Baltray Little Tern Colony Report 2023
Louth Nature Trust

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ABSTRACT

The wardening for Season 2023 started on the15th of May and continued to the 11th of August. Two full-time day wardens and two night wardens were in operation throughout the season, with volunteers filling the gaps, to provide 24 hour coverage. The 2023 breeding season in Baltray resulted in 80 fledged chicks, a decrease from the previous season, as a result of higher predator occurrence on site, extreme weather, and high tides. A total of 125 nests were found; 45 nests with 3 eggs (36%), 63 with two eggs (50%), and 17 with 1 egg (14%), making an average clutch size of 2.22 eggs per nest. The estimated number of breeding pairs for the season is 76, with an average incubation time of 20 days. 86 nests were lost in this breeding season: the largest cause of nest destruction was predation (58% of total nest loss) followed by high tides in June and July (29% of nest total loss). The first chick born was on Monday 19th June and the last was born on the 4th of August. 83 chicks hatched on site, the distribution throughout the season was 42.2% in June, 56.6% in July, with the least amount of hatching in August (1.2%).

1. BACKGROUND AND AIMS

1.1. BACKGROUND

The Little Tern (*Sternula albifrons*) is the smallest of Irelands five breeding tern species. Like many tern species, Little Terns are long distance migrants and are protected under the EU Birds Directive as an Annex 1, migratory bird (Birds directive 2009/147/EC), which means under Article 4 1. '*Annex I shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution*' in addition to this Little terns' breeding ground, nests and eggs are also fully protected under the Wildlife Act (1976, Amended 2000). Human disturbance is a significant and longstanding cause of reduced nesting success in Little terns (Fasola et al., 2002; Ratcliffe et al., 2008). Conservation action, i.e. wardening, electric fencing and predator management is thus required at all sizeable colonies including Baltray.

Little Terns winter in West Africa and return to the Irish shores to nest in late April and early May before departing again in late July or August. Unlike the other four Irish tern species, which usually breed on islands, the Irish Little Tern population nests on mainland sand or shingle beaches. Nests are composed of a shallow dip scraped in the beach substrate above the high tide line, and the eggs and chicks are well camouflaged in the sand and shingle. This means that they are highly vulnerable to human recreational disturbance and sea level rise and, exposed to the complete suite of predators.

1.2. LITTLE TERN COLONIES IN IRELAND

Little Terns form relatively small colonies along the west and east coasts of Ireland, with 14 of the 24 colonies found in 1995 on coastal islands and ten colonies on the mainland. On the east coast there are colonies from Wexford to Louth, and on the west coast from Kerry [the map shows a site in Cork] to Donegal (Hannon et al., 1997). Primary sites on the east coast are better known. Those that have recently supported colonies of breeding Little Tern are Kilcoole (Co. Wicklow), Baltray (Co. Louth, as covered in this report), Wexford Harbour and Tacumshin (Co. Wexford), and Portrane/Rogerstown (Co. Dublin). North Bull Island (Co. Dublin), and Buckroney (Co. Wicklow), historically supported Little Tern colonies but are no longer used due to high levels of recreational disturbance.

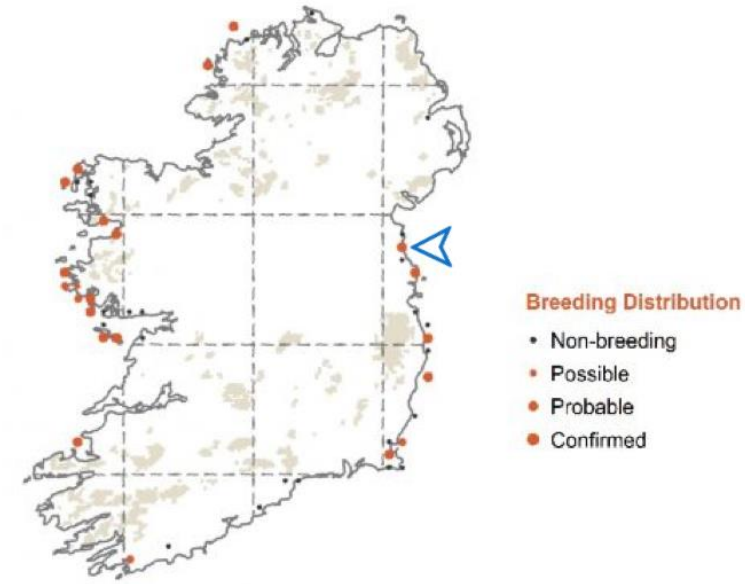

Figure 1. Breeding distribution of Little Terns in Ireland. Blue arrow indicates Baltray. (birdwatchireland.ie/birds/little-tern/)

In County Wexford Little Terns have been recorded nesting in new breeding locations at Raven Point and a site known as "New Tern Island" off the Rosslare Backstrand in Wexford Harbour since 2009. Elsewhere in Co. Wexford, there are reports of nesting at Cahore in recent years. Despite the success at sites such as Baltray (up to 2014) and the apparent expansion to former breeding locations, Kilcoole is most likely the only site on the east coast to have attracted nesting Little Terns every year since 1984. The most successful breeding year to date, for little terns was at Kilcoole, was in 2015, with 155 pairs producing 301 chicks, 289 of which were presumed successfully fledged (Doyle et al., 2015).

1.3. LITTLE TERN COLONY IN BALTRAY

3.1.1. THE NINETEENTH AND EARLY TWENTIETH CENTURIES

Little Terns were first definitively reported breeding in county Louth in 1900 by RJ Ussher: "Little Terns have laid on the coasts of Louth…" and this refers to records collected from 1866 (Ussher & Warren, 1900); unfortunately, Ussher does not mention the location in county Louth. Kennedy refers to a possible decline in Little Tern numbers since Ussher's report but reports one unidentified area in county Louth with up to ten nests in 1946 (Kennedy, 1953). Subsequently Kennedy (1954) reported a possible decline of

Little Terns, however Hutchinson (Hutchinson, 1994) thought that this may have more accurately reflected changes to their nesting site, a phenomenon well known in the ecology of Little Terns (Cabot & Nisbet, 2013).

3.1.2. THE LATE TWENTIETH CENTURY (1960S AND 1970S ONWARDS)

There are no detailed records of the site during the 1960s and 1970s, but reliable observers noted Little Terns flying up and down the estuary, apparently nesting on both the beach and on sandbanks/mud banks farther up the estuary than the present-day site (Dominic Hartigan, pers. comm. 2013). During the 1960s and 1970s, Irish people started to frequent beach areas in unprecedented numbers. The site at Baltray is relatively inaccessible with 2km of dunes to cross, but nevertheless An Foras Forbartha reported that this was starting to become a significant issue by 1970 (NPWS). The 1968–72 Breeding Atlas (Gibbons, 1973) recorded a small colony at Baltray. Following the results of the 1984 tern survey (Whilde, 1985), the need for conservation of Little Terns was identified due to declining numbers. This effort was spearheaded by the Irish Wildbird Conservancy (now BirdWatch Ireland) in 1986 by John Coveney, Ian Herbert and Larry Lenehan with fencing, wardening and detailed surveillance and reporting. Thereafter, sporadic efforts were made at fencing and wardening but as this was largely volunteer-dependent it had mixed success (L. Lenehan, pers. comm. 2014). Historically the Little Terns at Baltray have undergone a series of extremely poor breeding seasons and occasional rearing of a small number of young but with productivity hovering just above zero. Attempts were made to monitor the site from 1984 onwards, with observers noting that Little Terns continued to attempt to breed at Baltray, but that breeding success was very low (Larry Lenehan, pers. comm.). Principally, breeding productivity of the colony was hampered by a combination of disturbance and predation by a range of nest predators.

3.1.3. INTENSIVE WARDENING AT BALTRAY, IN THE TWENTY-FIRST CENTURY

The Little Tern protection Scheme began in 2007 set up by Sandra McKeever and Margaret Reilly and comprised a team of volunteers, since then it has grown into the Louth Nature Trust gaining more volunteers and funding from Heritage Council and the NPWS and has continued to spread awareness throughout the local area and throughout Ireland. The implementation of wardening and fencing has led to an improvement of breeding success of Little Terns at Baltray. In 2007 and 2008 the project did not have sufficient funding for paid night wardens and suffered heavily from predation by Hooded Crows (*Corvus cornix*) (2007) and gull spp. (*Larus* spp.) (2008). The project reached its peak success in 2009 and 2010 when funding from both the NPWS and Heritage Council helped pay for wardens to cover the entire night, providing the colony with 24-hour protection. In both 2009 and 2010, 43 pairs bred, fledging 94 and 96 chicks respectively (Reilly, 2009; 2010). In 2011 withdrawal of NPWS funding meant that 24-hour wardening could not be provided, leading to the predation of 37 eggs, mostly between 11pm and 4am when wardens were absent. However, 2011 was still very successful with 49 pairs fledging 84 chicks (Reilly, 2011). However, 2011 was still very successful with 49 pairs fledging 84 chicks (Reilly, 2011). The following year, 2012, proved to be a difficult year as extremely inclement weather led to the loss of 41 eggs to spring tides and 45 eggs were predated by a fox in the early hours of 17 June before the night warden arrived. Therefore 33 pairs fledged only 24 chicks (Reilly, 2012). This was the poorest breeding year experienced by the project so far, however given the very poor conditions for breeding in 2012 even 24 fledged chicks was a significant

achievement and a testament to the hard work of the project wardens. This is especially true considering that Kilcoole experienced zero breeding success in 2012 due to similar circumstances (Keogh *et al.*, 2012). The 2012 breeding season illustrates the importance of the Little Tern protection scheme at Baltray. Since the Little Tern protection scheme at Kilcoole was set up in 1985, the breeding success of Little Terns on the east coast has been largely dependent on this one site. Such heavy dependence on one site would leave the east coast population very vulnerable if Kilcoole were to suffer a number of disastrous washout years such as was experienced in 2012. Therefore, the setting up of a second, intensively -wardened Little Tern protection scheme at Baltray has been vitally important. It is helping the Irish Little Tern population to grow as well, as reducing the dependence on a single breeding site. Recent years shown good breeding success at Baltray Beach with 90 fledged chicks in 2020 (Normanly et al.2020), 142 fleged chicks in 2021 (Kenny et al. 2021) and last year achieving 146 fledglings (Moenner et al.2022).

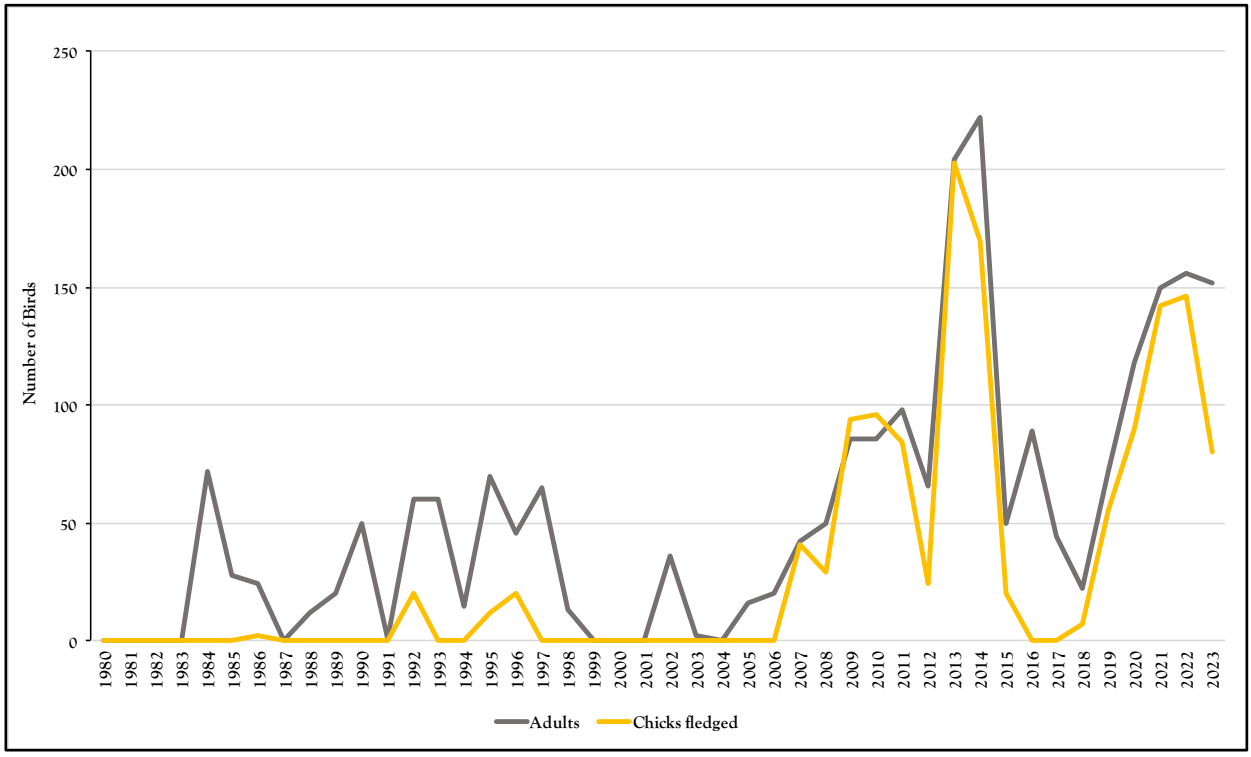

Figure 2: Number of Adult Little Terns (Grey) and fledged Little Tern chicks (Yellow) from 1980 - 2023

1.4. AIMS

Given the fact that Ireland holds internationally important populations of nesting Little Terns, and with the species listed as Amber on *Birds of Conservation Concern In Ireland 2020-2026* (Gilbert *et al.* 2021), and protected under the EU Birds Directive as a migratory bird (Birds directive 2009/147/EC), it is important to monitor Little Terns throughout the nesting season, their period of greatest vulnerability.

The aim of the Little Tern Protection Scheme in Baltray is ....

- To protect both adult Little Terns and chicks during their breeding season at Baltray to optimise their survival.
- To monitor Little Tern data such as nest numbers, eggs laid, chicks hatched, and fledglings.
- While the birds are easily viewable it makes the breeding season a prime time to collect additional data on Little Terns' breeding, feeding behaviour, and ecology.

- Other additional aims are to promote awareness as both a form of education on Little Terns but also to minimise human disturbance in the area.
- Gather additional data on other species in the area.

2. STUDY SITE

Baltray's Little Tern colony nest on Baltray Beach, in an area known as the Haven (53°43'42.3"N 6°15'00.0"W). The colony site contains both sand and shingle and is located between the sea and the Boyne estuary, which is a marked Special Protection Area and Special Area of Conservation. The location is suitable for Little Terns as their foraging range is small (Taylor and Roe, 2004; Ramos et al. 2013) and the proximity to the estuary/river is ideal as they contain nurseries for juvenile fish (Taylor and Roe 2004; Conner et al.2019). The beach structure of Baltray Beach changes considerably year after year as a result of extreme weather, characteristics of each pen for the 2023 season is explained in Table 2. Section 5 of the Report. The nesting site characteristics were not only prone to change season-to-season but also within the same season due to weather, namely large amounts of sand blowing up into the pens particularly the northern end pens. The 2023 penned nesting area began at its southern end roughly 16 meters in from the training wall next to the Boyne river, and continued 900m northwards to the shingle area adjacent to the pump house. This season, an addition small pen (colloquially referred to as "Maurice's Pen") was placed 40meters more northerly to protect 3 nests which were outside the original pens. In front of the nesting site is the intertidal area of the beach, the distance from mean high water mark to mean low water mark is roughly 300meters. Behind the nesting site is a buffer zone of Marram grass and small embryonic sand dunes roughly 30-40m in size. Roughly the last 9-10 meters at the back of the pens were more heavily vegetated areas (changes between pens see Table 2, Section 5). To facilitate the wardens and volunteers, A portaloo, volunteer caravan (used as a base) and a warden caravan (to live onsite) were present on site the during of the nesting season.

Figure 3. Baltray Little tern breeding site situated between the Boyne estuary and coast. Pens were divided up into 12 different sections with a buffer zone in front and behind. Image created through GoogleEarthPro.

3. CONSERVATION MEASURES

3.1. FENCING

At the start of each breeding season fencing is put in place on site. 10 Pens were fenced with electric fencing the main purpose of which was to deter foxes, to discourage dogs from wandering into pens, but also to provide a visual boundary for beach goers (Figure 4). Non-electric flexi plastic fencing was used to fence off a buffer zone behind the pens roughly 40 meters back from the pens (Figure 5) to limit disturbance and damage further. Motion-activated solar powered lights were placed on the buffer zone poles and fencing. In front (downshore) of the pens, a distance of 20 meters was marked with large wooden pillars and the public was asked to keep to the further side through signage and verbal communication (Figure 6). Ideally this area between the pens and the wooden pillars would also be fenced up, but as the tide regularly reaches this level of the beach, the fencing would get regularly damaged and catch debris.

Additional spare fencing and poles were used for an extra pen when it was found that Little Terns were nesting further north than usual. The fence was rendered unusable by a rising high tide during the season and was replaced by poles and string. The string fencing aimed to protect the nests from trampling by humans but did not prove to be an effective deterrent for dogs.

Figure 4. Electric fencing divided nesting zone into 10 pens, its purpose to deter foxes and as visual boundary to public

Figure 5. Green plastic fencing to mark the buffer zone

3.2. SIGNS

Many different forms of signage were placed around the Terns' nesting site. Two large weatherproof informational bullet notices which showed basic information on little terns: information on their breeding grounds, images, and advice for the public to limit disturbance. In addition, many smaller signs were attached to the poles surrounding the site. There were many of these smaller signs placed on both the northern end, southern end for those entering the beach, and along the width of the pens beachside as well. Smaller signs included the message to keep dogs on leads and also not to enter this breeding area of a protected species. Blackboards were also updated throughout the season which helped to limit disturbance, especially once chicks had arrived. It was also for the public to get the information on how the season was doing.

Figure 6 and 7. Figure 6 shows wooden pillars and sign asking the public to not pass that point of the beach and both Figure 6 and 7 contain chalk board updates for the public updated throughout the season.

Figure 8. Shows chalkboard update as well as weatherproof informational bullet notice which showed basic information on Little Terns, information on their breeding grounds, images and advice for the public to limit disturbance.

3.3. RELOCATION OF NESTS

Due to the proximity of the nesting site to the shore line, high tides were a factor of high concern in relation to nest loss. In an attempt to combat this, and minimize damage to nests on days/nights that tides were predicted to be high, vulnerable nests (mainly those in the buffer zone) were relocated slightly further back up the beach. The relocation was done by taking an image of the original nest then replicating the nest

further back between (50cm- 2 meters from the original nest). Relocated nests were made by imprinting a fist into the sand and replicating the decoration of the original eg. arrangement of shells. After the new nest looked sufficiently like the photo, the tern eggs were moved to the relocated nest and the original nest was covered so as to not disorientate the parent bird. The task of making the relocated nest was done carefully, but quickly to minimize agitation of the parent bird or leave the eggs unattended too long. The relocation, in preparation for high tides, was done on 4 nests in the buffer zone during the season, and the parent bird was observed to sit successfully following each. The fastest returned back and sat 1 minute after completing the move, the slowest took 30 minutes. (This was the first attempt at relocation and the original nest was not efficiently hidden, the parent bird experienced disorientation, initially returning to the original nest). As well as in advance of predicted high tides, relocations were also required after tides unexpectedly made it up into the pens and eggs were submerged under water. 11 eggs from 7 nests were located (most found in amongst the seaweed), these were placed 1-2m back from the high tide line (and in some cases up to 4m from where the original nest had been). High tide on the 7th July was at 6am and these relocations were done was done at 9am-11am. Out of these "seaweed nests" 6 nests had a parent bird return and sit on them and 5 nests resulted in a chick hatching. It is worthy to note that although some eggs that were submerged in the water were abandoned or were inviable this season, not all eggs found in the seaweed were rendered inviable, similar to findings of last year and other papers (O'Connell *et al.* 2014; Moenner et al. 2022). Recovery efforts of the 7th of July lead to 5 nests successfully hatching 7 chicks from egg retrieval and relocation of nests that day. Recommendation for next season as seen in a paper from Kilcoole (O'Connell *et al.* 2014): a day before the move, objects were placed beside the nest (often brightly coloured). When the nest was moved, the bottle caps were moved in relation to it to help the parents orientate to their new nest. Eggs fostering is becoming a more common wardening technique, to increase colony production by minimizing losses. Egg fostering is the placing of eggs abandoned after partial predation or damage to a nest, into another nest. There was no egg fostering done this season as the appropriate conditions did not arise. Egg fostering requires that eggs are placed in a nest at a similar incubation stage, which has an incomplete clutch and it risks abandonment of the original eggs in the foster nest. However, it was possibly done unintentionally as the eggs found in the seaweed were could have come from a number of nests and a reasonable guess had to be made, and could have resulted in a fostering scenario. There was an occasion where, on entering a pen after fox was recorded, 3 Common ringed plover (*Charadrius hiaticula*) eggs were found spread around loosely out of nests. Knowing that there had been two full nests of ringed plovers in the pen, one nest was located which had 1 egg remaining the three found were placed in it. A parent bird sat on the nest and resulted in 3 chicks.

3.4. TUNNELS

Tunnels were placed out in pens when chicks began to hatch, this was for two main reasons 1) Chicks are vulnerable to harsh weather: intense rain, wind and heat and 2) For protection: tunnels acted as hiding spots against avian and land predators. Marram grass was observed to be the main hiding spot for chicks when humans entered the pens, however, on one occasion, on entering to mark and count eggs and nests, a chick was observed in the shelter using it as a hiding space (as shown in fig 9). It offers some shelter on otherwise baron (bar the odd bit of vegetation) habitat.

Figure 9. Chick hiding in tunnel shelter provided, Image taken under NPWS Licensing

3.5. PREDATOR MANAGEMENT

Wardens act as a deterrent to predators and keep an eye out for them, or evidence of them. During the egg stage, the biggest day predator of the eggs were the Hooded crows (*Corvus cornix*) around which, the terns would congregate and swoop while the corvid was in the air and effectively repel it, but, when the crow is on the ground, this behaviour is less effective. The role for the warden is clapping them away and making loud noises if they would get near pens. It was necessary when marking nest locations to be subtle, and mark a distance from the nest because of the crows' ability to spot identifers. The Sparrow hawk, Kestrel and Perigrine falcon visited the colony this season. A knowledge of the different behaviours allows the warden to deal with the threats to the colony. The Sparrow hawk flies low to the ground so the warden scans low in the buffer zone to look for them and makes noise if seen. The kestrel was a slower hunter and hovered over the area. This given time for the Wardens to get to that area clapping the hands and chasing the bird away to more distant dunes. There have been reports suggesting that Little Turns do not interact with the kestrel, but the colony at Baltray certainly did, mobbing them which served more to alert the warden than driving the Kestrel away. The Peregrine falcon was harder to deter if not on a perch: they flew in at such speed and took birds from shore line. The threat to the Little Turn colony was reduced due to the abundance of juvenile common terns on the beach at the end of the season which because their prey of choice which were identified by feathers and severed head found a short distance away from site.
The fencing was also to deter predators (although in the log book it was recorded that a fox was seen jumping over the fences through the pens while being chased off). The electric fence feature of the fencing was only effective towards the centre pens which resulted in the outer pens becoming more vulnerable (and were the most frequently targeted). Night wardens and Maurice Conaghy had to deal most with the mammalian predators which consisted of fox and stoat at night. The night wardens carried firearms and they also had traps laid out in buffer zones (but nothing was caught in traps).

3.6. WARDENING

This season, full-time day wardening started on 15th of May and continued to the 11th of August. Two full-time paid day wardens and two night wardens were in operation throughout the season with volunteers filling the gaps and the day warden's day off (Saturday), for 24 hour coverage. Wardening consists of using binoculars and telescopes to observe the Little terns, locate nests, and scan for predators. In addition to recording nest location and egg numbers, information was noted on data such as animal behaviours, feeding and ecology. When a parent bird stayed sitting on a nest for a prolonged period and a nest was established, an exploratory visit was made to the location and nest contents were noted. These visits normally involved one warden going into the pen while the other stood at the fencing in order to direct from the outside of the pen. The nest area was marked with a black tent peg approximately half a meter directly in front of the nest, a stone was place upright against the peg with the nest number written in black sharpie for example #100 (see *Figure 12.).* The writer, outside the pen, would write nest number, contents (1-3 eggs), sometimes a short nest description (decorated/or not / sandy or shingle etc) and then a location code to associate with that particular nest. The location code was determined by the following method: Each pen had a number P0 to P10. This is the first part of the location code. Along the outside fencing of each pen had been placed pegs marked A-J dividing the pen up horizontally into 10 bands along the length, a letter and number (0-9) was given to its position so if a nest was halfway between peg A and B was given the code A5. This was the second part of the code. The Pen was vertically split into 3: close(X), middle(Y) and far(Z) relative to the observation point. (observed from a paper of previous warden Doyle et al. 2013) so nest in Pen 4, between A and B, Far back (towards the sea) was given the code P4.A5.Z (see Location in *Table 1.*) This made the weekly scan of nest and recording their contents considerably quicker and lessened disturbance to the parent birds, as the directing warden on the outside would simply direct the inside warden with the codes and swiftly record and move onto next. The inside visits were also beneficial as there were some areas of the pen, due to the geography and shaping of the land, which were not visible from the outside of the fencing. If pen exploration had not been done, some nests would not have been observed and recorded. To avoid disturbance there were days when no exploratory visits were made. On these days, 'Role call' was done through the telescope and binoculars to observe whether a parent bird was sitting on its nest, to identify when a nest was abandoned or predated. It was not possible to count how many eggs were in a nest, despite having a high quality telescope. Egg count was useful to determine if the clutch was complete. It was deemed complete if there were 3 eggs or if no new eggs were laid after 3 days. The egg observations and recording, give a better idea of expected hatching dates for nests.

Figure 10. Warden Nina Rogerson using Binoculars to locate new nests

Figure 11. Warden Brónagh Barnes using telescope to count Little terns at the shoreline

Table 1. Sample of how nest were logged: location was noted by Pen number in red, location in pen blue, x near, y middle and z far and then V or NV for if it was visible or not from outside the pen. Row was highlighted when nest was lost/no longer active.

Nest Number	Location	Notes	Status	Ringed	Thu 01 Jun	Fri 02 Jun	Sat 03 Jun	Sun 04 Jun	Mon 05 Jun	Tue 06 Jun	Wed 07 Jun	Thu 08 Jun	Fri 09 Jun	Sat 10 Jun	Sun 11 Jun
1	P6.E2.X.V	In front of grass tufts			found on 26th	2E	-	-	-	2E	-	-	2E	-	-
2	P6.E7.Y.V	behind to the right of second veg in row				2E	-	-	-	2E	-	-	2E	-	-
3	P3.G9.Y.V	Mound top right hand corner	Incubating	Sat 03 Jun			3E	-	-	3E	-	-	3E	-	-
4	P3.I0.Z.NV	Razor clams top right hand corner	Hatched	Sat 03 Jun			2E	-	-	3E	-	-	3E	-	-
5	P3.H4.Y.V	left of brick	Incubating	Sat 03 Jun			3E	-	-	3E	-	-	3E	-	-
6	P3.F8.Y.V	Pottery Stone	Incubating	Sat 03 Jun			2E	-	-	2E	-	-	2E	-	-
7	P3.B8.X.V	Down from veg left	Hatched				2E	-	-	2E	-	-	2E	-	-
8	P3.H5.Y.V	End of grass	Incubating				2E	-	-	3E	-	-	3E	-	-
9	P3.A8.Z.NV	Top left	Incubating				2E	-	-	3E	-	-	3E	-	-
10	P3.H2.Y.V									2E	-	-	2E	-	-

Figure 12. Nest 100 marked with black tent peg and stone with nest number

Figure 13. Nest 51 marked with stick and labelled stone nest was in front of pens and fencing in buffer zone

3.7. PUBLIC OUTREACH

Educating the public about Little Terns was an everyday occurrence for wardens, from explaining the Little Tern ecology to lone beach visitors to giving a talk on this season's progress to a group of Ramblers. Public disturbance consisted mainly of beach goers walking in the buffer zone or without their dogs on a lead. Most did so unknowingly and were happy oblige when informed, and many were eager to learn more about Little Terns and how this season was going. The Louth Nature Trust blog was updated throughout the season to update the public on this season's progress, keeping it engaging while getting the core message of nest, chicks and updates out to the public. Updating the public via the blog allows those for whom the location is inaccessible, for whatever reason, to not miss out on learning the year's nests and numbers. Communication with the public is a key feature in conservation and charities.

4. TOTAL NUMBERS AND NESTING PAIRS

A total of 125 Little Term nests were recorded over the 2023 breeding season, however due to disruption of nests throughout the season with predators and high tides, this number does not accurately capture birds using the beach or quantify the distinct nesting pairs. Flock counts combined with observations of roosting Little Terns on the shore line were averaged to be 124.24 +/- s.d. 27.36. At its highest, counts of Little Terns on the beach reached 300 (though as an outlier was not included in the statistics - this count was late in the season it wouldn't have given an accurate depiction of this colony's size as many of them were visitors based on their colour ring). Lower numbers were counted following the destructive high tide on the 6th of July, suggesting that some little terns in the Baltray colony relocated to Portrane and Kilcoole to re-lay. So the overall numbers of Little Terns in Baltray's colony did not remain linear throughout the season and may lead to over counting if these birds are included in breeding pairs of other colonies. The highest estimated number of breeding pairs occurred during the week of the high predator disturbance: 60 nests were labelled although many nests were lost by 19th June, 3 days later 16 more nests were located. Assuming there was not enough time passed for those extra nests to be re-lays (10+ days recorded for Sooty Terns in C.J. Feare,1975), there would have been a total of 76 nests on the beach that week. With 76 breeding pairs we can say that there were at least 152 adult Little Terns at one point during the season using Baltray Beach as a nesting zone, however only 40 breeding pairs actually had nests that resulted in successfully fledged chicks this season.

5. NESTS

5.1. LOCATION OF NESTS

The popularity of each pen was not equal, and it was clear to see pens which received a higher preference (see Figs 14 and 15). The busiest of pens did, however, change throughout the season as there were disruptions from predators and tides. A common trend that seems to be emerging on Baltray is the shift more northerly up the beach. The southern end (pens 0 and 1) used to be the main nesting area when the project began in 2007, however, they were very quiet areas in years leading up to 2023 and again this year. New fencing had to be put up after the initial set-up as the terns nested further up the northern end of the beach than expected, or was common of them to do so on this beach.

The pens' composition, may have been a factor in pen preference, such as vegetation, elevation, shingle-to-sand ratio. Another factor could have purely been that once an initial settlement of nests is established, this tends to encourage more nests in that area. Little terns do nest in groups; the mobbing behaviour of tern groups is a strong deterrent to predators, also increases predator vigilance, and early detection and warning of predators (Jungwirth *et al.*, 2015). There is strength in numbers, as an individual's risk of being predated is reduced in a group: the, dilution effect (Jungwirth *et al.*, 2015).

Two pens; 3 (21 nests) and 8 (20 nests) contained the most nests over the season. Pen 3 peaked at the beginning of the season (June) whereas pen 8 had a more consistent number throughout the season. Pen 2, 5, and 7 started to get busier towards the second half of the season (July-August). Surprisingly, 12 nests were in the buffer zone outside of marked pens (in front/shoreside). Edge pens, 10 and 0, had low numbers of nests (2 and 3 respectively) which is likely to be due to pen 10 being mostly sand, very open and bare, and pen 0 mainly made up of large rocks and pebbles. Both were near entrances to the beach and parts vulnerable to disturbance and predation. None from these edge pens resulted in hatched chicks. Pen 4, despite its neighbouring pens both having high numbers of nests, only held 3. One possible explanation is the almost complete lack of vegetation in this pen - other pens had scattered Marram grass and Sea beet throughout the pen or towards the rear of the pen This offers protection from wind and predation, in the chick rearing stage (Davis, 1981) when the chicks are more independent but not yet able to take flight. With the exception of pen 4, the centre of the colony does show higher nest numbers, more experienced birds are thought to nest in the centre whereas newly formed partners/first breeders tend to stay to the edge of colonies (McManus 2019).
Pen 1 was also low in nesting numbers, this could be for the opposite reason to pen 4: too much vegetation. Lopes et al. 2015 study found that for Little tern nesting pairs on sandy beaches, the optimal vegetation cover is 10%. They found that model indicated that just 4% of mating couples would endure with 90% vegetation cover, none would endure 92% vegetation cover and that the average breakpoint was 42% vegetation cover which Pen 1 considerably exceeded.

Table 2. Lists of pens, a short description of structure and how many nest were found in each

Short description of pen	pens	nests
Larger rocks and pebbles and lots of vegetation towards back of pen	pen 0:	3
Lots of vegetation back of pen/ more shingle to sand at front of pen	pen 1:	4
Mixture of sand and single, long mound at the front of pen, scattered vegetation	pen 2:	12
Sand and fine shingle, sparse scattered vegetation, identifying objects such as red bricks	pen 3:	21
Lots of Mounds, fine shinge, very little vegetation bare	pen 4:	3
Mixture of medium to fine shingel/ pebbles lots of bricks , veg etc	pen 5:	9
Lots of scattered vegetation and a large log, few sparse vegetation clumps	pen 6:	16
sand and fine single, more uneven ground, scattered vegetation	pen 7:	16
sand and fine single/ lots of vegetation towards back of pen	pen 8:	20
More sandy then shingle/ vulnerable to strong winds	pen 9:	4
More sandy then shingle/ vulnerable to strong winds	pen 10:	2
Nests Outiside the pen area More sand then further back the beach/ vulnerable to tides	OP(front)	12
Sand and fine shingle/lots of vegetation/high human and dog disturbance	Maurice's pen(north)	3

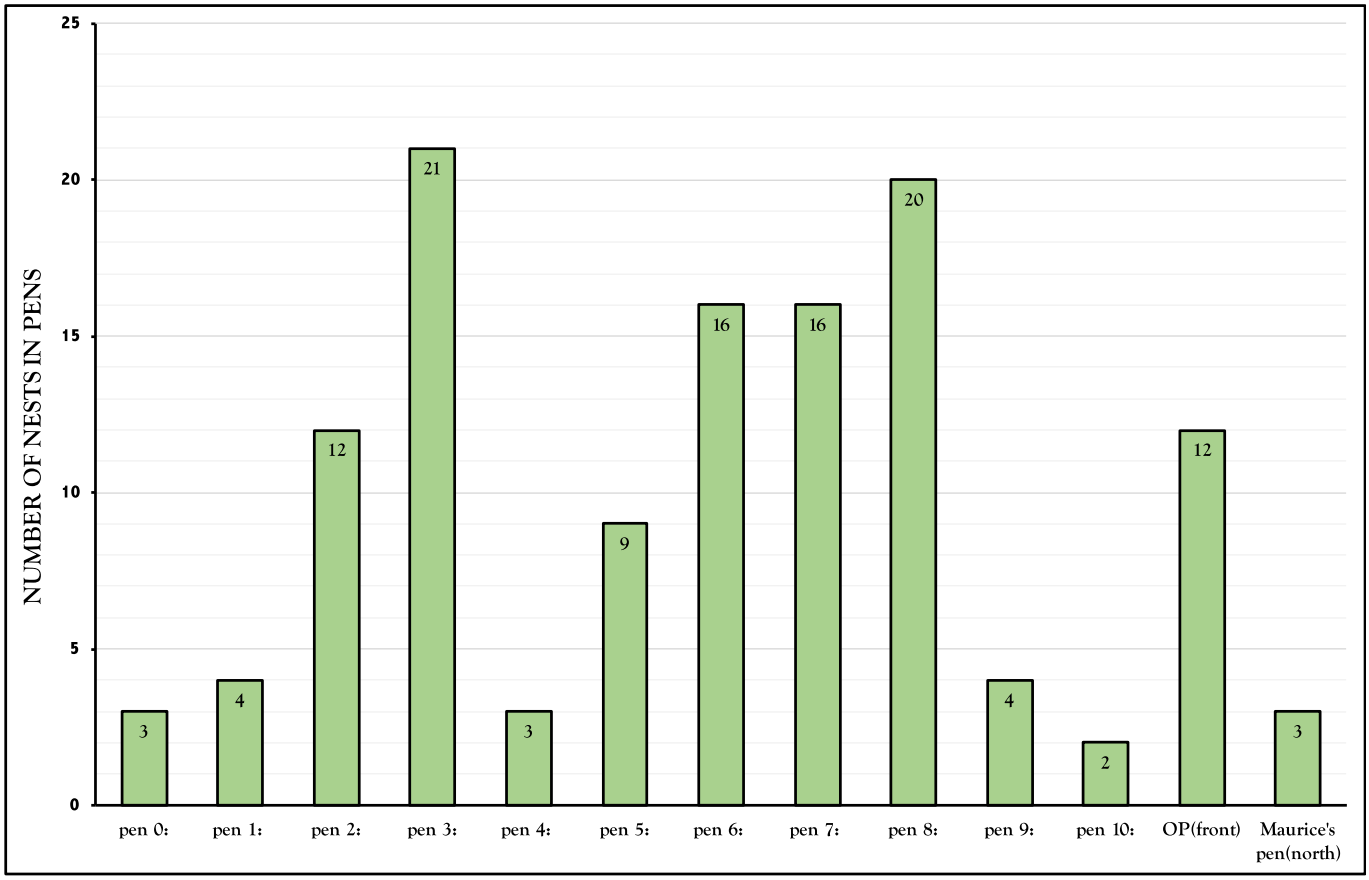

Figure 14. Number of nests found in each pen. Pens 0-10, OP stands for those found outside pens, and Maurice's Pen was a small pen north of the main pens.

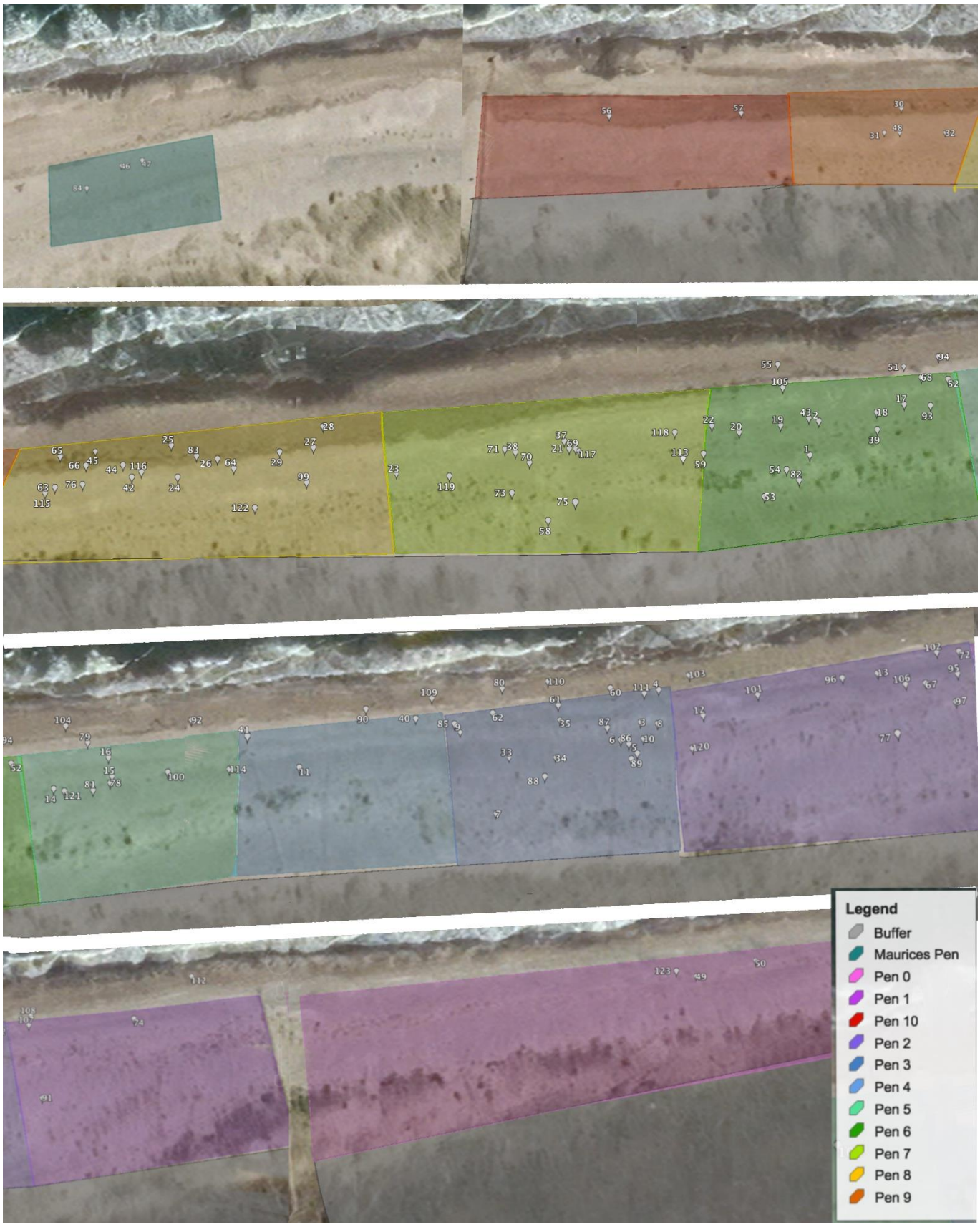

Figure 15. *Baltray beach with* Numbered nests Gps location marked. Image created with the use of GoogleEarthPro.

5.2. DECORATION

Some nests remained bare, while other nests were ornamented: decorated with shell fragments, stones, and twigs.

Figure 16. Highly decorated nest with stones and shells

5.3. NEST ATTENDANCE AND CHANGEOVERS

The coordination of partners is important both at the egg stage, to ensure one partner is present incubating, and at chick stage for protection. Previous studies of Little terns found that more nest/chick attendance resulted in more successful hatchlings/fledglings (McManus, 2019). Fasola & Saino, 1995 paper finds that in Little terns, the females spent almost one-quarter more time than males on incubation, brooding, and protection

During the time where the egg is left unattended, it is extremely vulnerable to predators and a drop in egg temperature. Small scale observation were conducted on only 10 sample nests to view changeovers and capture the time in which egg was left exposed. The median time for birds to leave the egg was found to be 13 seconds. This varied widely; many changeovers were quick with the other partner in view and the egg exposed for only 1-2 seconds. Some pairs stayed together for a minute or two near the nest or did a chasing flight behaviour with partner before the other going off foraging. Some eggs were left completely unattended for longer a period of time (2 minutes). This could have been in the early stages of egg laying where the egg is not yet in incubation. It may not even be a switch, but rather the same bird returning (there was no ring or ring was unreadable from distance). It may be inexperienced breeders not coordinating well.

Mean Average 22.9. lowest 1 second, highest 141 second (2 minutes and 21 seconds) (only from 10 nests, 20 samples)

An interesting future study would be to collect more data on time between changeovers and how this changes throughout the season from incubation to brooding. Although it is generally accepted that less time is spent on nest attendance as the chicks grow older and become more independent (Davies, 1981).

5.4. EGG NUMBERS/CLUTCH SIZE

125 nests were recorded which comprised 45 nests with 3 eggs (36%), 63 with two eggs (50%) and 17 with 1 egg (14%) (figure 18). The nests with three eggs were found earlier in the season, and the nests with only a singular egg were found more towards the end. This result follows the trend in Little terns of high productivity associated with the season's earlier clutches and follows a seasonal decline (Medeiros et al., 2007), the hypothesis of "parental quality" proposes that this is due to younger, inexperienced; and parent birds with lower body condition being more likely to breed later in the season (Arnold, 2008). This season with many nests destroyed by high tides and predation many of the late nesters are likely to be re-layers. Clutch size may be an indication of the structure of a colony and how well it is functioning in its environment. The colony, towards the start of the season, had numerous nests with three eggs and so it is reasonable to assume that the early nesters had adequate food supply and parent birds had a good body condition.
125 nests were recorded throughout the season with a total of 278 eggs, giving a mean clutch size of 2.22 eggs per nest.

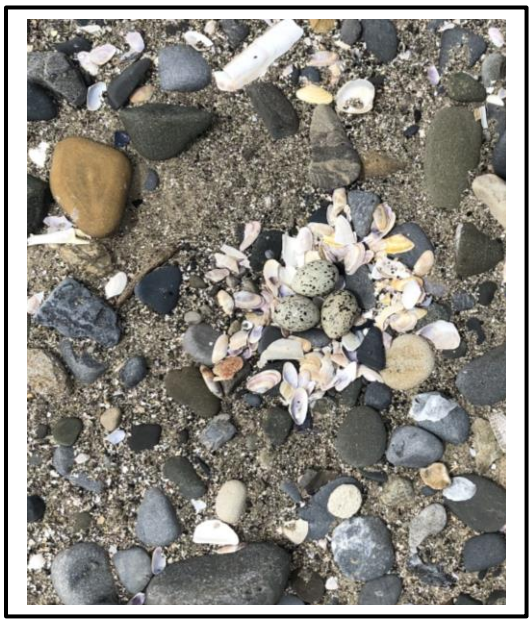

Figure 17. full clutch of 3 eggs.

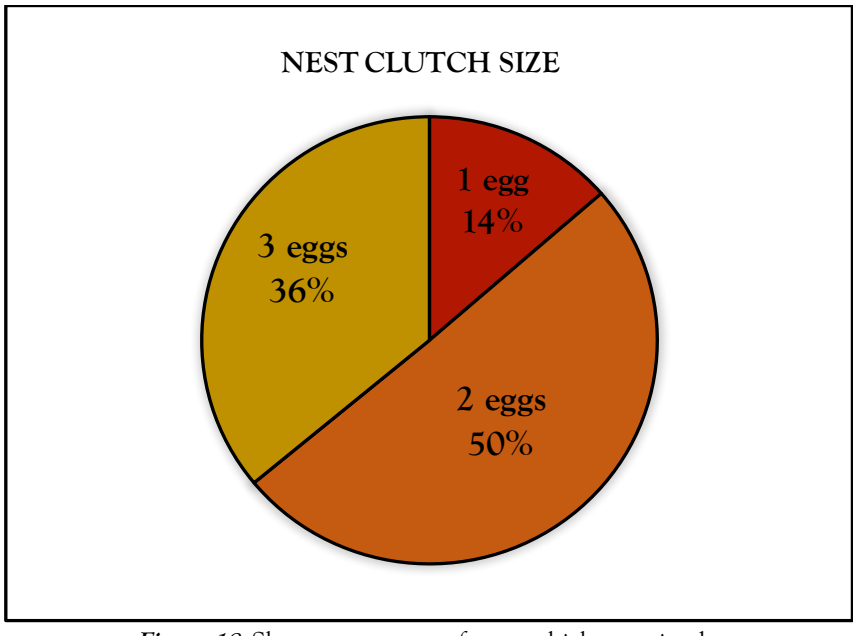

Figure 18. Shows percentage of nests which contained:
3 eggs (36%) - yellow, 2 eggs (50%) – orange, and 1 egg (14%) - red

6. CHICKS

6.1. FOOD TO CHICKS

Studying seabird diet has been a useful tool to understand a bird's ecology, but in addition it can often provide information and indicate predictions on habitat disturbances and/or the recruitment of fish species in the local area (Frederikensen et al. 2004; Velarde et al. 2013). Sand-smelts (*Atherina spp.),* Gobies (*Pomatoschistus spp.),* Crustaceans (*Gammarus spp.),* sardines, sandeels (*Ammodytes spp. mainly Ammodytes tobianus*) and various fry spp. have been all been recorded as a food source of Little Terns at various colonies around Europe (Baltray, Kilccole, Algarve) (Ramos et al 2013, Lopes- Correria 2016; McManus 2019). Little Terns have often been referred to as opportunistic feeders, feeding on the most abundant food source locally (Lopes- Correria 2019). Conversely, they are known to do seek out areas of high productivity as they need abundant food resources very close to the colony, due to their restricted foraging range compared with other seabirds. They have also shown their sensitivity by having low nesting numbers or high chick mortality in the past when food source of favoured prey in breeding area was low (seen in 2016, 2018 in Baltray suspected food shortage/low quality food).

This section focuses on the prey brought back to the chicks by parents during the chick rearing period. Little terns have biparental care, with both partners contributing to incubating and rearing duties such as sitting on the eggs, looking after chicks and foraging (Fasola & Saino, 1995). However, throughout the chick rearing stage there is a skew towards the more male food provisioning and more female incubation and protection (Fasola & Saino, 1995).
60 observations of parents feeding chicks were made during the chick rearing stage and written in the logbook. These observations occurred from 19th June to August 7th and includes hatchings through to fledglings. The results show three food sources: sandeels, sprat and fry spp. Sandeels were observed 21 times, sprat had 27 written observations, and 12 fry spp. were noted. It is worth noting that earlier in the season, pre-chicks, sandeels were commonly seen in the beaks of flying Little terns, sprat was more commonly seen. It was also observed that sprat and fry spp was more frequently given to younger chicks in the pens, but when observing chicks old enough to wandering at the shoreline, they were seen being fed with sandeels, this would be in tune with a paper that found that the mass of prey brought to chicks increased with the age of the chick (Fasola & Saino, 1995). The observations for this collection of data may therefore have been biased by observing feeding more in the pens that out at the shore line.

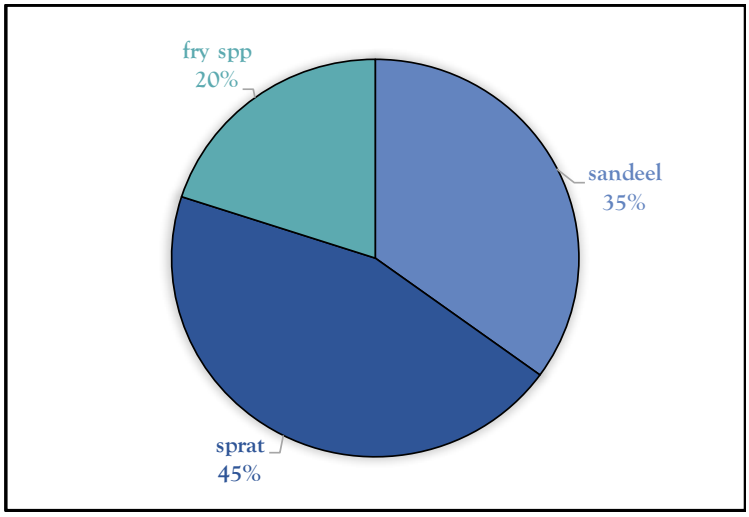

Figure 19. Food to Chicks. the proportion of food feed to chick based on 60 sample observations. 3 food types recorded, sprat being the most commonly feed to chicks. 27 sprat (dark blue), 21 sandeels (light blue) and 12 fry spp (turquoise)

6.2. WEIGHT AND LENGTH

There was a period of time this season, where entrance into the pens was not recommended after signs of avian flu was reported at other colonies in Ireland. After a few weeks with no evidence of its presence at the Baltray colony, entrance resumed, but was limited. Then, towards the end of the season, entrance and handling of any kind stopped again when dead Common Terns were found on the beach with Avian flu. This left a small window in the middle of the season where a sample of 20 chicks were weighed a day post-hatching. Two wardens entered, one weighing and one recording. The average time to enter, record, and leave would be maximum 2 minutes to limit disturbance, and was done during dry and calm weather. Chicks were placed on an electronic scale, and remained still. They were weighed and the weight was recorded (in grammes). Length was also noted from rump to tip of bill with a ruler (in millimeters). Chicks were placed back and the parent was always observed to return to its chicks within a minute. The average weight of a day-old chick, from the samples was 8.61g+/- s.d. 3.06g and the average length was 65.7mm+/- s.d. 6.7mm. Unfortunately, due to avian flu, we were unable to weigh them again to show weight changes in the weeks following, but from previous studies, it is understood that chicks will increase in mass quite quickly in the first few days and that roughly by day nine this slows and gradually builds up to adult weight which is roughly 50g (Gochfeld and Burger, 1996; O'Connell *et al.* 2014). Measuring weight can help understand the colony better and see if chicks are losing a significant amount of weight, indicating food scarcity or high disturbance. This information can be used as a good comparison between better years. The average chick weight of day-old chicks this year were similar to those previously recorded at the Baltray nesting site in 2020 (8.69g) and 2021 (8.45g) (Normanly *et al.* 2020; Kenny *et al.* 2021)

Figure 20. Chick from Nest #84, 1 day old being weighed on electrical scale.

6.3. INCUBATION PERIOD EGG TO CHICK

The incubation period of Little terns varies among different pairs and different years, but an estimation of 18-22 days is generally expected (Cramp, 1985). The mean incubation period this season was 20.03 days, the longest time recorded this season was 24 days to hatch, and was an egg that was found submerged in the seaweed which probably played a role in its slightly delayed hatching, but others that were also submerged in the seaweed, still hatched within the 18-22 day frame. It was suggested in last year's warden to possibly be down to the insulating ability of the seaweed on the eggs (Moënner *et al.*2023). The shortest incubation was 17 days, however, in this scenario it is possible that the warden may have been a day late marking the bird to be incubating, as entrance to pens were limited. This made it difficult to accurately determine when a full clutch was established and therefore when incubation started, but daily observations of birds siting on nests were carried out and reasonable estimates where used.

6.4. HATCHING SUCCESS

278 eggs were counted on the beach this season from 125 nests. Throughout the season 39 nests hatched 83 chicks. The first chick was born on Monday 19th June a week or two behind other Irish colonies Kilcoole and Portrane. The last chick was born on 4th August. The hatching distribution of the 83 chicks was 42.2% in June, 56.6% in July, and the least amount of hatching was in August (1.2%).

There was less hatching in August, when the season was coming to an end. The the breeding season coincides with peak fish abundance (Perrow et al., 2006) and the birds will need to have their young ready for long travel. There was also less percentage hatching success (not including predators), this is a common trend seen amongst little terns, when breeders later in the season are more likely to be unexperienced partners or re-laying after a failed first attempt and have lower body condition due to investment and energy having been put into the first set of eggs. A study by Medeiros et al., 2007 showed seasonal decline both egg size and hatching success throughout the season, as well showing that protection earlier in the season is of prime importance for wardening and volunteers because that is when hatching is presumed to be most successful (Medeiros et al., 2007). Some attended clutches failed entirely, one of which had been submerged in water, but others just failed to produce viable young.

There were nests observed where some eggs within the nest hatched and others did not. This happened exclusively in clutches of 3 where only 2 hatched. Further studies could be done to examine whether the final egg was just infertile or with two active chicks walking around the pen, the parent bird directs less time to incubating the final egg. The study could measure how much time goes into incubation once the first chick is active. The nest abandonment rate was found to be 9% in Baltray this year. The specifics of nest loss in covered in the following section 7.

Figure 21. Full clutch of 3 chicks

6.5. FLEDGLING NUMBERS

Of the 83 chicks that hatched, 80 chicks are presumed to have fledged. 2 young chicks which were found dead in the nest, following the extreme wind and rain on the night of 5th July, were found with no external signs of predation. The 3rd chick to not make it to fledgling age was a chick that was born an observed in a set of 3 and in the following days, only 2 were seen in and around the nest. No body was found suggesting predation.

Although there was a lot of predation, most instances involved eggs loss, and predator control had gotten tighter throughout the hatchling stage, and we are confident that >90% of the total chicks hatched fledged successfully. Fledgling counts on the shoreline are unlikely to be accurate as fledglings may at any time leave the colony and others may come and visit from other colonies. The estimate of fledglings is therefore obtained by assuming that any of the observed hatchlings chicks not thought to have died are alive. This gives a figure of 80 fledglings (96.39%) this season. This number could potentially be an overestimation, but given that wardens did observe the colony 24 hours a day and regular inspections of chicks were carried out, it is believed that the majority of predation and other chick fatalities were accounted for and gives confidence that this is close to the true number.

Figure 22. Two Baltray Fledglings on the shoreline (no rings, other colonies in Ireland ringed their chicks)

7. NEST/BIRD LOSS

During the breeding season there are many factors that can have an effect on a seabirds breeding success. Food availability, disease, habitat disturbance, human pressures as well as predation are challenges to overcome for seabirds (Weimerskirch 2002; Beale and Monaghan 2004; Ramos et al. 2013). 86 nests were lost this season, the main causes of nest loss consisted of mammalian predators, avian predators, high tides and turbulent weather, human and dog disturbance and abandonment.

7.1. PREDATORS

Predators came in two categories: in mammalian predators and avian predators.
Mammalian predators were responsible for 54% of nest loss this season. The mammalian predators logged on site consisted of Foxes, Stoats, Hedgehogs, Rats and Otters, however, it is not believed that the Hedgehog, Rat or Otter resulted in the loss of any eggs on site. Foxes were logged on site a total of 28 times and at least 6 different foxes were seen this season. Foxes are believed to have caused the loss of 34 nests in total. What is presumed to be a stoat (viewed through thermal imagery) got into pen 3 on two occasions resulting in the loss of 12 nests. Although there were many recordings of mammalian predators on site, the frequency of visits around the outside or corner pens was not as significant as the damage done after entering the more crowded pens. One of the largest losses happened the week of 11th-16th of June when both a Stoat and Red fox got entrance into the busiest pens (Pens 3,5,6,7,8). Out of 86 lost nests lost in total this season 36 nests (42%) were lost that week.
Avian predators were also present at the site: sightings consisted of Buzzards, Peregrine Falcon, Sparrow hawk, Kestrel and Hooded crows. During the egg stage, Hooded crows were the largest avian threat, resulting in the loss of 3 nests (4% of total nest loss). These nests were on the edge/buffer zone of the colony which is a common attack method of corvids (Brunton, 1997). When in flight, groups of Little Terns could be seen diving repeatedly at corvids but were less effective when the bird was on the ground. The Buzzard, although recorded in the area over the caravan, never ventured to the pens, the kestrel did on a few occasions but was never recorded to have gotten any Little terns, its method of hunting was much

slower than other birds of prey and gave wardens enough time to run to the area and shoo off, aided by a group of chasing terns. The Peregrine Falcon, however, was very fast in its hunt, and successful catches were recorded, all of which happened out at the shore line. On Thursday the 20th of July a Peregrine falcon was followed after it had caught a Tern on the beach. Catching up with the bird further along the beach, the tern caught was identified as a juvenile Common tern from a dismembered head and pile of feathers. On Monday the 24th the Peregrine again took a Tern from the shore line however the encounter was so fast it was not possible to confirm the species, but from birds on the shore that day, the most probable indication is Common or Little Tern. On the 28th of July a beheaded Kittiwake was found after disturbing a peregrine feeding on beach, and on the 1st of August it was observed to chase and catch a Dunlin on the shore. The Sparrow hawk was also a bird of prey at the site, mentioned in the logbook a total of 23 times. It was only ever recorded on two occasions to catch a bird from a pen, neither time could the witness properly identify the bird caught, though on the first instance was thought to be a plover. The sparrow hawk was observed catching starlings and meadow pipits in the surrounding area.

7.2. HUMAN AND DOG DISTURBANCE

Heavy use of the beach by the public has been shown to have a negative effect on the breeding success Humans and their dogs, if unaware or otherwise, are likely to walk on nests but also cause disruption to the incubation, brooding, or courtship process (Ratcliffe et al., 2008) and can also be a reason for abandonment of nest or breeding site (Kotliar & Burger 1986; Ratcliffe et al., 2008). Since longer attendance on the nest increases likelihood of hatching success, decreasing human disturbance is of great importance and through our conservation measures listed in section 3 this has been addressed, but, as 3 nests (14% of total nest loss) were lost to human/dog disturbance, there is still room for improvement. 2 of the nests were in the northern make-shift pen, this was located at the entrance to the beach and so, an area of high disturbance. Signs, rope, and visitor communication was used, but the first two nests were lost in that area, however, when a third nest in the area was found later in the season and greater effort was put into protecting it ie. more signage, and warden more present down northern end, 2 chicks successfully fledged from this area of high human activity. The other nest lost to human/dog disturbance was located in the buffer zone in front of pens, which didn't have any fencing to protect it. The buffer zone is an area in which the wardens had to quite regularly ask visitors to put their dogs on leads, and walk further out the on the beach. No nests were lost due to human/dog disturbances in the main core 10 pens nesting sites, showing the effective use of fencing and how, during the egg stage, wardening off the areas of eggs prevents them from being trampled, even during busy sunny days on the beach, and shows that humans and Little Terns can share the beach.

7.3. STRONG WINDS AND HIGH TIDES

Strong winds and high tides were the second largest factor in nest loss, making up 29% of nests lost (25 nests). Strong winds resulted in sand blowing up into the pens and covering the nests, the only two deceased chicks found this season were found on 6th July, the morning after a night of strong winds and heavy rain. There were no signs of predators, and the chicks were found in their nests and were only 1 day old so very small and fragile to the elements. The weather conditions that night/ morning of the 5th-6th of July also resulted in extremely high tides. These were predicted, and some relocations were made in preparation, but the tide was much greater than anticipated and it cleared many pens and came half way up others. The most effected was nests just in front of fences in the buffer zone and at the ridges by the front

of the pens. Some post-tide rescuing of nests and eggs took place after finding them in the seaweed, and placing back in relocated nests, but in the end 22 nest and 40 eggs were lost due to that night. Another weather event occurred on the 8th-9th of June 2 nests were lost when strong wind blew sand over, burying them. On the same day, the tide breached pen 9, and one further nest was lost. On both these occasions, fencing was damaged and needed volunteers to help out in putting back up the pens (this might have affected the effectiveness of the electric fencing at the margins).

7.4. ABANDONED

The nest abandonment rate was found to be 9% in Baltray this year. Much of this abandonment is likely to be the effect of predation, high tides and weather which had a drastic effect this year. even though some parents had eggs which survived these days/nights, their eggs were abandoned in the days following, indirectly adding to the earlier direct loss of eggs caused on those days. Parent birds abandoned and went to other colonies in Ireland such as Kilcoole or Portrane.

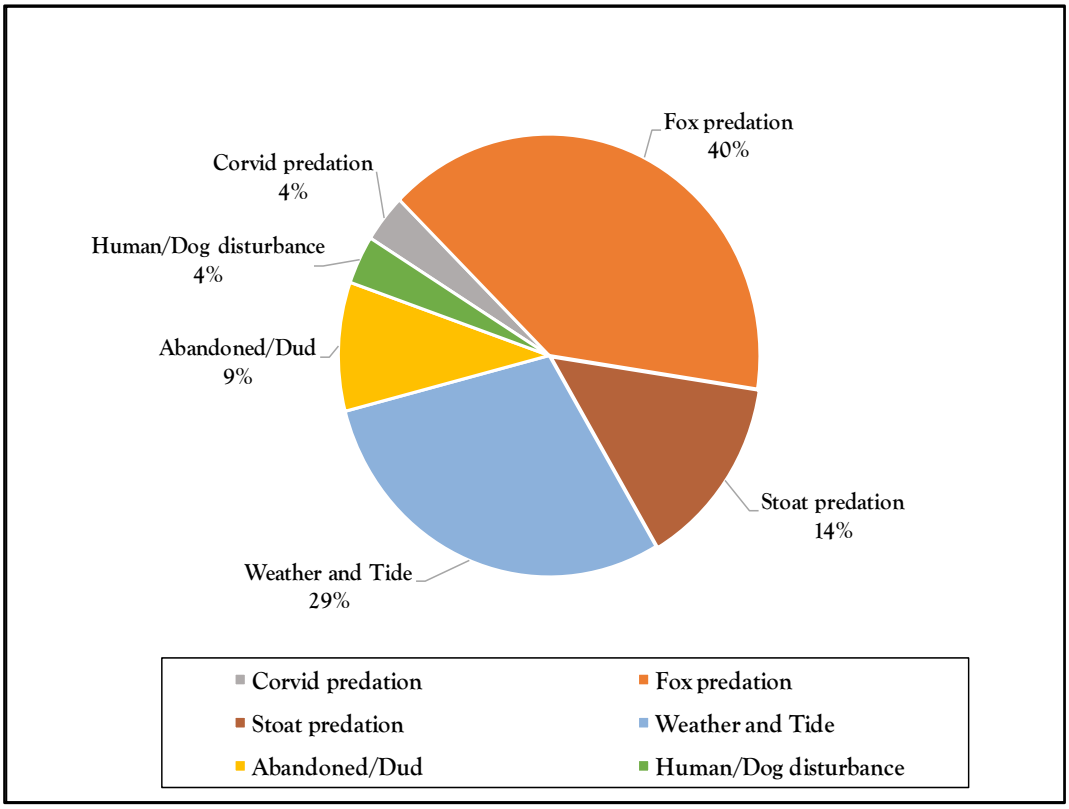

Figure 23. percentage outcomes of nest loss of 86 nests lost 2023 season

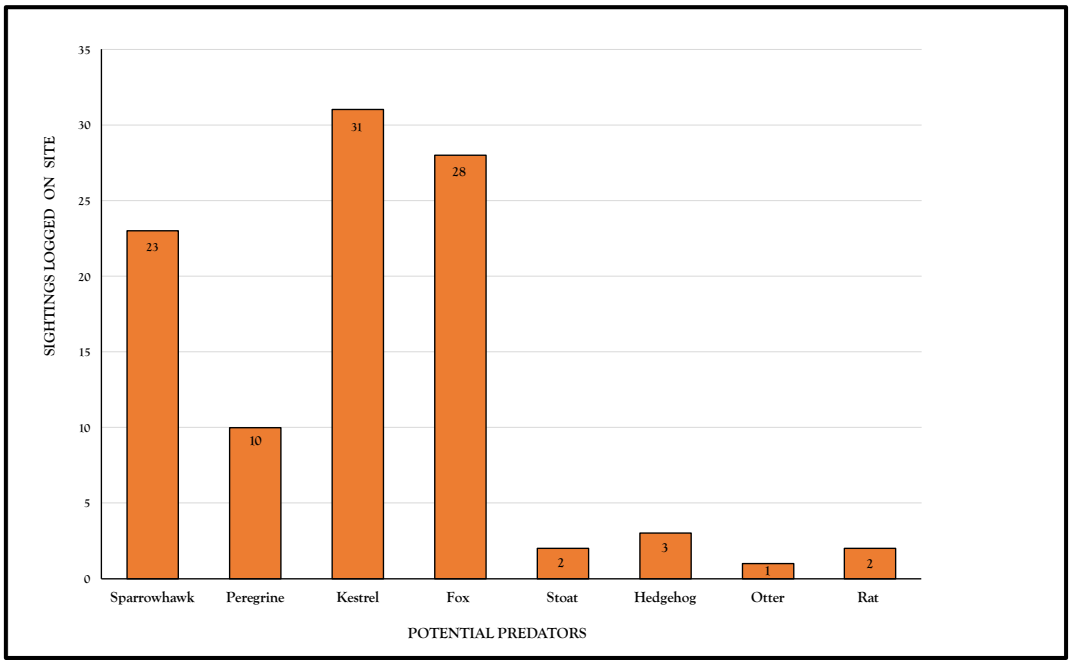

Figure 24. Number of sightings of potential predators seen on site

8. AVIAN FLU

Highly Pathogenic Avian Influenza (H5N1) is of rising concern in an increasing number of seabird species (Cunningham et al. 2022). It has been recorded in different Tern colonies in Ireland, many of which are in close proximity to Baltray, (Rockabil, Kilcoole, Portrane, Lady's island and Port of Dublin). No mortality or observations of Avian flu in Little Terns was recorded this season at the Baltray colony, however, 8 Common terns, 3 Guillemots, 3 Northern gannets, and 2 Herring Gulls were found deceased and based on lack of signs of injury or predation were presumed to be result of Avian flu. Some seabirds were witnessed sick before dying, and were showing flu-like symptoms: huddled down, not moving, gaping beak, eyes shut and shivering/shaking. Avian influenza spreads in seabirds through direct contact or through exposure to bodily fluids and faeces (CDC 2022). Wardens must be careful, as the virus can also survive for extended period of time in the environment and so be transferred indirectly through water or food sources, footwear and clothing, or fieldworker equipment (Cunningham et al 2022). Dead seabirds were carefully disposed of following county council guidelines by using a litter picker to place the bird in a black bin bag which was tied and placed in a secondary bag along with the mask and gloves that were worn by person clearing the area.

Figure 25. Gloves and Mask worn to prepare to clear a dead Common tern from the Little tern pen

9. RINGING AND RING RECOVERY

Early in the season before the chicks arrived, ringing of adult birds by Jan Rod was carried out in two sessions, on the 3rd and then 11th of June. In total, 19 adult nesting Little terns and 4 adult nesting Ringed Plovers were ringed with both a metal BTO band and Darvic colour bands. As more reports of Avian flu were circulating later in the season, it was decided the chicks would not be ringed this season.
Rings were recovered on 5 dead Common terns found at the site. 1 had been ringed in Port of Dublin, 3 ringed from Rockabill and 1 that was ringed in La Langue de Barbarie, Senegal.

10. BEHAVIOURAL OBSERVATIONS

Table 3. Ethogram of behavioural states and their descriptions as was seen exhibiting this season

Behavioural state	description
alert on nest scanning	scanning moving head side to side, aware of surroundings
nest decorating	picking up and moving shells into nest
offereing fish	offering fish to mate (courtship)
chasing	when flying in air one tern chasing another (courtship)
diving, swooping	attack short quick downward dives at other birds/predators (normally grouped together)
blinking/ shutting eyes	lower eyelid moves upward to close and back downwards open again
opening bill	opening of bill for pronglonged period (thermoregulation)
preening	using the bill to stroke through feathers for upkeep and waterproofing
shake/drying	shake out their feathers seen after periods of rain to dry off
young under wing (tenting)	keep chicks warm and away from elements under their wing
chicks hunker down	chicks hunkered down behind object avoid detection and avoid wind,sand etc
chicks begging	chicks opening bill and making noise for food
making scraps	preperation for nesting, digging small scraps into shingle/sand (may a few before settling)
Foraging	hover, search, repeated dive attempts and capture of prey
Flight	flapping flight
vocalisation	Shrill call, for courtship and parental recognision
removing eggshell	parent bird was observed carying and dropping the egshell away from the nest post hatching

Ethogram next season could allow for behavioural studies to be conducted, focal and sample scans and how much time is spent on each action.

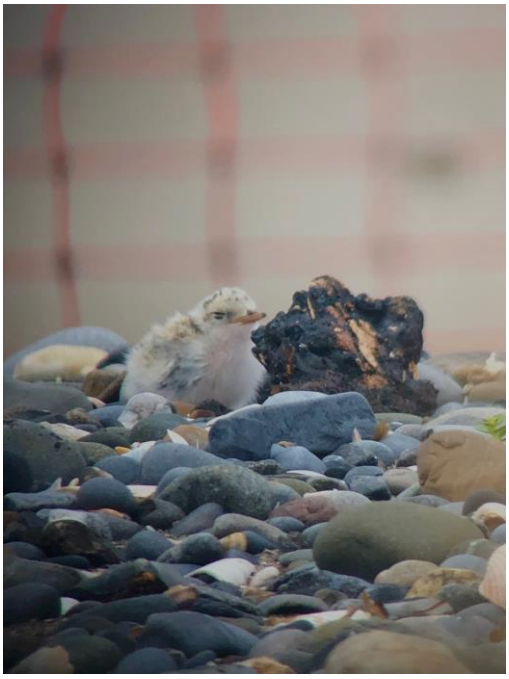

Figure 26. young chick begging

Figure 27. chick sheltering downwind hunked behind debris.

11. DREDGING

At Baltray, sand and silt are excavated from the port channel, the bar, and Tom Roes Point and dumped offshore along the coastline to prevent build-up of sediments to allow the entrance and exit of vessels from the dock. The amount dredged in April 2023 was 45,155 tonnes, relatively small in relation to other years when as much as 250,000 tonnes was dredged. This material was all dumped at sea (EPA annual reports) during April according the the DPC AER 2023 submitted to the EPA. This season the dredger was frequently recorded out and for a few hours at a time usually daytime at low tides during the little tern nesting season through June and July. The dredger was often observed working the bar, then dumping on the north side of the estuary, apparently at times dumping a trail s it went in apparent effort at "beach nutrition". It is reported that the rest of the material was landed at Drogheda port docks for the purpose of construction after desalting. Both the above activities come under the heading of "beneficial reuse" and so are not regulated by the EPA. The LNT made several EIA requests to DPC in order to determine the exact dates and times of this activity, as well as the quantities dredged and the purpose of the activity, bot to date to no avail. Clearly the impact of dredging during the little tern breeding season has the potential to adversely impact on breeding, through displacement and turbidity effects.

Dredging, including the extraction and sale of a maximum of 60,000 cubic metres of Material per annum obtained only from the Extraction Area, is regulated by the Foreshore license Ref. FS007028 issued by the Department for Housing, Local Government and Heritage. The Dumping at sea permit regulates the loading and dumping at sea activities. This material (60,000m3 for extraction) is not regulated under the dumping at sea permit and quantities brought onshore are not required to be reported as part of the Annual Environmental Report. It would seem that the summer dredging activity is exclusively for beneficial reuse since dumping at sea is restricted to April in 2023.

There is little scientific literature on the effects of port dredging on seabirds and shorebirds although it is known to cause increased sedimentary turbidity. Sedimentation turbidity (a cloudiness to the water) can affect a seabird's ability to hunt if it is a visual hunter (Little Terns fall in to this group). A Review of the

Potential Impacts of Marine Aggregate Extraction on Seabirds, (Cook *et al.*2010) assessed Little Terns as being *"very highly vulnerable to changes in turbidity associated with marine aggregate dredging"*. Tern species have been observed to react differently to excess sedimentation. Common terns in Ghana were found to still feed in turbid waters (Holbech et al 2018) and some have suggested that it is not as much as a factor for shallow diving seabirds, However, the prey capture rate of Damara terns was higher in less-turbid water in Namibia (Braby et al., 2011) (Obtained from Lukies *et al.* 2021)

Dredging can alter seafloor which may have knock-on effects to the ecosystem, '*for key prey such as Sandeels (Ammodytes spp. mainly Ammodytes tobianus). The species lives and breeds over sandy and light shingle seabeds close to the shore and are rarely found in water more than twenty metres deep. Harbours, estuaries and sheltered bays often hold large populations where they are depredated by fish and seabirds. They typically spawn twice a year, once in spring and once in autumn. Spawning involves depositing eggs on the substrate (sand or mud) where they hatch into larvae. They typically spend the winter hibernating in up to 20cm of sand. Other prey include sprat (Sprattus sprattus), young herring (Clupea sp.), butterfish (Pholis sp.) and others, which may also be adversely affected by dredging. It may be inferred that the November 2016 campaign likely impacted overwintering sandeels, the spring campaign impacted spawning and eggs, and the extended summer dredging increased turbidity in the water. This may explain the almost complete failure of the Little Tern colony in 2017, hitherto unprecedented.'*- previous Baltray reports Breffni Martin

Although there has been an Appropriate Assessment of the port's dredging and dumping as sea on foot of their foreshore license, the dredging for beneficial reuse has never been subjected to Appropriate Assessment. There is clearly the potential for adverse effects on the Little Terns or other seabirds and shorebirds nesting in the vicinity.

12. RECOMMENDATIONS

- **Vantage Observation Points:** It is difficult to view some nests from outside of their pens. A raised area or a hide would be really helpful to keep an eye on nests and limit in person incursion into pens.
- **High tide:** When the tide was high, the public walking area was reduced/eliminated. This brought walkers closer to the pens. Many beach visitors walked in the buffer zone unknowingly. Possible solutions: flag system or signage indicating where not to walk.
- **Communications with public:** Chalkboard towards the end of the season was difficult to update public, as the rain just washed it away moments later (some way of updating beach walkers that was rainproof, sign with little roof)
- **Relocation of nests:** As seen in a paper from Kilcoole (O'Connell et el. 2014): a day before the move, objects were placed beside the nest (often brightly coloured). When the nest was moved, the objects were moved in relation to it to help the parents orientate to their new nest.
- **Appropriate Assessment: the probability that** AA of the impact of dredging for beneficial reuse of 60,000 tonnes per annum is likely to be required under the Habitats Directive to be raised with NPWS.

13. OTHER BIRDS ON SITE

A total of 66 different Bird species were recorded at the Haven and SAC Estuary from May to August 2023. This consisted of 27 Green listed, 28 Amber listed and 10 Red Listed Birds. List made up of observations throughout the season by Nina Rogerson, Brónagh Barnes and Gerard Murray.

Common Name	Irish name	Latin Name	Conservation Status
Artic tern	Geabhróg artach	*Sterna paradisaea*	Amber listed
Black-headed Gull	Sléibhín	*Larus ridibundus*	Red listed
Black-legged Kittiwake	Saidhbhéar	*Rissa tridactyla*	Amber listed
Black-tailed Godwit	Guilbneach earrdhubh	*Limosa limosa*	Amber listed
Blackbird	*Lon Dubh*	*Turdus merula*	Green listed
Buzzard	Clamhán	*Buteo buteo*	Green listed
Chiffchaff	Tuí-teaf	*Phylloscopus collybita*	Green listed
Common Gull	Faoileán bán	*Larus canus*	Amber listed
Common Sandpiper	Gobadán coiteann	*Actitus hypoleucos*	Amber listed
Common Scoter	Scótar	*Melanitta nigra*	Red listed
Common tern	Geabhróg	*Sterna hirundo*	Amber listed
Cormorant	Broigheall	*Phalacrocorax carbo*	Amber listed
Cuckoo	Cuach	*Cuculus canorus*	Green listed
Curlew	Crotach	*Numenius arquata*	Red listed
Dunlin	Breacóg	*Calidris alpina*	Red listed
Eurasian black cap	Caipín dubh	*Sylvia atricapilla*	Green listed
Golden plover	Feadóg bhuí	*Pluvialis apricaria*	Red listed
Goldfinch	Lasair choille	*Carduelis carduelis*	Green listed
Grasshoper warbler	Ceolaire casarnaí	*Locustella naevia*	Amber listed
Great Black back Gull	Droimneach mór	*Larus marinus*	Amber listed
Great Crested Grebe	foitheach mór	*Podiceps cristatus*	Amber listed
Greater white throat	Gilphíb	*Sylvia communis*	Green listed
Greenshank	Laidhrín glas	*Tringa nebularia*	Amber listed
Grey Heron	Corr réisc	*Ardea cinerea*	Green listed
Grey Plover	Feadóg ghlas	*Pluvialis squatarola*	Amber listed
Guillemot	Foracha	*Uria aalge*	Amber listed
Herring Gull	Faoileán scadán	*Larus argentatus*	Amber listed
Hooded Crow	Caróg liath	*Corvus cornix*	Green listed
Jackdaw	Cág	*Corvus monedula*	Green listed
Kestrel	Pocaire gaoithe	*Falco tinnunculus*	Red listed
Knot	Cnota	*Calidris canutus*	Amber listed
Lapwing	Pilibín	*Vanellus vanellus*	Red listed
Least Tern	-	*Sternula antillarum*	* (not in Birds of Conservation concern Ireland)
Linnet	Gleoiseach	*Carduelis cannabina*	Amber listed
Little Egret	Éigrit bheag	*Egretta garzetta*	Green listed
Little Tern	Geabhróg bheag	*Sterna Albifrons*	Amber listed
Magpie	Snag breac	*Pica pica*	Green listed
Manx Shearwaters	Cánóg dhubh	*Puffinus puffinus*	Amber listed
Meadow Pipit	Riabhóg Mhóna	*Anthus pratensis*	Red listed
Mistle Thrush	Smólach Mór	*Turdus viscivorus*	Green listed
Northern Gannet	Gainead	*Morus bassanus*	Amber listed
Oystercatchers	Roilleach	*Haematopus ostralegus*	Amber listed
Peregrine Falcon	Fabhcún gorm	*Falco peregrinus*	Green listed
Pied wagtails	Glasóg shráide	*Motacilla alba yarrellii*	Green listed
Red Breasted Merganser	Síolta Rua	*Mergus serrator*	Green listed
Red-throated Diver	Lóma Rua	*Gavia stellata*	Amber listed
Redshank	Cosdeargán	*Tringa totanus*	Red listed
Reed bunting	Gealóg ghiolcaí	*Emberiza schoeniclus*	Green listed
Ringed Plover	Feadóg chladaigh	*Charadrius hiaticula*	Green listed
Rook	Rúcach	*Corvus frugilegus*	Green listed
Roseate Tern	Geabhróg rósach	*Sterna dougallii*	Amber listed
Sanderlings	Luathrán	*Calidris alba*	Green listed
Sandwich Tern	Geabhróg scothdhubh	*Sterna sandvicensis*	Amber listed
Sedge warbler	Ceolaire cíbe	*Acrocephalus schoenobaenus*	Green listed
Shelduck	Seil-lacha	*Tadorna tadorna*	Amber listed
Skylark	Fuiseog	*Alauda arvensis*	Amber listed
Sparrowhawk	Spióróg	*Accipiter nisus*	Green listed
Starlings	Druid	*Sternus vulgaris*	Amber listed
Stonechat	Caislín cloch	*Saxicola rubicola*	Green listed
Swallow	Fáinleog	*Hirundo rustica*	Amber listed
Swift	Gabhlán gaoithe	*Apus apus*	Red listed
Turnstone	Piardálaí trá	*Arenaria interpres*	Green listed
Wheateater	Clochrán	*Oenanthe oenanthe*	Amber listed
Whimbrel	Crotach eanaigh	*Numenius phaeopus*	Green listed
Willow warbler	Ceolaire saili	*Phylloscopus trochilus*	Green listed
Wood Pigeon	Colm coille	*Columba palumbus*	Green listed

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