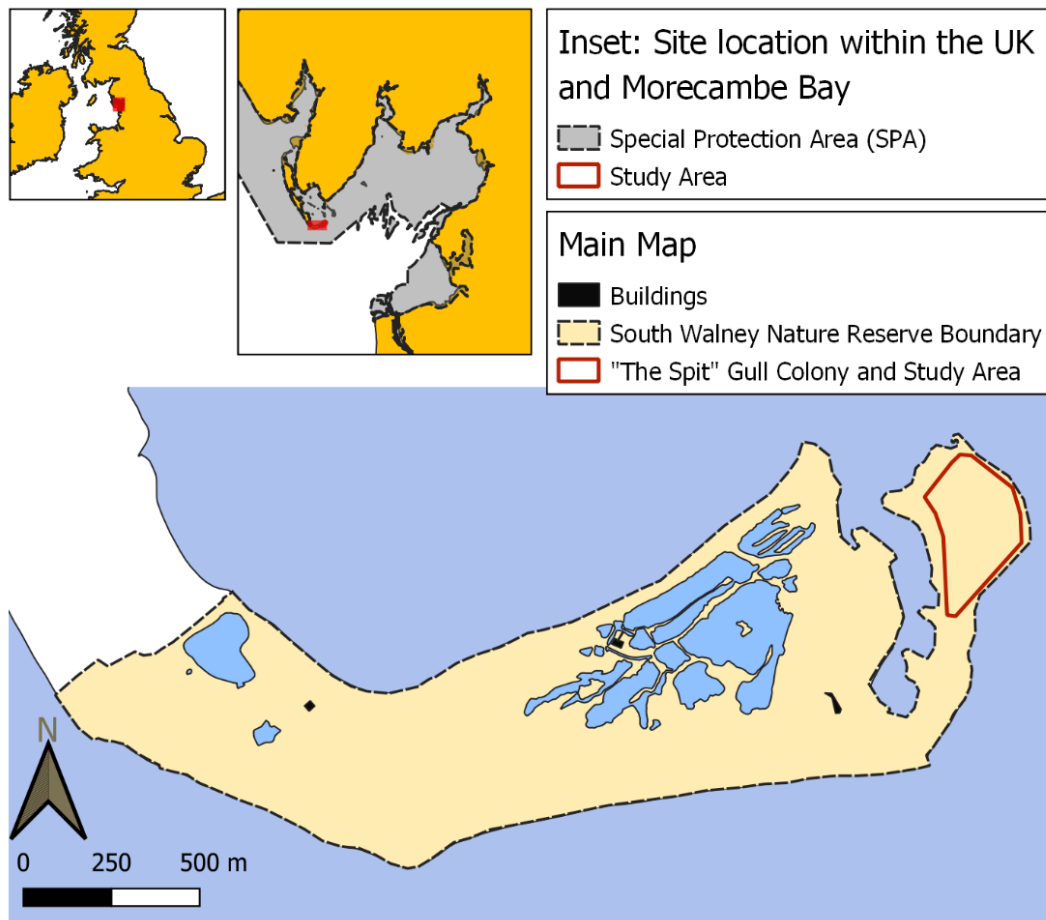


Figure 1: The location of Walney Island within the Morecambe Bay & Duddon Estuary Special Protected Area, northwest England.



Figure 2: Aerial view of the Walney Island gull colony, northwest England, looking north. Photo taken in May 2022.

Historic colony monitoring

Gulls have been recorded nesting at South Walney since the late 1800s (Smith 1864), reaching a peak in the 1970s of 41,000 pairs of Lesser Black-backed Gulls and Herring Gulls (Hosey & Goodridge 1980). Historic numbers of pairs of Herring, Lesser black-and Great Black-backed Gull at South Walney are shown in Figure 3.

Since the 1970s, a steady decline has been observed in Herring Gull numbers, coinciding with the reduction and eventual closure of a neighbouring landfill, located 4 km northwest of the site, between 1979 and 1987. This decline was not seen within the Lesser Black-backed Gull and Great Black-backed breeding population until the late 1990s, however, suggesting that these species were less reliant on the landfill site as a food source; the Great Black-backed Gull population rose during this time from 24 pairs in 1980 to 54 in 1987, when the landfill was closed.

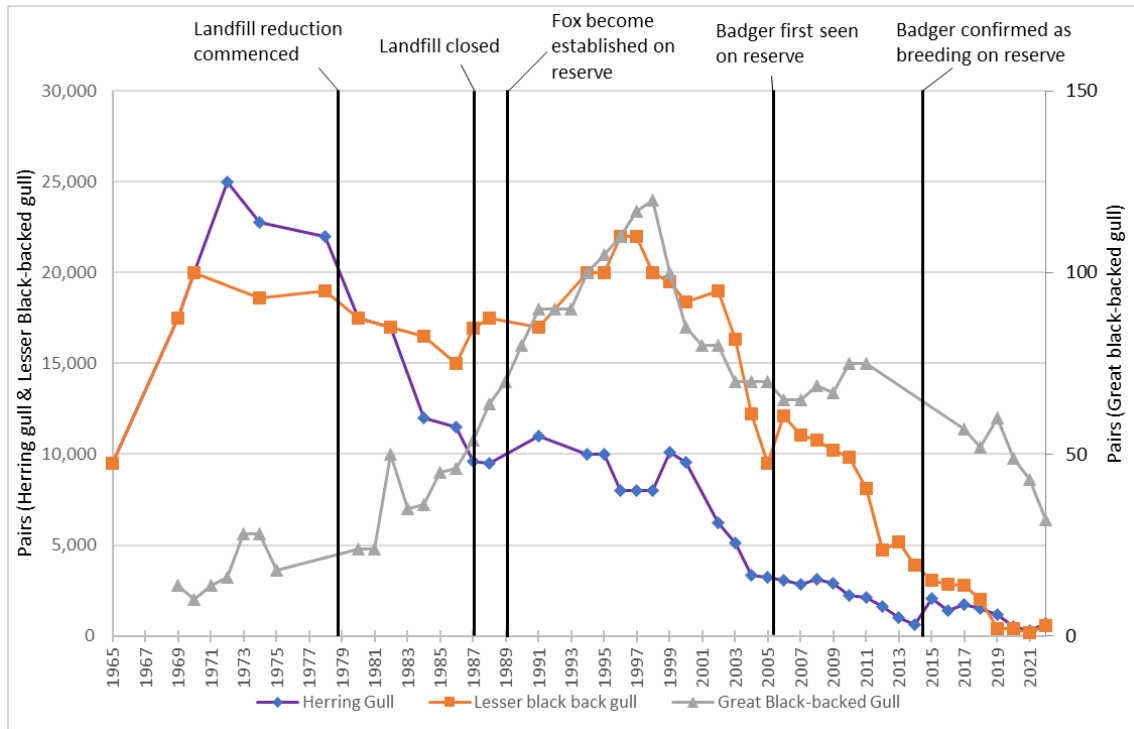


Figure 3: Nesting pairs of Herring Gulls *Larus argentatus*, Lesser Black-backed Gulls *L. fuscus*, and Great Black-backed Gulls *L. marinus* at South Walney, 1965–2021. Data: (Brown 1967; Hosey & Goodridge 1980; Dean 1990; unpublished data held by Cumbria Wildlife Trust and the Walney Bird Observatory).

While the Herring Gull decline continued, Lesser and Great Black-backed Gull numbers increased in the 1990s; Lesser Black-backed Gulls showed a moderate increase reaching a peak in 1996 of 22,000 pairs, and Great Black-backed Gulls reached a peak of 120 pairs in 1998. Following this, both of these species declined rapidly and the cause for this was not clear. Declines of all species occurred several years after Foxes were first seen on the island but continued further with the arrival and establishment of European Badger *Meles meles* (hereafter Badger) in the 2000s (C. Raven, 2022 pers. comm.).

Prior studies of the productivity of the colony have been conducted (Brown, 1967; Davis *et al.* 2018; Norris & Raven 2011), the latter two comparing the productivity within and outside areas of 12-strand electric fences erected from 2010 onwards (Table 1).

Table 1: Results of historic productivity studies of Herring Gull *Larus argentatus* and Lesser Black-backed Gull *L. fuscus* at South Walney.

Citation	Year	Lesser Black-backed Gull	Herring Gull
Brown (1966)	1962–65	1 chick fledged per pair	1 chick fledged per pair
Colin & Raven (2011)	2010	(Species not differentiated) 0.79 within electric fence, 0.16 outside	
	2011	(Species not differentiated) Zero both within and outside electric fence	
Davis <i>et al.</i> (2018)	2012	0.25 and 0.68 in two fenced areas 0.26 in an unfenced area	0.15 and 1.18 in two fenced areas 0.4 in an unfenced area

Productivity for both Lesser Black-backed and Herring Gulls was reported as ‘low’ or ‘catastrophic’ in the Walney Bird Observatory’s annual reports in six of the years between 1998 and 2010, and ‘poor’ from 2013 to 2016. Since 2017, there was zero productivity at the colony, largely attributed to Fox and, increasingly, Badger predation, as evidenced by trailcam footage of both Badgers and Foxes within the colony (Cumbria Wildlife Trust, unpublished data). Cumbria Wildlife Trust arranged for the necropsy of 40 dead birds (38 chicks and two adults, all Herring or Lesser Black-backed Gull) between 2017 and 2020 and mammalian predation was proven to be a significant mortality driver. This was particularly evident in 2020 where trauma caused by mammalian predators was found to be the cause of death of six of 12 birds examined, with a further four killed that year by trauma from an unknown source.

Great Black-backed Gulls nest both within the main gull colony and elsewhere on the reserve at South Walney. Their population size and breeding success has not been studied in as great detail as the other two species, but they have been recorded as breeding on Walney Island since 1700 (in ‘vast numbers’, Mitchell 1892), then continuously from 1946 when a single nest was recorded on the reserve (Dean 1990).

Fence construction

Due to continuing decline in numbers and productivity (Norris & Raven 2011, Davis *et al.* 2018) a 12-strand electric fence was erected seasonally around the Spit Colony from 2012 onwards (Figure 4 and

Figure 5). Although there was some reduction in predation recorded, by 2016 it was clear that it was no longer effective, with signs of Badger and Fox regularly found within the fenced area.

The temporary fencing was replaced with permanent fencing: a 1.15 km fence enclosing an area of 7.34 ha was installed in March 2021. The fencing used was Tornado HT15/158/8 high tensile Badger-proof fencing (White & Hirons 2019). It has an 'apron' of fence dug-in to the shingle substrate at a depth of approximately 20 cm, and extending horizontally for 30 cm, and a height above ground of 1.5 m. This was then topped by three strands of electric fence to bring the full height to 1.8 m. Between the 2021 and 2022 seasons, an additional overhang was added to bring the total height to 2 m. As it must allow stock to move freely through the area outside of the bird breeding season, two gates were installed at opposite ends of the colony; when closed for the season these are crossed several times with live electric wire to dissuade any attempts by predators to push through. The gates also rest on a buried solid concrete lintel, again with a subterranean 'apron' of fence dug in but extending instead to 1 m horizontally to provide additional protection.



Figure 4: Clockwise from top-left: 12-strand temporary electric fencing used from 2011 to 2020; fence in 2022 showing overhang; gate configuration in 2022.

Recent colony monitoring

In both 2021 and 2022, a count of AON of all three species nesting in the colony (Herring Gull, Lesser Black-backed Gull and Great Black-backed Gull) was undertaken using an unoccupied aerial vehicle (UAV, or drone). A DJI Inspire 1 Pro with a Zenmuse X5 camera was used to photograph the colony from a height of 40 m. This allowed the species of adult gull to be identified from the resulting imagery but did not cause disturbance to the colony; studies have shown gulls able to tolerate drones flown as low as 5 m (Rush *et al.* 2018).

Flights were undertaken on the 1 and 3 June 2021, and the 29 May 2022 and 1 June 2022, when most gulls had full clutches. Images were processed and orthorectified using OpenDroneMap software (OpenDroneMap Authors 2020). The images were then georeferenced using known ground features, and manually analysed using QGIS software (QGIS Development Team 2022). Gull AONs were defined either as locations that were an obvious nest, or where gulls were observed at the same position during both flights.

Productivity was measured via chick ringing. On each visit, all young gulls found were ringed if they were of ringable size with a metal British Trust for Ornithology ring and a green colour ring as part of the North West England Gull Project (<https://www.nwgulls.org.uk/>). On each subsequent visit, all chicks recaptured or found dead were recorded, and once all chicks had fledged at the end of the season, several searches were made for any dead chicks with rings. In 2021, four visits were made on the 1, 5, 6 and 20 July and the ringing totals method was used, as per Gilbert *et al.* (1998). In 2022, with a greater number of chicks present, the capture-mark-release method was used (Gilbert *et al.* 1998), with three visits made on the 4, 15 and 21 July.

Results

In 2021, we recorded the lowest numbers of nesting Herring and Lesser Black-backed Gulls at the South Walney colony since the 1940s (Oakes 1953). In 2022, AON numbers increased from 263 Herring Gull to 575 (an increase of 119%) and from 186 Lesser Black-backed Gull to 553 (an increase of 197%). This was the first increase in numbers for Herring Gull at this site since the 1960s (Brown, 1967), and for Lesser Black-backed since 1997. Great Black-backed numbers within the colony declined from 49 in 2019, to 38 in 2020 and 28 in 2021 (Table 2 and Figure 5).

Table 2: Number of Apparently Occupied Nests as identified on unoccupied aerial vehicle imagery in 2021 and 2022.

Species	Apparently Occupied Nests 2021	Apparently Occupied Nests 2022
Herring Gull	263	511
Lesser Black-backed Gull	186	448
Total	449	959
Great Black-backed Gull	38	28

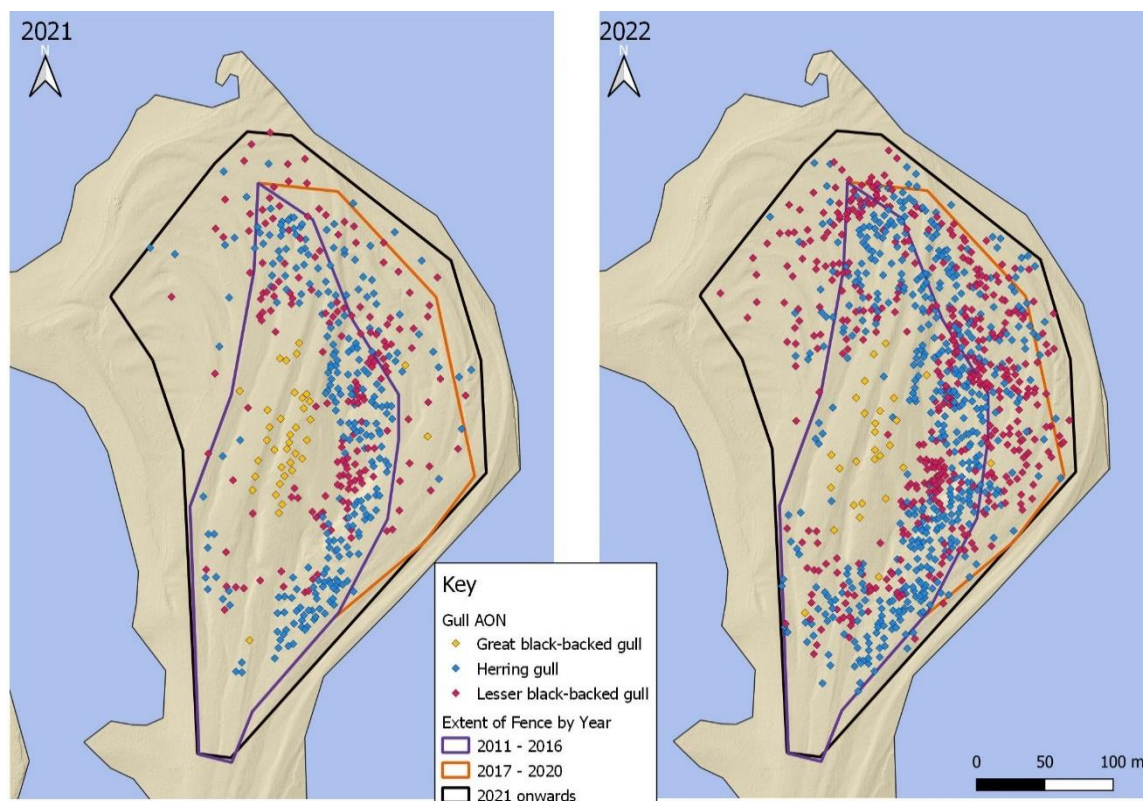


Figure 5: Maps showing locations of Apparently Occupied Nests (AON) of Herring Gull *Larus argentatus* and Lesser Black-backed Gull *L. fuscus* at South Walney in 2021 and 2022, and the fence layout from 2011 (12-strand electric), 2017 (12-strand electric) and 2021 onwards (permanent).

In 2021, a total of 153 chicks were ringed across the 3 species of gull (Table 3). Of these, 22 Herring Gull, four Lesser Black-backed Gull, and two Great Black-backed Gull ringed juveniles were later found dead in the colony. The final productivity figure assumes all other chicks not found dead had fledged, and that all chicks were ringed.

In 2022, a total of 205 Herring Gull chicks, 274 Lesser Black-backed Gull chicks and 48 Great Black-backed Gull chicks were ringed on three visits (Table 3). Of these birds, eight Herring Gull and two Lesser Black-backed Gulls were found dead on subsequent visits (Table 3). We estimated total productivity per AON for each year using a mark-recapture method (Gilbert *et al.* 1998; Table 3).

Table 3: Productivity of Herring Gulls *Larus argentatus*, Lesser Black-backed Gulls *L. fuscus*, and Great Black-backed Gulls *L. marinus* at South Walney 2021 and 2022, estimated from chick ringing, mark-recapture methods and counts of Apparently Occupied Nests (AONs).

Species	Number of chicks		Chicks found dead		AONs		Productivity	
	2021 (ringed)	2022 (estimate)	2021	2022	2021	2022	2021	2022
Herring Gull	75	205	21	8	263	511	0.21	0.4
Lesser Black-backed Gull	31	274	4	2	186	448	0.15	0.61
Great Black-backed Gull	42	48	2	0	38	28	1.05	1.21
Total	153	527	27	10	494	987		

Predation

Predators were not observed within the colony in 2021 until 6 August, when young Foxes were captured on trailcam within the colony, possibly having jumped over the fence. Evidence of chick remains preyed upon by mammals was found on the 11 July, and possible signs of digging from within the colony (attempting to dig out under the fence) had been noticed on visits in late July, suggesting that foxes had been active within the fence from early July onwards. As a result of this, an overhang was added to the fence in winter 2021/22, and consequently no Fox activity was recorded within the fenced area in the breeding season of 2022. No evidence of Badgers was found within the fence, nor any sign of digging attempts on the exterior of the fence, in 2021 or 2022.

The plucked remains of two large chicks were found on the 2 August 2021 suggest an avian predator predated in the colony at this time. In 2022, several prey remains with signs of avian predation were found, particularly later in the season. Remains of gull chicks (legs, breastbones) were found adjacent to Great Black-backed Gull nests in 2022.

As in previous years, dead chicks were submitted for necropsy by the Animal and Plant Health Agency. In 2021, only three dead chicks were found in condition suitable for this. Of these, one small chick (< 3 days old) died of yolk sac issues. Of the other two, both had peck wounds, and whilst these were only serious enough to cause death in one, the other died of starvation.

In 2022, seven birds were found in suitable condition for necropsy; six chicks and one adult. All but one of the six chicks appear to have starved, with scant or no food remains found in the gizzard or stomach. One chick had small pieces of glass, string and plastic in the gizzard, whilst glass was also found in the gizzard of the adult bird. The cause of death for one chick could not be determined.

All birds sent for necropsy tested negative for highly pathogenic avian influenza.

Discussion

Gulls fledged in 2021 at South Walney for the first time since 2016, and their productivity continued to improve in 2022. However, other than for Great Black-backed Gulls, productivity remained low. The productivity figure of 0.21 for Herring Gull in 2021 and 0.40 in 2022 is well below the figure required for stable population (between 1.3 and 1.5; Cook & Robinson 2010) and below the mean national productivity value (0.57 in 2019; JNCC 2021). For Lesser Black-backed Gull, we are unsure of the productivity required to maintain a stable population, but the figure of 0.15 in 2021 also falls below the mean national productivity of 0.52 chicks per nest (JNCC 2021), although this improved to 0.61 in 2022. It is therefore clear that there is still an issue with productivity at the Walney colony with these two species. The higher productivity (1.05 in 2021 and 1.21 in 2022, against a national average of 0.9 in 2019; JNCC 2021) of Great Black-backed Gulls suggests that the factors affecting the two smaller gull species in the colony – such as difficulties with food source, or predation – are not affecting this species. However, unlike the Herring and Lesser Black-backed gulls, numbers of Great Black-backed Gull continued to decline in 2022.

The increase in the number of breeding birds in 2022 could be the result of recruitment of failed breeders from a nearby colony at Spirit Energy's Rampsid Gas Terminal, 4.2 km to the north of the South Walney colony. This colony held 150 Herring Gull and 329 Lesser Black-backed AON in 2019, increasing to 450 and 695 respectively in 2021 (Cumbria Wildlife Trust 2021, unpublished data); but a breach of the perimeter fence by Foxes caused complete failure of the colony in both 2021 and 2022, when the colony had reduced to an estimated 300 pairs of gulls (G. Brooke, 2022, pers. comm.).

The continuing low productivity of Herring and Lesser Black-backed Gulls requires further investigation. Evidence points to at least some of this being due to predation by Great Black-backed Gulls within the colony itself.

It can be concluded that the erection of the permanent predator fence prevented complete failure of the South Walney colony by reducing (in 2021) and eliminating (in 2022) large mammal predation. It is recommended that similar fencing be installed at sites experiencing similar issues with predation.

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