

Baltray Little Tern Colony Report 2021

Luke Kenny*, Dominic Hartigan, Breffni Martin



The Little Tern Conservation Project in Baltray, Co. Louth is managed by Louth Nature Trust. In 2021 this project was funded by The Department of Housing, Local Government and Heritage through the National Parks and Wildlife Service's National Biodiversity Action Plan Fund, and by Louth County Council.



**An Roinn Tithíochta,
Rialtais Áitiúil agus Oidhreachta**
Department of Housing,
Local Government and Heritage



*Author for correspondence

Table of Contents

Acknowledgements	4
Abstract	5
1. Introduction	6
1.1 Background	6
1.2 Little Tern colonies in Ireland.....	7
1.3 Little Tern Colony in Baltray.....	8
1.3.1 The nineteenth and early twentieth centuries	8
1.3.2 The late twentieth century (1960s and 1970s onwards)	8
1.3.3 Intensive wardening at Baltray, in the twenty-first century	9
1.4 Project Aims	12
2. Methods	13
2.1 Study Site	13
2.2. Monitoring	13
2.2.1. Little Tern Numbers	14
2.2.2. Nest Locations and Observations	14
2.2.3. Biometrics and Ringing	15
2.3. Conservation Measures	15
2.3.1. Use of Fences.....	15
2.3.2. Use of Signs.....	17
.....	18
2.3.3. Chick Shelters	18
2.3.4. Predator Management	18
2.4. Public Awareness	18
2.4.1 Interaction with beach users	19
2.4.2 Group Talks & Outings.....	19
2.4.3 Media Coverage.....	19
3. Results	20
3.1 Weather	20
3.2 Little Tern Numbers	21
3.3 Nesting	22
3.3.1 Number of Breeding Pairs	22
3.3.2 Pattern of Nesting.....	22
3.3.3 Cutch Size and Incubation Period	23

3.3.4 Hatching Success	24
3.3.5 Fledgling Success	25
3.3.6 Productivity.....	27
3.4 Ringing and morphometric measurements	27
3.4.1 Ringing	27
3.4.2 Ring Recoveries.....	27
3.4.3 Ring Resightings.....	28
3.4.4 Summary Statistics	32
3.4.5 Chick Wing Length	33
3.4.6 Chick Weight.....	34
3.7 Predators and Disturbance	34
3.7.1 Terrestrial Predators.....	34
3.7.2 Avian Predators	34
3.7.3 Human Disturbance	36
3.7.4 Dredging	37
3.8 Ringed Plover and other species.....	38
3.8.1 Waders.....	40
4. Discussion	41
4.1 The 2020 Breeding Season in Baltray	41
4.2 Dredging.....	43
5. Recommendations	46
5.1 Dredging.....	46
5.2 Monitoring	46
5.3 Equipment.....	47
5.4 Community Engagement	48
References	50
Appendices	52
Appendix 1: Avian Biodiversity in Baltray	52
Appendix 2: Nesting Data	54

Acknowledgements

We would like to thank the Department of Housing, Local Government and Heritage who provided generous funding through the National Parks and Wildlife Service's National Biodiversity Action Plan Fund. We would also like to thank our partners Louth County Council for their ongoing support. In particular, we would like to thank Brendan McSherry, Heritage Officer with Louth County Council for securing the funding for this project. Many thanks also to Louth National Parks and Wildlife Service ranger Jennifer Lynch for her assistance and continued support.

We gratefully acknowledge Anne Hartigan and Dominic Hartigan for granting access to their land and facilitating the project. Our appreciation and thanks go to Dominic for his dedication, help, kind hospitality and much more.

We are very grateful to the dedicated team of volunteers who contributed time and assistance to the project: Maurice Conaghy, Michael Conaghy, Áine Walsh, Ray McElhinney, Brendan Carty, Matt and Cepta Byrne, Billy Clarke, Gerard Murray, Ian Craig, Sam McCarthy, Stuart Turnbull, Garry Mc Mahon, Mel Gibney, Tahirih O'Brien, Shannon Mac Kenna, Valerie Leddy, Tom Kavanagh, Mary Mulligan, Kevin Anderson, Louise Brennan, Johnny Galway, Loraine Pratt, Dónal Coveney, Sarah Lynott, Joe Byrne, Helena Sheeran, Eithne and Martin Hamill, Oisín Ó Maoláin, Daniel English, Lisette Heijnen, Elizabeth Botes, Janice and Paul Mulligan, Julian Valla, Seán Corbett, and all other volunteers who helped throughout the season.

We would like to thank Karen Donlon, Organisation Support Officer, and the rest of the team at Louth Volunteer Centre who advertised our need of volunteers both on their website and with adjacent branches.

We are also indebted to the Birdwatch Ireland ringing team of Dr Steve Newton, Thorfinn Newton, Brian Burke and Tara Adcock.

We greatly appreciated the assistance of the Portrane Little Tern project volunteers who were eager to lend a hand when it came to finding chicks to ring. This season they included Jan Rod, Niall O'Reilly, Paul Lynch, Paul O'Flaherty, Tom Kavanagh, Séamus Murray and Daniele Gioppo. Additional thanks are owed to Jan Rod who dedicated much of his time to track down and read leg rings of Little Terns along the east coast.

Finally, we would like to thank regular visitors to the colony and members of the public who adhered to the restrictions in place. We greatly appreciated those who took an interest in the project and expressed their good wishes.

In memory of Tim Hartigan, custodian of The Haven.

Abstract

Wardening of the Little Tern (*Sternula albifrons*) colony at Baltray began on 10th May 2021 and ended on 4th August 2021. Night wardening (thus 24-hour colony-coverage) was initiated on 25th May. A total of 98 nesting attempts were made by an estimated 75 breeding pairs of Little Tern in 2021. The first eggs were found on 21st May. The last clutch was estimated to have been completed on 14th July. The 2nd August was the latest recorded hatching date. A total of 192 eggs were laid; the mean size of completed clutches was 2.07 eggs per nest.

The largest single-event loss of eggs related to 8 eggs from 7 nests which were lost to an unknown overnight or crepuscular predator - no obvious tracks were present. A further 9 eggs disappeared in similar circumstances, while foxes were recorded as predators of 6 eggs from 3 nests. Four eggs which were washed away by spring tides, five nests with a total of seven eggs were abandoned and seven eggs failed to hatch owing to infertility. A total of 151 chicks were known to have hatched out of 75 nests between 19th June and 28th July. The mean incubation period was 19.82 days. In total 49 chicks were ringed with metal rings this season, 35 of which also received green colour bands. Re-trap data were collected to estimate average growth rates.

Of the 151 chicks hatched, remains were discovered indicating the loss of a total of 9 young. A sparrowhawk (*Accipiter nisus*) was witnessed flying out from the pens with a chick on one occasion, however five further remains were consistent with attacks by the same bird. One fledgling was taken by a great black-backed gull. Two very young chicks were found dead: a one-day old specimen squashed in its scrape, and an approximately 3-day old specimen found desiccated under thick vegetation. Thus, 142 chicks were presumed to have fledged, which equates to productivity this year of 1.89 fledglings per breeding pair. This is likely to be an overestimate - especially given that only one of the seven known predation events was witnessed - however, it gives a good indication of the overall success of the 2021 breeding season, as well as being comparable to the previous years' efforts. The result is the highest number of breeding pairs since 2014, and chicks presumed fledged since 2013.

1. Introduction

1.1 Background

The Little Tern (*Sternula albifrons*) is the smallest and scarcest of Ireland's five breeding tern species. Like many tern species, Little Terns are long distance migrants, wintering in West Africa and returning to Irish coasts to breed in late April and early May and departing again in late July or August. Unlike the other four Irish tern species, which primarily nest on islands, the majority of 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. Due to their nesting habitat, Little Terns are very vulnerable to recreational human disturbance, sea level rise and predation.

Little Terns are classed as an Annex 1 species under the EU birds Directive (79/409/EEC), requiring member states to take special conservation measures to ensure their survival and breeding success. In Ireland and the United Kingdom, the species is amber listed by BirdWatch Ireland and the RSPB (Royal Society for the Protection of Birds), indicating that this species is of medium conservation concern. The Little Tern is fully protected under the Wildlife Act (1976, Amended 2000).



Figure 1: Pair of Little Terns at nest in Baltray (Photo taken under NPWS licence by Billy Clarke)

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). The number of breeding pairs of Little Terns on the west coast is less well known than that on the east, but in 2016 a minimum of 100 pairs was reported in the NPWS Seabird Survey in Kerry, Galway, Mayo and Donegal (Newton *et al.*, 2016). 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).

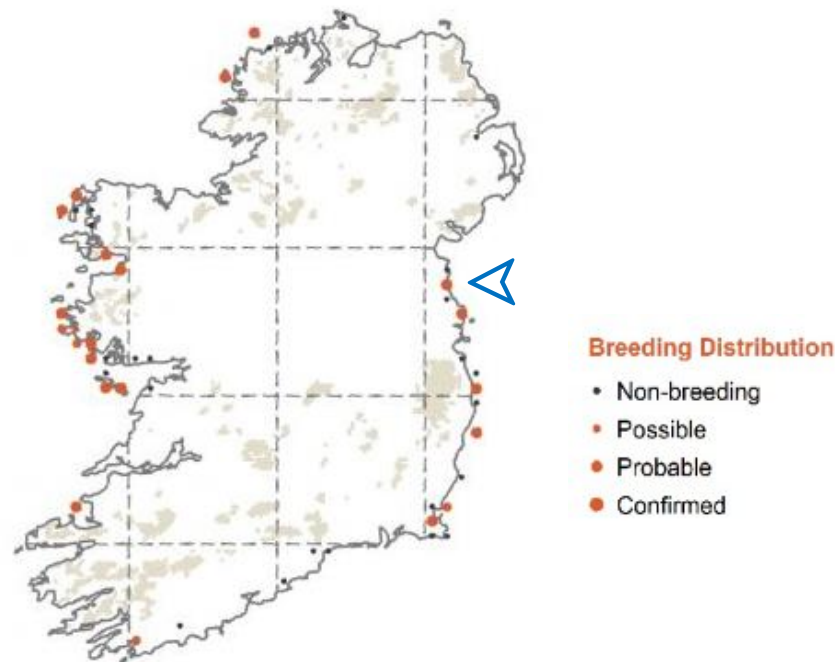


Figure 2: Breeding distribution of Little Terns in Ireland. Blue arrow indicates Baltray. (birdwatchireland.ie/birds/little-tern/)

North Bull Island (Co. Dublin), and Buckronev (Co. Wicklow) historically supported Little Tern colonies but are no longer used due to high levels of recreational disturbance. At Portrane, just a single pair successfully bred in the years 2009 to 2012. From 2013 to 2015, one or more pairs may have nested successfully but in 2016 a hot and sunny spell in early summer brought large crowds on to North Dublin beaches, including Portrane and this probably deterred Little Terns from settling. The establishment of a wardening scheme at Portrane in 2018 resulted in eleven breeding pairs producing fourteen fledged chicks that year. Breeding success in 2019 was hampered due to predation by Red Fox, resulting in just one pair out of fifteen fledging three young.

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. In 2017, an attempt was made to monitor the colony in Wexford Harbour (details extracted from the Irish Sea Tern Colony Network Facebook Page); the first visit on 9th June yielded a total of approximately 150 pairs and 64 nests were located of which more than 20 contained only a single egg. On the 22nd June, the same number of adults were present, and a few chicks had hatched. No obvious change in colony status was detected on 5th July but the site was deserted by the 13th July and the colony was judged to have failed. Elsewhere in Wexford during 2017, two Little Terns were seen at Tacumshin Lake on 9th April, and a Little Tern nest with three eggs was located by Oran

O'Sullivan at the 'cut' on 18th May, though its fate was not followed up. Only two birds were seen at Cahore on the 8th May (<http://www.irishbirding.com>).

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. At Kilcoole in 2013, 45 pairs fledged 75 chicks (Keogh *et al.*, 2013). The relatively low number of pairs in 2013 may have been a result of the record breeding year here at Baltray, Co. Louth (Doyle *et al.*, 2013). The most successful breeding year to date, at Kilcoole, was in 2015, with 155 pairs producing 301 chicks, 289 of which were presumed successfully fledged (Doyle *et al.*, 2015). A poorer year was experienced in 2016 with starvation and significant fox predation of chicks the most significant factors behind poor productivity (Manley *et al.*, 2016). The 2017 season saw a significant improvement, with 141 pairs laying clutches and an overall productivity of 1.81 fledged young per pair (Johnson *et al.*, 2017). Kilcoole was the only fully wardened active Little Tern colony in 2018.

1.3 Little Tern Colony in Baltray

1.3.1 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).

1.3.2 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/mudbanks 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. Oscar J. Merne reported Little Terns at Clogherhead in 1967. 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 and this was apparently unchanged when the 1988-91 survey (Chapman, 1992) was undertaken, even though many of the other colonies on the east coast had clearly declined. Several surveys since then, notably Operation Seafarer covering 1969-70, the All Ireland Tern Survey in 1984 and 1995, as well as Seabird 2000 covering 1998 – 2002, have provided more solid information on Little Tern numbers and trends.

Following the results of the 1984 tern survey (Whilde, 1985), the need for conservation of Little Terns was identified due to declining numbers and contraction into fewer colonies (Herbert, 1986). 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.

1.3.3 Intensive wardening at Baltray, in the twenty-first century

It is from this point that the project at Baltray began in 2007, initially run by a team of volunteers coordinated by Sandra McKeever and Margaret Reilly; this effort resulted in their foundation of the Louth Nature Trust, with others, a factor which permitted the funding from the Heritage Council, Louth County Council and the NPWS.

The implementation of wardening by dedicated volunteers, in conjunction with fencing to protect the colony, led to a dramatic improvement in the breeding success of the Little Terns at Baltray. In 2007, 21 pairs fledged 41 chicks (McKeever and Reilly, 2007) and in 2008, 25 pairs fledged 29 chicks (Reilly, 2008). 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). 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. The upturn in fortunes in the Little Terns breeding in the vicinity of Wexford Harbour has helped to alleviate this problem, however this site does not enjoy the intensive protection enjoyed at Kilcoole and breeding success has been more intermittent. 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. From 2013 scientific reports were produced following the contracting of the ecological aspects of the project to BirdWatch Ireland.

The 2013 and 2014 seasons were very successful years with 102 breeding pairs, 203 hatched chicks and 193 fledglings in 2013, and 150 nesting attempts, 170 hatched chicks and 91 successfully fledged Little Tern chicks in 2014.

Due to a reduction of funding only one day time warden was in place in 2015 and this had a severe negative impact on the project's ability to mitigate corvid predation. A total of 66 nesting attempts were made by 25 breeding pairs, the lowest total of pairs recorded since the project began in 2007. Of the 66 nests, 20 chicks are known to have hatched successfully, and due to the hard work of the wardens no predation of chicks was observed and all 20 chicks successfully fledged. The project was funded, indirectly, by the Heritage Council in 2013, through the Heritage Office of Louth County Council, which dedicated the whole of its annual project funding from the HC to the Baltray project.



Figure 3: Little Tern flying over Baltray Beach, 2020.

The 2016 season was not a successful year for the Little Tern colony at Baltray, especially in comparison with the previous three years. Bird numbers were low (typically max counts of 20 with only 8-16 birds regularly recorded; there was some evidence of courtship and nest scraping but no chicks were produced). Later in the season a peak of 89 adults and at least three colour ringed fledglings (ringed in Kilcoole) were observed. Possible reasons for this poor breeding season in 2016 relate to a late start in wardening, a large corvid presence, and sustained easterly winds early in the season. During the Little Tern migration from West Africa towards Europe there were some continuous days of very strong easterly winds and it is possible that some birds got blown off course and did not make it to Ireland (B. Martin, pers. comm.). This bad weather seems to have affected all of the Little Tern colonies throughout Ireland and the United Kingdom with the exception of the Gronant colony in Wales (P. Manley, pers. comm.), which has a westerly exposure rather than easterly, and could explain the low numbers of birds seen in the Baltray area. The Gronant colony recorded two adult Little Terns that had been ringed in Baltray, indicating that the species will move between sites and is not necessarily loyal to just one breeding site. This reinforces the idea that the terns just nested elsewhere in 2016. Another possible explanation for the lack of Little Terns at Baltray in 2016 may have been a food shortage. Food shortages have been reported as causing major mortality at both the Kilcoole nesting site and for the Common and Roseate Terns on Rockabill in 2016 (S. Newton & P. Manley, pers. comm.). Multiple dead chicks, with no external physical damage, were found along the foreshore in Kilcoole, some near fledgling age, indicating that they had probably died of starvation. On discussing this issue with the local anglers in the Baltray area, we were informed that a possible cause of this problem was that the mackerel had not begun to move in close to the coast yet (R. McElhinney, pers. comm.). As the mackerel move in, they push the sandeels and sprats closer to the coast, with Sprats going up the estuary, moving into the shallower water in which the Little Terns prefer to hunt.

Overall, the low tern numbers in the area in 2016 were likely down to a combination of reasons, including adverse weather during the migration, food shortage and heavy corvid disturbance suffered by the birds that did arrive. As the Little Terns arrived in such small numbers, they were unable to effectively mob the Hooded Crows and Rooks that were feeding in the nesting area and, although the wardens chased the corvids out as quickly as they were coming in, the large size of the nesting area (between 800 and 900m long) and the sheer number of corvids made this

difficult. Corvids were observed to move in at several points simultaneously, therefore it was not possible to protect the entire area all of the time, even with both wardens working together.

The 2017 season was the worst breeding season seen at the Baltray site since the inception of the organised wardening and protection scheme in 2007, marked by the almost complete absence of courtship display. An exhaustive analysis of the possible causes of this eliminated factors such as weather, disturbance, predation etc and suggests that an increased dredging regimen both in time and in volume in late 2016 and through the breeding season in 2017 is a likely cause. The Little Tern conservation project in Baltray was not carried out in 2018 following the failure of Little Terns to breed in Baltray in the two years previously. A grant was not applied for due to the severe deleterious effects of the dredging (Breffni Martin, pers comm.)

Breeding success improved markedly in the following two years, with over 36 pairs fledging an estimated 50 chicks in 2019, and 59 pairs producing an estimated 90 fledglings in 2020. In both years the project was carried out with funding from the National Biodiversity Action Plan obtained through and supplemented by the Heritage Office of Louth County Council.

1.4 Project Aims

The principal aim of the Baltray Little Tern Protection Scheme is:

“To ensure the survival and breeding success of Little Terns at Baltray by minimising disturbance by humans and predators, in order to help fulfil Ireland’s legal obligations under the EU Birds Directive”.

Strategies employed by the Louth Nature Trust/BirdWatch Ireland partnership to achieve this aim are:

- To promote awareness amongst the visiting public, in order to seek their co-operation in minimising human disturbance.
- To create physical barriers to prevent terrestrial predators accessing nest sites, where possible.
- To maintain colony surveillance for the early detection of both avian and terrestrial predators, and take appropriate steps to prevent loss of eggs, chicks and adults to predators.
- To monitor the breeding performance of the colony, in order to measure the success of the project and increase our knowledge of Little Tern ecology.
- To survey and monitor other species and habitats at the mouth of the Boyne estuary

2. Methods

2.1 Study Site

Little Terns at Baltray breed in an area known as the Haven. The colony is situated within the boundary of the Boyne Coast and Estuary Special Area of Conservation (SAC) and the Boyne Estuary Special Protection Area (SPA). Little Terns have very specific requirements for nesting and this area is suitable because of the presence of a ridge of shingle and its proximity to the river Boyne. As a consequence of winter storms, the beach configuration at the Haven changes dramatically year on year. A combination of embryonic dune formation, vegetation encroachment and wave dynamics act together to shape the topography of the area. In 2020 the potential nesting area extended from the training wall next to the Boyne river ca. 900m northwards to the shingle area adjacent to the pump house. This area is constantly changing due to the effects of weather, primarily the direction of the wind, which redistributes the sand along the beach.

The Baltray site is subject to very large tides, with the horizontal width of the intertidal area measuring approximately 300m between the Mean High Water (MHW) and Mean Low Water (MLW) mark. The nesting area stretched from the MHW mark c.50m inland, though much less in certain areas. From the MHW there was c.20m gently sloped sand/small shingle followed by a c.10m transitional zone of mixed sand/medium shingle straddling a ridge which marked the beginning of the vegetation line and embryonic dune formation dominated by Marram Grass (*Ammophila arenaria*) and Sea Lyme Grass (*Elymus arenarius*)(Figure 4). In some sections the nesting area extended another c.20m into an area of large shingle mixed with patches of vegetation, though in much of the potential colony the vegetation was too dense for the terns to breed.



Figure 4: Nesting habitat of Little Terns on Baltray beach.

A track runs along behind the breeding area, separating it from the dunes, and is used to service the colony during the setting up and taking down of the fence. To facilitate the wardens and volunteers' presence on site, a portaloo was hired in each year from 2013. Due to health guidelines relating to Covid-19, two caravans were present on site in 2021 to allow adequate distancing while providing shelter to both wardens and volunteers. These facilities are vital to the running of this project.

2.2. Monitoring

A full-time day warden (Luke Kenny) began monitoring the nesting site in Baltray from the 10th May, covering from 09:00 to 18:00 Monday to Saturday, with hours outside this period covered by volunteers. No full-time night warden was employed during 2021 but monitoring between 22:00-06:00 was undertaken by Maurice Conaghy, Dominic Hartigan, Gerard Murray and other willing volunteers after 25th May, shortly after the first nocturnal egg losses.

The warden's daily routine consisted of locating new nests and monitoring existing nests for the presence or absence of incubating birds. Nest visits were made to check the number of eggs and/or chicks present. As well as Little Terns, Ringed Plovers (*Charadrius hiaticula*) which nested within the colony were monitored in the same way. A daily log was kept, where details of personnel present, weather, tides, work done, tern activity, nest status, disturbances, visitors and all wildlife observations were recorded. Nest data tables were kept outlining the progress and due hatching dates for each nest. However, as entering the colony (beyond the electric fence) causes disturbance which may result in nests being abandoned, every effort was made to minimise both the frequency and duration of visits into the colony. The colony was never entered in adverse weather conditions (during rainfall, high winds or fog). In addition to these duties, the wardens were responsible for erecting and maintaining the colony fence.

2.2.1. Little Tern Numbers

The number of adult Little Terns present at the colony was recorded by the wardens as often as possible, and at the end of each day the maximum number was entered into the daily log. Counts were conducted during full dreads, when the birds were flushed, or when they were roosting on the foreshore (using a telescope); this was noted separately when it occurred. The presence of any colour ringed terns was also noted, and inscriptions read when conditions allowed.

Once chicks start to fledge, separate counts are made of fledglings to give an idea of productivity. This estimate is known to decrease in accuracy after the first two weeks however, as fledglings begin to leave the colony around two weeks after fledging (Keogh *et al.*, 2011). Furthermore, fledglings may arrive into the colony from other regional breeding sites, particularly as the case was this year, when those other sites were ahead in the breeding cycle. Therefore, fledgling counts are not used to estimate the total number of fledglings produced in a breeding season. However, they are a useful monitoring technique, as very low fledgling counts may indicate that chicks are being heavily predated. Survey methods for fledglings consisted of opportunistic counts on the foreshore, at times of little disturbance and low feeding frequency (when fledglings are less likely to fly after and beg for food from parents). These counts were undertaken during calm and clear weather when fledglings can easily be distinguished amongst a flock of adults.

2.2.2. Nest Locations and Observations

Binoculars and telescopes were used to monitor tern activity and locate nests within the colony. Note was taken of the following behaviours: courtship feeding, courtship displaying, aerial displaying, copulating, making nest scrapes or incubating. When it was noted that a bird was sitting for an extended period of time in a scrape, and therefore presumed to be laying or incubating, the position of the bird was noted by means of nearby objects or by lining up fence posts. With careful observations over a wide area of the colony, multiple potential scrapes could then be checked during a single visit inside the colony's fences, rather than making an exploratory visit to each newly noted potential scrape, thus minimising disturbance. Nest contents (*i.e.* number of eggs), nest substrate and approximate position in the colony were noted. The nest was marked by placing an upright brick, stick or prominent stone 1-2m in front of the nest.

Little tern nests were coded as follows: L X.n, where X is the pen number in which the nest occurs (see Figure 6) and n is the number of the nest in the order found, with Ringed Plover nests coded as RP X.n. If a nest was discovered outside a pen, it was given the number of the pen closest and labelled with an 'o' before the pen number to indicate that it was outside. As the 2021 nesting period progressed, and the number of nests outside the pens increased, supplemental fencing was

obtained and erected so as to enclose these otherwise unprotected nests. The majority of the nests were therefore within a fenced area, and so the additional “o” in the nest code became somewhat misleading, other than to indicate that the nest was outside the boundaries of the original pens. A map of each pen was drawn with the location of each new nest added. This greatly facilitated nest checks and observations. By the end of the season, 47 nests had been recorded within the boundaries of the original fenced pens, 31 nests enclosed by supplemental fencing, with a further 20 nests recorded outside of the fenced areas.

All nests were observed daily for presence or absence of an incubating bird, thus allowing identification of abandoned or predated nests. When a clutch did not increase in size over three consecutive days, or when a third egg was laid, the clutch was considered complete. Ideally nests should not be visited after clutch completion in order to minimise disturbance, however the nests of nearby breeding pairs often still needed to be checked for clutch size and so all birds in the area would flush. The over-riding principle was to conduct all checks as swiftly as possible so as to reduce unnecessary disturbance. Not all nests were easily observable, owing to the topography of the site, and thus it was very difficult to observe whether these nests were being actively incubated. In such cases nests were considered to be still active if the scrape and immediate surrounding was being maintained. Hatching dates were predicted where the clutch completion date was known, and daily nest visits were resumed at this point to check for hatching. All details of daily nest visits and chicks re-trapped were recorded daily in a summary table. The data recorded here were the number of eggs or chicks per nest, and whether any predation incidents had taken place (Table 1). These details were confirmed each evening and allowed the warden on duty to identify which nests needed to be checked.

2.2.3. Biometrics and Ringing

During the 2021 season, ringing of Little Tern chicks was carried out once by Jennifer Lynch (National Parks and Wildlife Service) and twice by a team under the supervision of Dr Stephen Newton (Birdwatch Ireland), who also supplied the rings. The ringing sessions were conducted on 24th June, 5th July and 21st July. The foreshore was searched during high tide and once a tern chick was found, its leg size was assessed to determine whether it was large enough to ring. When possible, chicks were fitted with a metal British Trust for Ornithology (BTO) ring in size B+ on their left leg, and a green plastic Darvic colour ring on their right leg.

The green Darvic band is used for Little Terns on the east coast of Ireland, and the position of the rings allows them to be distinguished from Kilcoole chicks from a distance, which have metal rings on the right and Darvic rings on the left. The green Darvic rings have a unique three letter/number code engraved in white lettering which can be read through a telescope to identify the individual. Chicks can only be colour ringed when their tarsus is long enough to fit a colour ring, usually at around one week old. Each chick had to be assessed on an individual basis to see if its tarsus was long enough. Metal bands can be fitted from hatching and chicks were usually ringed in or near the nest scrape, meaning that the exact age and nest of origin of these chicks was known if they were recaptured. Day 0 was used to denote the day of hatch, so 1-day old chicks had hatched the previous day.

Wing length and weight were measured when chicks were encountered to monitor their development. The nest site was searched for chicks during egg checks, and after most chicks had left the nest scrape, the foreshore was searched most days. Ring numbers, when present, were recorded and used to identify the age of the chick. Wing length (maximum chord length) was measured to the nearest mm using a stopped rule. Weight was measured using an electronic balance to the nearest 0.01g.

2.3. Conservation Measures

2.3.1. Use of Fences

Initial work on erecting fencing and signs began in mid-May thanks to Dominic Hartigan and a team of volunteers. Fencing from previous years was reused again in 2021. The area of shingle enclosed stretched from approximately 500 metres north of the Boyne wall northwards towards the pump house. The fence is used to reduce the probability of breeding failure caused by mammalian predators and to protect the area from human disturbance. Green plastic mesh was used on all but the east (seaward) side of the site (Figure 5). This made repair of storm damage easier and allowed chicks to leave the fenced area. A section of approximately 20 metres of dunes to the west of the beach was also enclosed, and the green mesh fence also went further north than the actual nesting enclosure. This was very useful as it acted as a buffer zone so that people and dogs were kept well away from the nesting terns when they approached from the north side of the beach.



Figure 5: Green mesh outer fence, with motion-activated solar powered lamp.

This year, the nesting area was divided into eight pens and each pen was enclosed separately (Figure 6). These pens were created using posts and one metre high electric mesh fence. A line of posts was erected along the HWM to the seaward side of the fence, to remind people to keep away from the fence.

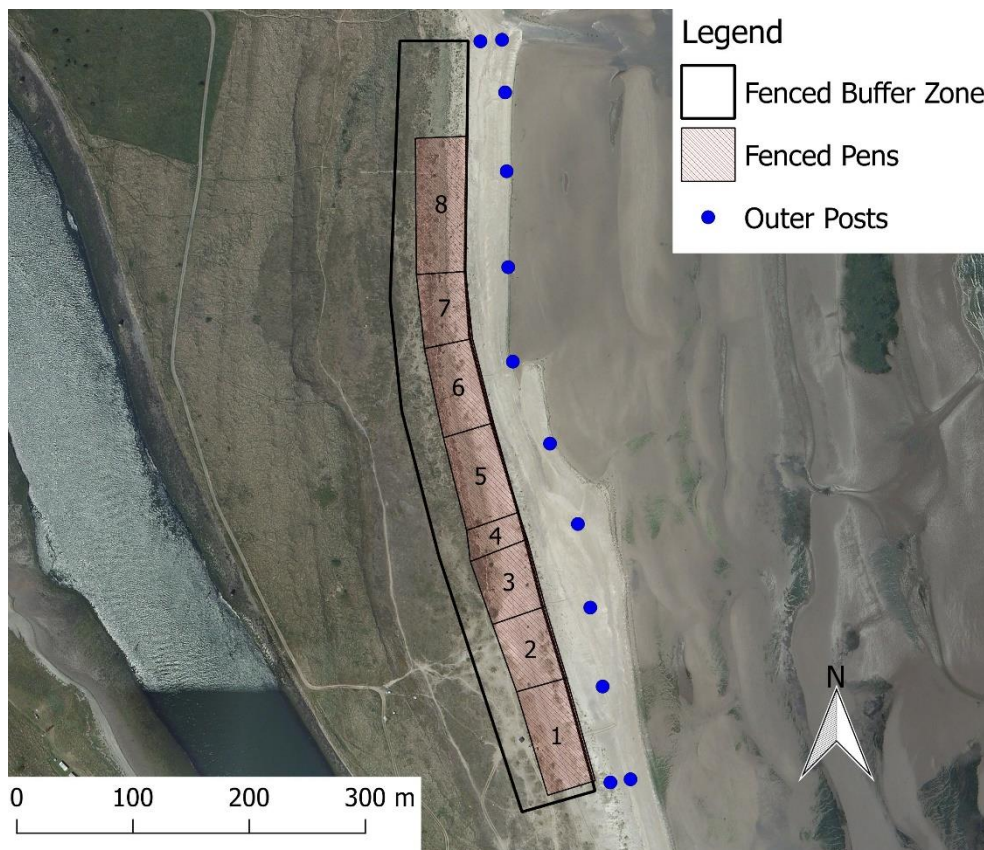


Figure 6: Map of the Little Tern nesting area showing total fenced area, fenced pens (1-8) and line of outer posts on seaward side of the colony.

To prevent avian predators using the wooden posts as perches, cut plastic bottles were attached on top of each post. Consequently, if a bird attempted to land, the cut bottles would not support their weight. This worked well as a deterrent.

Motion-activated solar powered lamps were positioned at strategic points around the north, west and south ends of the green mesh (buffer area) fence. These lamps charge during the day and are activated at night when something crosses the sensor within a metre in front of the lamp. This served as a deterrent to nocturnal predators and a warning system for night wardens.

2.3.2. Use of Signs

Several types of signs were erected around the conservation site (Figure 7). These included basic information signs regarding the Little Terns, protected area signs, warning signs for the electric fence and chicks on the foreshore signs. To cater for non-English speaking visitors, some were designed using symbols and pictures. These were erected at all entrances to the area, on the northern end of the beach and all around the nesting enclosure. Two large 1m² signs were erected at the entrances to the beach North and South of the site. These were full colour interpretive signs, outlining the project and providing information about the Little Tern.

Signs were erected along the walkway from Baltray to the beach as well as along the fence at either end, asking people to keep dogs on leads to protect ground-nesting birds. Signs were placed along the stakes of the buffer zone around the entire north and south ends of the colony and

at a stile by which many people access the beach. This proved very successful at cutting down on the number of people who attempted to walk along the foreshore.



Figure 7: A selection of signs erected around the Little Tern conservation site.

2.3.3. Chick Shelters

Around 15 lengths plastic pipe were placed on the beach as chick shelters. A variety of pipes were used, the diameters ranged from 6cm to 10cm, and the length was typically 20cm. These were half-buried in the shingle and sand to provide chicks with shelter from the elements and from predators. Shelters were placed beside newly hatched nests, soon to hatch nests and on the foreshore on the seaward side of the fence. They were redistributed to areas with a lot of chick activity as necessary. Several young chicks were observed sheltering in and beside the pipes throughout June and July. A variety of natural and man-made debris present on the shore was also utilised by chicks for shelter and included pieces of driftwood, large rocks and large plastic rubbish. During the 2021 season there was also a noticeable migration of chicks into areas adjacent to the shingle bank with thick vegetation, which no doubt provided good cover from the elements as well as predators.

2.3.4. Predator Management

As a ground-nesting species, Little Terns are very vulnerable to predators during the breeding season. In addition to the protection afforded by the fencing, wardens and volunteers were present 24 hours a day between 8th June and 28th July and attempted to scare away any potential predator spotted. The presence of people on site was a deterrent to most predators. The focus of predator management this year were Red Foxes (*Vulpes vulpes*), Sparrowhawks (*Accipiter nisus*) and corvids (Hooded Crows (*Corvus cornex*) and Rooks (*Corvus frugilegus*)).

Motion activated solar lights were placed at intervals along the fence, to disturb predators and alert wardens to their presence. During nocturnal disturbances, a searchlight was used to locate and scare foxes, and a radio was used as a noise deterrent. Cage traps of various sizes and designs were set in the vicinity of the site to capture potential predators so they could be relocated to a more suitable area.

2.4. Public Awareness

2.4.1 Interaction with beach users

A daily effort was made to increase public awareness and appreciation of the Little Tern. This was carried out by talking to interested walkers and, when possible, showing them an incubating adult or chick through a telescope or on a leaflet. When beach users were seen to be walking along the foreshore on the seaward side of the colony, or were in danger of entering the colony, they were approached by wardens, informed about the Little Tern colony and politely redirected. When people were unaware of the project it was explained, nests were pointed out when possible and alternative routes were suggested. When loose dogs came too close to the colony, wardens asked owners to place them on leads or take them away from the nesting site.

A blackboard was placed at the north end by the access pathway from Baltray and at the south end next to the river wall. These were updated regularly with counts of nests and eggs, and any news on the colony. This was well received, and many regular beach users enjoyed keeping updated on the colony.

2.4.2 Group Talks & Outings

On the 22nd June the Little Tern project hosted the 5th and 6th classes from Termonfeckin National School. After a brief introduction to the project and a talk about the risks posed by humans and natural predators, the schoolchildren were put to the test to see if they could spot “dummy” nests that had been carefully constructed by the warden. This proved to be a popular and challenging game that perfectly illustrated how easy it is to potentially step on a real Little Tern nest.

On 11th July a group of approximately 60 walkers from the Fehard Rambler group visited the colony. Volunteers Áine Walsh and Brendan Carty were on duty at the time (it coincided with the warden’s day off) and gave a talk to the group outlining the importance of the project as well as giving them a tour of the colony. A second group, of approximately 25 local rambles visited on the 17th July and were given a talk by both Dominic Hartigan and the warden. The talks were well received and much appreciated by all of those who attended.

2.4.3 Media Coverage

Louth Nature Trust (LNT) has an active Facebook page which was used regularly to create awareness, promote, support, and share information about Baltray’s Little Tern Conservation Project. The Facebook page now has 1193 followers and is a great resource for inviting new volunteers to join the project. Many of the new volunteers this year joined after following the progress of the Little Terns on this page. Long term volunteer Matt Byrne is an administrator of the page and was very involved in taking photographs and posting them on LNT’s Facebook page. A website is operated by B. Martin.

3. Results

3.1 Weather

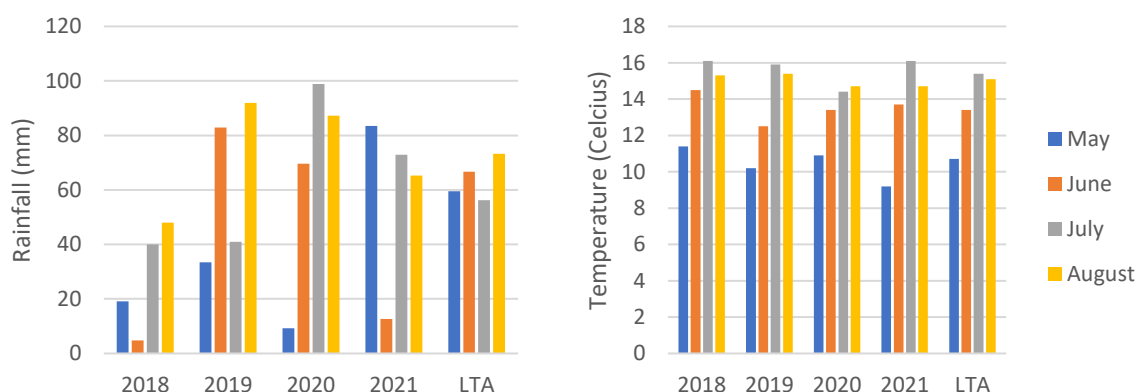


Figure 8: Average monthly rainfall and temperature (May-blue, June-orange, July-grey and August-yellow) at Dublin Airport weather station between 2018 and 2021, with the Long Term Average (LTA) values for the reference period 1981-2010. (www.met.ie/climate/available-data/monthly-data?LW=)

The 2021 season was marked by a cool, unsettled and wet May before steadily improving during the next two months, peaking with a two-week heat wave that began in the middle of July (a heat wave is determined by “...any period of five or more consecutive days when the maximum temperature exceeds 25°C at a single weather station.”).

The nearest Met Eireann recording station of Dublin Airport – which may be used for reference values – recorded mean monthly rainfall for May as 83.5 millimetres (mm) compared to the Long Term Average (LTA hereafter) value of 59.5mm. At the same station, June’s rainfall value of 12.6mm was well below the LTA of 66.7mm; July’s value of 72.9mm was above the LTA of 56.2mm (most probably the result of heavy and localised thundery showers); and August’s value of 65.3mm was above/below the LTA value of 73.3mm.

The average daily temperature for May at Dublin airport was recorded as 9.2°C, 1.5°C cooler than the LTA value of 10.7°C. June’s temperatures were average, with a value of 13.7°C compared to the LTA of 13.4°C; July recorded a daily temperature average of 16.1°C, 0.7°C above the LTA; and August was slightly below average, with a value of 14.7°C compared to 15.1°C.

It has been suggested that the cool, unsettled weather was responsible for a notably slow start to tern activity, though the exact factors at play remain unknown. A strong south-easterly storm occurred on the 20th May and certainly didn’t help matters, by depositing large quantities of sand onto the shingle banks. Storm-associated rain caused this sand to “set” like concrete over much of the site meaning much of the ground was considered largely unsuitable for nesting.

An extended period of dry, settled weather at Baltray Beach coincided with the peak hatching period (late June until mid-July) and persisted for a further two weeks, and most probably had a positive effect on chick survival, since chicks in their first week or so of life cannot thermoregulate effectively and so can easily succumb to exposure if the weather turns wet and cold. Chick shelters in the form of short lengths of pipe were placed near nests due to hatch, as per standard practice, however only one of these shelters was observed to be occupied on one occasion. Other years these may prove vital to certain chicks to escape from the elements.

Apart from sea breezes moderating temperatures, wind can also play two direct roles in nest and egg survival. During the nesting period, four nests containing eggs were almost covered over by wind-blown sand at the northern end of the colony where the seaward side of the shingle bank was much less pronounced and many nesting birds made their scrapes on what was effectively a sandy

plain just above the high water mark. Two of these nests were eventually recorded as lost, though the cause was recorded as abandonment, as the presence of incubating birds on the other two nests protected those scrapes from being covered in by the sand.

When blowing strongly from the easterly quarter in conjunction with high tides, wind can raise the HWM significantly, and on occasion cause nests to be washed out. Two nests were washed out this season, though only one can be directly attributed to the coupled effect of wind and tide, whereas the other nest was certainly built too low down on the foreshore.

3.2 Little Tern Numbers

Counts to establish the number of terns present were carried out whenever possible, usually when birds lifted in what are known as “dreads”. Dreads typically consisted of 60 to 90 birds in the peak of the breeding season. These numbers are considerably lower than what would have been expected given the number of breeding pairs present (a maximum of 75 B.P. were recorded). Average flock size of these dreads remained below 30 until the end of May when an influx of birds was noted at the site.

The first egg was discovered on 21st May and despite this nest being predated overnight, the number of active nests continued to increase for the next 30 days. The first nest hatched on 19th June and thereafter the number of active nests decreased steadily.

Normally, as chicks fledge, there is a drop in Little Tern numbers as some of the local population began to move around the eastern coastline, however such a drop was not observed at Baltray this year given that the majority of nest formation occurred later than usual. Instead, the number of terns at the site began to rise once more from the middle of July as adults and their offspring from other sites began to arrive in, gathering in loafing flocks before migration (this was confirmed to a degree on the 15th July when the Darvic colour ring of a 2021 Kilcoole fledgling was sighted at Baltray in the roosting flock). The highest count of adults roosting on the beach was 129, on 20th July (it was estimated that a further 20 adults were in and around the nesting site at the same time) . In the final week of July numbers decreased steadily as the tern flock became more mobile in preparation for migration.

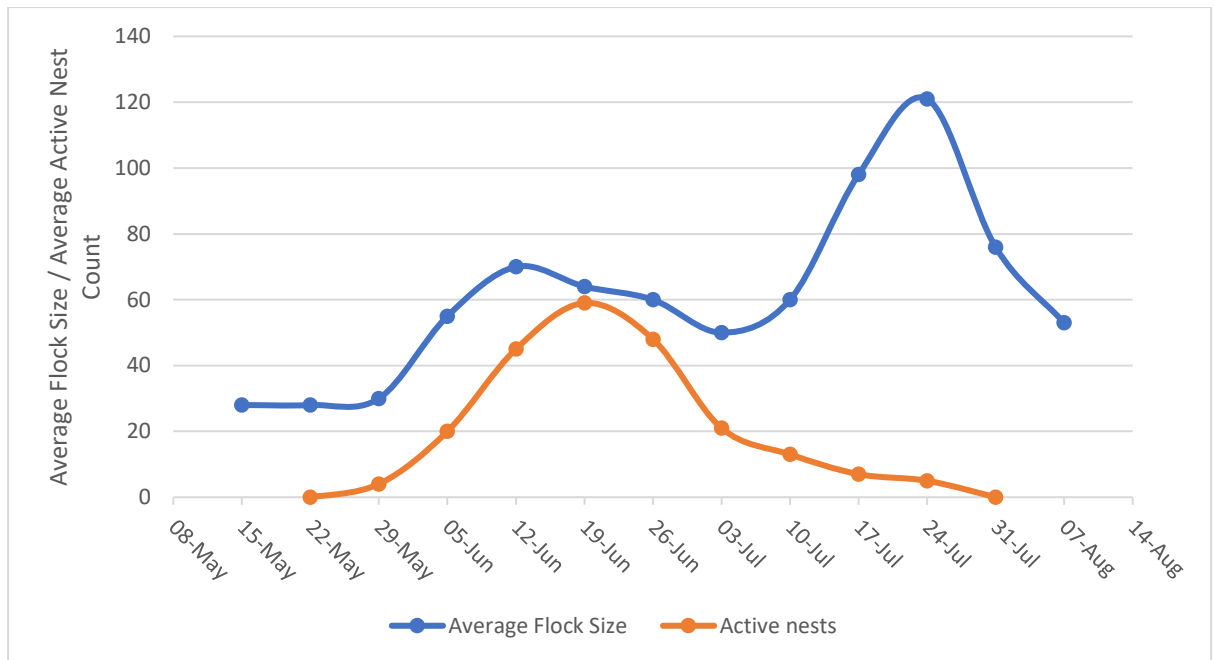


Figure 9: Average Little Tern flock size and the number of active nests per week at the Baltray colony from 15th May to 7th August 2021.

3.3 Nesting

3.3.1 Number of Breeding Pairs

Ascertaining the exact number of breeding pairs involved in a season is difficult given that nests are being lost or predated at the same time that additional nests are being laid or perhaps even re-laid. The maximum number of clutches (both hatched and incubating) occurred on the 23rd July, when 75 clutches were present. This means that at least 75 pairs were active in Baltray, however it is likely that the number of pairs that attempted to breed is higher. Predation events may cause breeding pairs to abandon a breeding site and re-lay at other sites, though some may have remained and attempted to re-nest in Baltray.

3.3.2 Pattern of Nesting

Of the 98 nesting attempts, 47 were made inside the electric fencing of the pens erected at the start of the season. As soon as nests were recorded outside of these pens, particularly on the seaward side, supplemental electric fencing was erected so as to enclose as many nests as possible. A further 32 attempts were protected by these additional electric fences. A total of 19 nests were not protected by electric fencing, as they fell outside of both the original pens as well as the supplemental fences, with six in the buffer area to the north of the pens and five in the buffer area to the south with the remaining eight nests being recorded between the electric fences and the HWM on a sand bank on the seaward side of the colony. While insufficient fencing material was available to enclose all nesting attempts, it should be noted that the layout of the beach and the risk of high tides reaching and damaging the electric fence generally precludes the enclosing of all nesting attempts between the fenced area and the HWM.

Of the 19 nests outside the fenced area, 21.0% were predated prior to hatching and of the 79 nests inside the fence, 20.3% were predated before hatching. In previous seasons the difference between the two figures was marked, highlighting the benefit to those nests within the fenced area. This year, the lower figures are more suggestive of either lower predator levels or more successful wardening, in particular the night watch shift.

The first nest was discovered on 21st May, and numbers increased steadily until 16th June. The rate of increase would have been greater had predation events not occurred on 3rd, 4th, 8th and

10th June resulting in the loss of seven, two, two and two nests respectively. Active nest numbers then levelled out with any newly recorded nests being offset by nests being to hatch out. Two minor peaks of additional nests occurred later in the season and corresponded to detailed sweep searches of the colony during chick ringing sessions that took place on the 5th and 21st July.

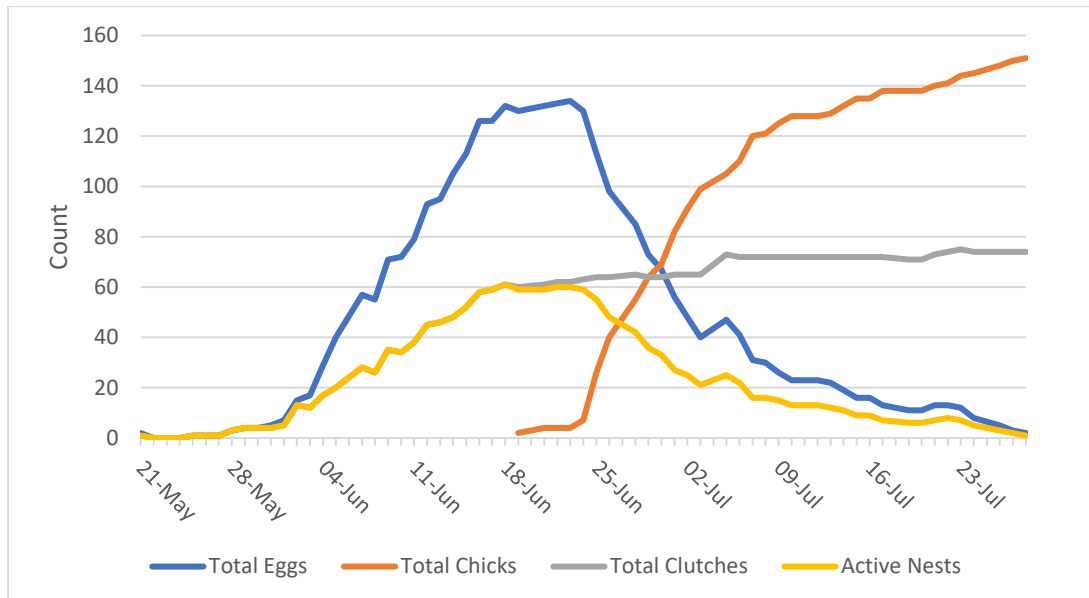


Figure 10: Trend of a) total egg numbers b) total chick numbers c) total clutches (active nests and hatched nests) d) active nests for the Little Terns over the whole nesting season (21st May – 28th July)

3.3.3 Clutch Size and Incubation Period

Of the 98 nesting attempts recorded, 85 clutches made it to completion (the remaining 13 were lost to predation or high tide before clutch completion was confirmed). Of those 85 completed clutches, nine clutches contained one egg, 61 clutches contained two eggs and 15 clutches contained three eggs. The average size therefore of completed clutches was 2.07 eggs. The exact incubation period is known for 22 nests (Table 1). The mean incubation period was 19.82 days. The shortest incubation period was 18 days, and the longest was 22 days.

Table 1: Incubation period of Baltray Little Terns in 2021 breeding season. Data only available for nests discovered before reaching full clutch. Incubation period covers time from when laying of the full clutch is completed until the first chick hatches (n = 22).

Nest Number	Incubation Period	Incubation Length (days)
L3.9	5 - 24 June	19
L3.10	3 - 24 June	21
Lo6.12	5 - 25 June	20
L7.13	5 - 24 June	19
L8.16	5 - 26 June	21
L4.17	5 - 25 June	20
L4.18	5 - 24 June	19
L4.19	5 - 25 June	20
L6.25	5 - 26 June	21
L2.32	9 - 28 June	19
L4.37	8 - 28 June	20
Lo4.38	9 - 29 June	20
L2.41	10 - 30 June	20
L4.42	10 - 29 June	19
L2.49	11 June - 1 July	20
L3.51	12 June - 1 July	19
L2.52	15 June - 3 July	18
L4.53	12 June - 2 July	20
L8. 63	16 June - 6 July	20
L5.67	16 June - 7 July	21
Lo7. 68	18 June - 10 July	22
Lo1.84	29 June - 17 July	18

3.3.4 Hatching Success

In total 192 eggs were laid throughout the season in 98 nests. Of this figure, 41 eggs did not hatch due to the following causes (Figure 11): fox predation (6 eggs), unidentified predation (17 eggs), washed away by spring tides (4 eggs), abandonment (7 eggs) and infertility (7 eggs). The remaining 151 chicks successfully hatched from 73 nests. The overall hatching success was 78.6% of eggs laid. Hatching commenced on 19th June and continued until 27th July.

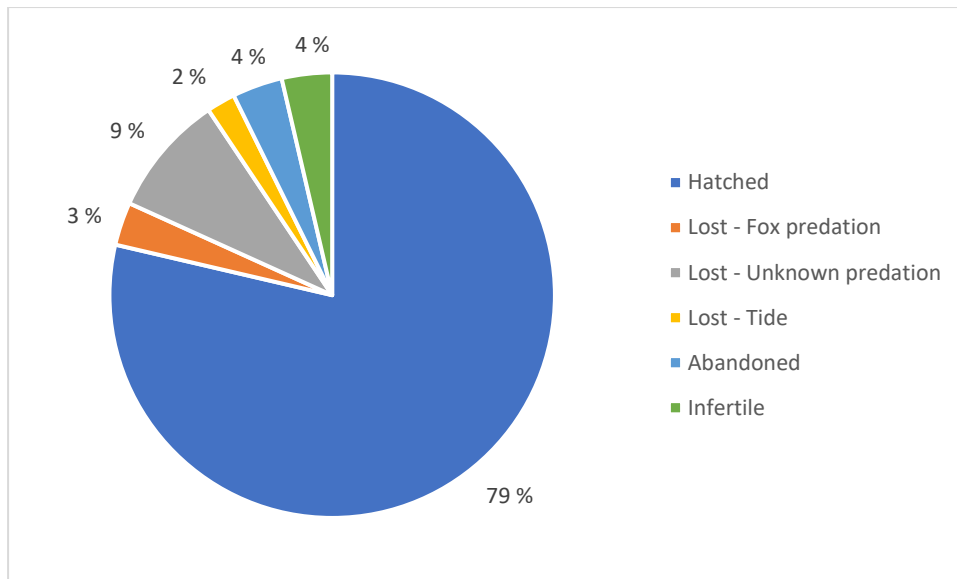


Figure 11: Percentage of outcomes of each Little Tern egg laid in Baltray in 2021 (n=192).

3.3.5 Fledgling Success

Of the 151 chicks hatched, remains were discovered indicating the loss of a total of 9 young. A sparrowhawk (*Accipiter nisus*) was witnessed flying out from the pens with a chick on one occasion, however five further remains were consistent with attacks by the same bird. One fledgling was taken by a great black-backed gull. Two very young chicks were found dead: a one-day old specimen squashed in its scrape, and an approximately 3-day old specimen found desiccated under thick vegetation. Thus, 142 chicks were presumed to have fledged, which equates to productivity this year of 1.89 fledglings per breeding pair. This is likely to be an overestimate - especially given that only one of the seven known predation events was witnessed - however, it gives a good indication of the overall success of the 2021 breeding season, as well as being comparable to the previous years' efforts. The result is the highest number of breeding pairs since 2014, and chicks presumed fledged since 2013.

Of 151 chicks hatched, 9 are known to have died before or shortly after fledging. One chick was found desiccated under thick vegetation in a pen. It was estimated to be about three-days old, and most probably died from starvation/abandonment. One chick was found squashed in its nest scrape, one day after hatching. The nature of its death suggested that it had been stepped upon by a human. The nest in question was outside of the fenced pens and in an area regularly encroached by human traffic.

A Sparrowhawk made regular visits between the 2nd July and 1st August which approximately corresponded to the period when chicks were present in the colony. Of 21 observed visits within this period, only one kill within the fenced pens was observed, however monitoring in the dunes behind the beach and searches around the fenced pens revealed the remains of five more Little Tern chick specimens. The remains included legs, wings, plucked feathers and an intact body with injuries to the wings and were all considered attributable to Sparrowhawk predation. The feather remains lacked full adult colouration as per Figure 12, and Baker 1993, and thus the remains were considered to be from chicks of between two and three weeks of age. One leg found amongst the remains of two chicks had a metal ring, NW55037.

One fledgling was taken by a Great Black-backed Gull on the tideline, in what was considered to be an opportunistic attack.



Figure 12: Little Tern Fledging with characteristic juvenile plumage.

Any chick not known to have died is assumed alive. Thus 142 chicks (94 % of the total hatched) are assumed alive and fledged (Figure 13). This is likely an overestimate, particularly as the colony was not observed on a 24 hour basis *e.g.* from the date of first hatching, 19th June, until the end of the monitored period, 4th August, 26 of the 46 early morning slots (0600 until 0900 hours) had volunteer presence, with a further three morning slots having been partly covered by a volunteer, while during the same period 29 of the 47 evening slots (1800 until 2130 hours) had volunteer presence with a further 15 slots partly covered. Given the considerable gaps in cover at the site, and that only one of the six known predation events on chicks by Sparrowhawks was witnessed, it is likely that more predation events may have gone undetected. That said, frequent searches within and around the colony for chicks and through the dune area produced no additional remains. Whether it is fair to assume that the majority of predation events were accounted for or not, the figures can be compared to previous years in terms of gauging the success of the colony.

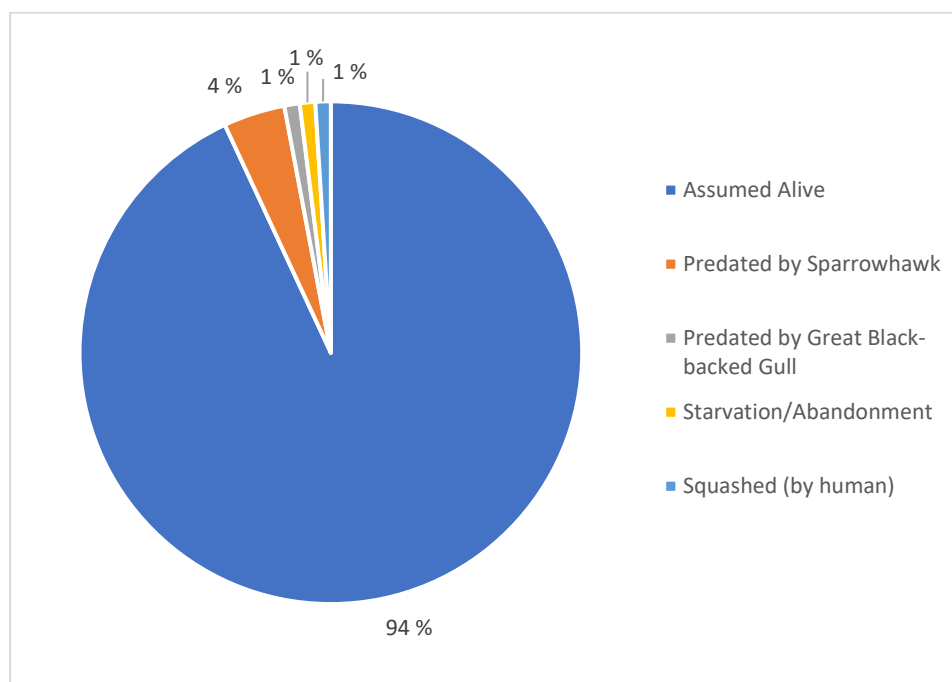


Figure 13: Outcome of each successfully hatched Little Tern chick in Baltray in 2021 (n=151)

3.3.6 Productivity

The productivity for this season is based on chicks assumed alive. As outlined above this is likely an overestimate but is thought to be the closest to the real figure. Seventy-five pairs produced 142 fledglings, giving a productivity of 1.89 fledglings per pair.

3.4 Ringing and morphometric measurements

3.4.1 Ringing

Ringing was carried out in three sessions on 24th June, 5th July and 21st July. In total 49 chicks were ringed with metal BTO band, 35 of which also received green Darvic colour bands. On a couple of occasions the decision was made not to ring a chick whose tarsus was considered too small to take a metal ring when initially trapped. The majority of chicks caught for ringing however, were large enough to fit with Darvic rings. Overall, 32.5 % of chicks were successfully ringed in 2021 with a metal band, while only 23.2 % of chicks were ringed with green Darvic rings.

3.4.2 Ring Recoveries

One ring was recovered from the remains of two dead chicks found on the 23rd July near the old pumping tower in the dunes level with the northern limit of the enclosure. The ring number was NW55037, ringed on the 5th July and last seen/measured on the 9th July at the southern end of the pens. The remains of both chicks indicated that a Sparrowhawk had predated them. The remains of two dead adults were found, one set of feathers in the dunes behind the colony and one week-old intact specimen on the beach just above the high water mark. The intact adult was ringed NW46537 and Green Darvic A61 ringed at Kilcoole on the 11th July 2019. No obvious cause of death was established.

3.4.3 Ring Resightings

In the 2021 season, 61 colour-ringed individuals were observed in Baltray (Table 2), comparing favourably to 2020 – 12, 2019 – 2, 2018 – 0, 2017 – 9.

One individual (ACA) was ringed with a metal band as a chick in Kilcoole in 2005, making it 16 years old. It was subsequently retrapped at Rue Point in the Isle of Man in 2016 when it was fitted with a yellow Darvic ring on its left leg. In July 2018 it was recorded in Gronant, Wales and in 2020 in Baltray. Of the 61 colour-ringed individuals recorded, 49 were adults and 12 were fledglings (10 Baltray, 2 Kilcoole). The first Kilcoole fledgling recorded at Baltray was AA2 and arrived on the 15.7.2021 having been sighted in Portrane on the 10.7.2021.

Table 2: Colour-ringed Little Terns observed at Baltray in 2021. Green Darvics are fitted in Ireland, with the dark green and lighter green colour differences referring to the first sighting of the season and subsequent sighting (where the first sighting may have been at a different location) respectively. Similarly with yellow and paler yellow, which were fitted in the UK.

Darvic	Leg	Location Ringed	Date Ringed	Date Observed	Observer	Comment
IX8	R			09.6.2021	Luke Kenny	Initially read as 8KI/8XI. Resighted 10.6.2021, 11.6.2021, 12.6.2021 all by L. Kenny
PEL	R			09.6.2021	Luke Kenny	Resighted 12.6.2021 by L. Kenny
PVT	R			09.6.2021	Luke Kenny	
ZKH	R			09.6.2021	Luke Kenny	Resighted 29.7.2021 by L. Kenny
ACA	L	Kilcoole (metal); Isle of Man (Darvic, 2016)	2005	09.6.2021	Luke Kenny	First ringed 2005 Kilcoole; retrapped and fitted with Darvic 7.6.2016 Rue Point, Isle of Man. Then recorded 6.7.2018 Gronant, Wales, 2020 Baltray. Resighted 12.6.2021 by L. Kenny
C4A	L			09.6.2021	Luke Kenny	Foulney Island pers com Jan Rod
IZ9?	R	Portrane	2018	10.6.2021	Luke Kenny	IZ9 seen regularly in Portrane during season
IT5	R			10.6.2021	Luke Kenny	Resighted 11.6.2021, 12.6.2021, 03.8.2021 all by L. Kenny
IZ6	R			10.6.2021	Luke Kenny	Sighted Portrane 8.6.21 by J. Rod and nested there, L1121. Partner metal right, 2 chicks fledged
IB5	L	Kilcoole	2018	10.6.2021	Luke Kenny	Resighted 11.6.2021 and 12.6.2021 both by L. Kenny

A58	L	Kilcoole	2019	10.6.2021	Luke Kenny	NW46512. Resighted 12.6.2021 by L. Kenny, 17.6.2021 by J. Rod
A48	L	Kilcoole	2019	10.6.2021	Luke Kenny	NW46511. Resighted 11.6.2021 by L. Kenny when it was initially recorded as AA8/A48. Resighted 12.6.2021 by L. Kenny
ID4	L	Kilcoole	2018	11.6.2021	Luke Kenny	NW46085. Some doubt over initial reading, but resighted on 17.6.2021 by J.Rod and on 21.6.2021 by L.Kenny.
XCP	R	Gronant	22.6.2017	12.6.2021	Luke Kenny	NW30435. Resighted 17.6.2021 by J. Rod
A61	L	Kilcoole	2019	12.6.2021	Luke Kenny	NW46537, female. Resighted 17.6.2021 by J. Rod, 30.6.2021 by L.Kenny. GoPro nest Lo7.68 10.7.2021. Recovered dead, intact, 21.7.2021 during chick ringing. Partner metal left.
IL7	L			12.6.2021	Luke Kenny	
IB7	L			12.6.2021	Luke Kenny	
PV7	R			12.6.2021	Luke Kenny	
I17	L	Baltray	2014	12.6.2021	Luke Kenny	NW38780. Nested in Portrane L0321. Partner unringed, 3 chicks fledged
ID?K	L			12.6.2021	Luke Kenny	
ANA	L			12.6.2021	Luke Kenny	NW46542
IN5	L	Kilcoole	2018	16.6.2021*	Luke Kenny	NW46199. GoPro nest Lo1.71. *Nest found on 16.6.2021. Partner Green right I55.
ANX	L	Kilcoole	2019	16.6.2021*	Luke Kenny	NW70702. GoPro nest L7.69. *Nest found on 16.6.2021. Partner also had green Darvic, but too far away from camera
I55	L			16.6.2021*	Luke Kenny	Partner of IN5, nest Lo1.71. Confirmed by GoPro. *Nest found on 16.6.2021
IJ7		Kilcoole	6.7.2018	17.6.2021	Jan Rod	NW46083
IK4		Kilcoole	2018	17.6.2021	Jan Rod	NW46170
I5L		Kilcoole		17.6.2021	Jan Rod	Mating, male. Resighted 21.6.2021 by L. Kenny
I44				17.6.2021	Jan Rod	
A04		Kilcoole	2019	17.6.2021	Jan Rod	NW46428, female
A49		Kilcoole	2019	17.6.2021	Jan Rod	NW46562. Resighted 27.7.2021
A60		Kilcoole	2019	17.6.2021	Jan Rod	NW46573
AAA		Kilcoole	2019	17.6.2021	Jan Rod	NW46575, male, displaying
ZHL		Gronant	22.7.2018	17.6.2021	Jan Rod	GoPro nest Lo8.79, 14.7.2021. Partner metal left
UHJ	R			17.6.2021	Jan Rod	

PHX	R			30.6.2021	Luke Kenny	GoPro nest Lo1.87, 26.7.2021
PVB	L			01.7.2021	Luke Kenny	GoPro nest L4.86, 8.7.2021
AEH	L			02.7.2021	Luke Kenny	
AA2	L	Kilcoole	2021	15.7.2021	Luke Kenny	First 2021 fledgling from Kilcoole, sighted first in Portrane 10.7.2021
AXV	L			17.7.2021*	Luke Kenny	GoPro nest footage 17.7.2021. Partner no rings.
AZL	R			23.7.2021	Luke Kenny	
AZX	R			23.7.2021	Luke Kenny	
A90	L			24.7.2021	Luke Kenny	GoPro nest footage Lo7.97. 24.7.2021. Initially considered as D6V
A2C	R	Baltray	2021	27.7.2021	Jan Rod & Luke Kenny	NW55040
A2K	R	Baltray	2021	27.7.2021	Jan Rod & Luke Kenny	NW55045
A2T	R	Baltray	2021	27.7.2021	Jan Rod & Luke Kenny	NW55051. Both observers thought it was a "T" but neither 100%
A2J	L*	Baltray	2021	27.7.2021	Jan Rod & Luke Kenny	NW55043. Darvic fitted to wrong leg. Baltray chick.
A2B	R	Baltray	2021	27.7.2021	Jan Rod	NW55039
A1X	R	Baltray	2021	27.7.2021	Jan Rod	NW55033
AES	L	Kilcoole	2020	27.7.2021	Jan Rod	Observed first in Portrane on 26.7.2021
A59	L	Kilcoole	2019	27.7.2021	Jan Rod	NW46514
ANL	L	Kilcoole	2019	27.7.2021	Jan Rod	NW70710. Male, mating attempt
AZ6?	L			29.7.2021	Luke Kenny	Initially recorded as A28/A26 and adult. However A2's are all this year's. Also AZ8 is Kilcoole 2021....so perhaps AZ6?
AES	L	Kilcoole	2020	29.7.2021	Luke Kenny	Adult. Observed first in Portrane on 26.7.2021
AH6	L	Kilcoole	2021	29.7.2021	Jan Rod	First observed 22.7.2021 in Rush
A2H	R	Baltray	2021	29.7.2021	Jan Rod	NW55042
A1N	R	Baltray	2021	29.7.2021	Jan Rod	NW55028
A3B	R	Baltray	2021	29.7.2021	Jan Rod	NW55071
A3P	R	Baltray	2021	29.7.2021	Jan Rod	NW55081
A41	L	Kilcoole	2019	29.7.2021	Jan Rod	NW46485. First observed 6.7.2021 in Portrane
IEK	L			29.7.2021	Jan Rod	
ID5	L	Kilcoole	2018	03.8.2021	Luke Kenny	NW46130. First sighting Rush 31.7.2021

Of the 35 chicks fitted with colour rings in Baltray this year, 20 were resighted by Jan Rod and Paul Lynch along the coast of north County Dublin and of County Meath between 27th July and 19th August. (Table 3)(Figure 14).

Table 3. Resightings of colour-ringed Little Terns fledglings from Baltray in 2021.

Darvic	Leg	Metal	Date Observed	Location Observed	Observer	Comment
A2L	R	NW55046	27.7.2021	Portrane	Jan Rod	Resighted 10.8.2021, 11.8.2021 Portrane by J. Rod
A2S	R	NW55049	29.7.2021	Rush	Paul Lynch	Resighted 10.8.2021 Portrane by J. Rod
A1T	R	NW55031	1.8.2021	Laytown	Jan Rod	Resighted 11.8.2021 Skerries by J. Rod
A2E	R	NW55041	1.8.2021	Laytown	Jan Rod	
A1P	R	NW55029	3.8.2021	Laytown	Jan Rod	Resighted 12.8.2021 Laytown by J. Rod
A2C	R	NW55040	10.8.2021	Laytown	Jan Rod	Resighted 12.8.2021 Laytown by J. Rod
A2H	R	NW55042	10.8.2021	Laytown	Jan Rod	
A3S	R	NW55084	10.8.2021	Laytown	Jan Rod	Resighted 12.8.2021 Laytown by J. Rod
A2P	R	NW55048	10.8.2021	Portrane	Jan Rod	Resighted 19.8.2021 Portrane by J. Rod
A2T	R	NW55051	10.8.2021	Portrane	Jan Rod	Resighted 11.8.2021 Portrane and 12.8.2021 Laytown by J. Rod
A2J	L	NW55043	10.8.2021	Portrane	Jan Rod	
A2K	R	NW55045	10.8.2021	Portrane	Jan Rod	Resighted 11.8.2021, 19.8.2021 Portrane by J. Rod
A1X	R	NW55033	12.8.2021	Laytown	Jan Rod	
A1S	R	NW55030	12.8.2021	Laytown	Jan Rod	
A3L	R	NW55082	12.8.2021	Laytown	Jan Rod	
A3B	R	NW55071	12.8.2021	Laytown	Jan Rod	
A3T	R	NW55062	12.8.2021	Laytown	Jan Rod	
A2N	R	NW55047	15.8.2021	Laytown	Jan Rod	
A3V	R	NW55085	17.8.2021	Laytown	Jan Rod	
A1Z	R	NW55034	19.8.2021	Portrane	Jan Rod	



Figure 14: Baltray Fledglings IT9 (left) and IT6 (right) in North Co. Dublin. (Photo by Jan Rod).

3.4.4 Summary Statistics

The numbers of Little Terns caught in their first few days is very high, though the sample size drops quickly after day 0-1 as they become more mobile and leave the nest scrape. There is some variation around the means, but the measurements were quite consistent for each age group; this is difficult to tell in older chicks due to the small sample size. Biometric measurements are summarised in Table 4.

Table 4: minimum, maximum, and mean (a) wing length and (b) weight values for Little Tern chicks age Day 0 to Day 16 (n=251).

Age (Days)	n	Wing Chord Length (mm)			Weight (g)		
		Min	Mean	Max	Min	Mean	Max
0	114	11	12.4	14	5.6	6.95	8.88
1	70	12	13.5	15	6.34	8.45	11.73
2	25	14	15.6	18	9.14	11.17	14.07
3	20	14	17.1	19	9.57	13.39	16.22
4	10	18	20.4	25	13.27	16.46	22.75
5	3	21	24.3	30	17.5	19.29	22.19
6	4	26	29	31	21.3	22.26	23.62
8	2	41	42	43	30.62	31.31	32
9	1	-	47	-	-	34.25	-
11	1	-	73	-	-	41.2	-
16	1	-	94	-	-	49.5	-

3.4.5 Chick Wing Length

Wing length increases slowly during the first few days. After day four, the rate of wing growth increased as the chicks' pins started to come through (Figure 15 and Table 4). The rate of wing length increase did not appear to be slowing in the older chicks, however for a truer picture, more older chicks of known hatching date would need to be caught and measured. The average wing length for adult Little Terns is 176-187mm for males and 167-180mm for females (Baker, 1993), so the wing length of the chicks would be expected to continue increasing until it reaches adult size.

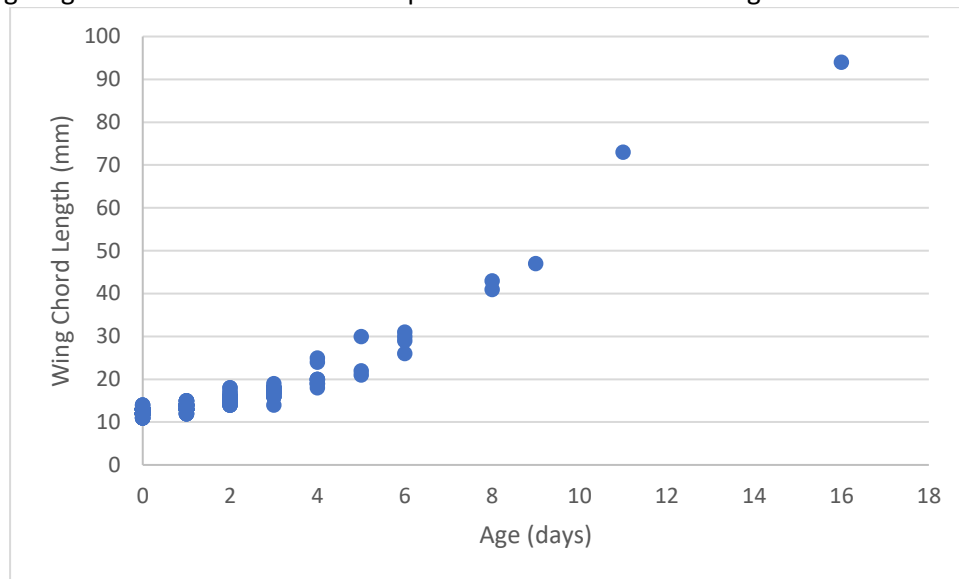


Figure 15: Little Tern wing length (mm) plotted against age (Days). n =251

3.4.6 Chick Weight

Chicks rapidly increased in weight during their first days (Figure 16). They typically doubled their weight or more in the first five days. Although limited data was available for chicks older than six days, the graph suggests that the growth rate begins to slow from approximately day 11 as the chick approaches its adult weight. The average weight for an adult Little Tern is 50g (Gochfeld and Burger, 1996), and this was reached by some chicks from Day 14 (Table 4 and Figure 16).

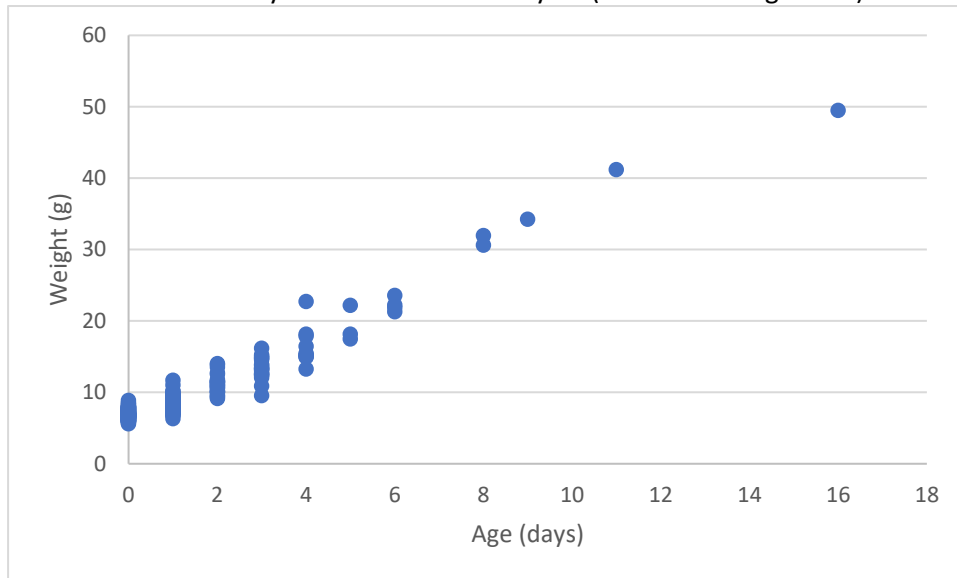


Figure 16: Little Tern chick weight (g) plotted against age (Days) (n = 251).

3.7 Predators and Disturbance

3.7.1 Terrestrial Predators

Predation by Red Foxes was the confirmed cause of six lost eggs this year. While this is not a significant egg loss, it should be noted that detecting the loss of young chicks to fox predation later in the season, when chicks leave the protection of the fenced pens, is almost impossible to record. The use of fences to pen off the majority of the Little Tern nests seems to be a successful preventative measure, particularly coupled with the presence of night wardens. Night wardens were on site for all save one night between and including the night of 25th May and the 30th July, and their presence acted as a fox deterrent and also a means of estimating the frequency of fox visits. A total of ten visits by foxes to the colony or adjacent area were recorded during the period of night watches, eight of which were by single animals. Two additional visits were recorded as having three foxes and two foxes (subsequent nights; 30th June and 1st July). The visits by a single fox on the night of the 28th/29th June resulted in the loss of two nests and four eggs from the area just to the north of the fenced pens, and on the night of the 18th/19th July resulted in the loss of one nest and two eggs, again outside the fenced area, on this occasion to the south of the pens. No foxes were seen in the vicinity of the colony after 21st July. Frequent rustling in the marram grass was noted in the dunes behind the caravan track, possibly from rats (*Rattus norvegicus*).

3.7.2 Avian Predators

Several potential avian predators posing a danger to fledged Little Terns and adults were observed in the area. As Kestrels (*Falco tinnunculus*) and Sparrowhawks (*Accipiter nisus*) have been major predators of Little Tern fledglings in Baltray in the past, the site was closely monitored for their presence.

Two Sparrowhawk sightings were recorded in May, when a flock of waders along the shoreline was targeted (one visit resulted in a wader being taken as prey). The first visit by a Sparrowhawk to the colony proper occurred on the 16th June, three days before the first chick hatched. It made regular

visits between the 2nd July and 1st August (once visiting at least three times during the same day). On the majority of visits, the Sparrowhawk was observed hunting low over the vegetation, adjacent to and inside the green mesh fence, where it made at least three observed kills of passerines (e.g. starling, meadow pipit or skylark). On several occasions it strayed in closer to the fenced pens, including one observed low pass over the pens – all with a warden in hot pursuit – though no tern kills were witnessed on these occasions. Only on one occasion was it observed flying out from the pens with a chick. On every recorded visit, all the Little Terns within the colony abandoned their nests and formed a dread high in the sky, alarm calling. Small numbers of terns also began swooping at the Sparrowhawk if it was perched on a fencepost.

Despite the low number of observed Sparrowhawk predation events, the remains discovered in the area (around the pens and nearby dunes) of five further Little Tern chicks/fledglings and one adult suggest that Sparrowhawk predation is likely to be a significant cause of chick mortality. Additional remains of a juvenile Common Tern, a Ringed Plover and an adult Ruddy Turnstone are all also likely to have been Sparrowhawk prey. Attempts to scare the Sparrowhawk away from the vicinity of the pens was generally unsuccessful, with the bird flying further along the green mesh fence so as to increase the distance between it and the warden. It was therefore concluded that the most successful method was to shadow the bird by following it as closely as possible as it hunted up along the green mesh fence, and only to attempt to scare it off by shouting and waving arms when it attempted to hunt in closer towards the fenced pens.

A Short-eared Owl (*Asio flammeus*) was observed hunting in the dunes on seven occasions during the season. On three further occasions it was recorded hunting within the green mesh fence, with one additional record (on the 28th July) of it being inside the pens. While Short-eared Owls were not recorded taking Little Tern adults or chicks at Baltray in 2021, it should be noted that birds can account for over 50% of the owl's prey items at certain times of the year (Cullen and Smiddy, 2012). Furthermore, at a Common Tern colony in Massachusetts, Short-eared Owls were recorded as taking 89 terns out of a total of 111 bird prey items (Holt, 1994).

A Peregrine Falcon (*Falco peregrinus*) was recorded making six visits to the beach area, two of which occurred on the same day. On all visits it appeared to show no interest in the colony, instead targeting waders along the shoreline. On one such occasion however, Little Terns were roosting along the tide with a flock of mixed waders (Dunlin and Sanderling) and so it was not possible to determine whether they too became targets for the Peregrine Falcon. On two of the six occasions it flew high over the colony disturbing the terns and consequently attracted a group of terns that began mobbing it.

There were seven recorded visits by Kestrel (*Falco tinnunculus*), four of which were of a bird hunting in the adjacent dune habitat and therefore not considered a threat to the colony. Three visits were recorded as being inside the green mesh fence enclosure, one of which was reported by a visiting volunteer from the Portrane Little Tern project, on which occasion the Kestrel was observed to have an unidentified prey item.

Flocks of Hooded Crows and Rooks numbering up to 50 and 40 respectively were present throughout the season, and often landed in the dunes to the west of the colony. One or two pairs of Hooded Crows were regularly seen foraging along the tide line while small numbers (<10) of both species encroached within the green mesh fence enclosure and within the fenced pens of the colony. Crows were observed flying low over the length of the colony searching for unattended nests during May and early June. During this time the wardens were kept busy trying to chase away and deter any crows from coming close to the colony. By the second week of June sufficient Little Terns had begun nesting at the colony such that any crow coming close was immediately mobbed. A total of 17 eggs were lost to an unknown predator that left behind little or no evidence, save for the odd fragment of broken shell. It is quite likely that crows were responsible for this loss, although none were witnessed.

Several seabirds which presented potential threats to Little Tern chicks and eggs were present throughout the season; Great Black-backed Gull (*Larus marinus*), Herring Gull (*Larus*

argentatus), Black-headed Gull (*Chroicocephalus ridibundus*), and Grey Heron (*Ardea cinerea*). Additionally, small numbers of Lesser Black-backed Gull (*Larus fuscus*) appeared from late July. Gulls were thought to have been responsible for heavy predation of Little Tern eggs in 2008 (Reilly, 2008) and any gull species flying over the colony was relentlessly mobbed by the Little Terns. A single predation event by a Great Black-backed Gull took place on the 18th July when a fully-fledged juvenile was opportunistically seized on the tide line.

Flocks of up to 200 Starlings (*Sturnus vulgaris*), the majority of which were juveniles, were observed from late May onwards. They were considered a potential threat to the Little Tern eggs as they are thought to have predated two nests in 2011 (Reilly, 2011), however for much of the season they did not enter the fenced pens, rather preferring to forage in the vegetation of the fenced exclusion area. On the few occasions that they entered the pens they were promptly seen off either by terns or the wardens, but overall the presence of such a large flock was considered to be beneficial, since it both offered a diversionary target for Sparrowhawks, as well as increasing the chances of their detection.

3.7.3 Human Disturbance

In May 2021 Covid-19 restrictions eased and once again the public was allowed to travel nationwide. This most likely meant a reduction in the number of visitors to the beach when compared to 2020, when strict limits on travel meant that more people than ever explored their local patch. That said, there remained a steady if small number of beach users that visited Baltray Beach, many on a regular basis, throughout the tern breeding season and presumably throughout the year. The huge expanse of foreshore during low tide is a particularly attractive public amenity for walkers and joggers gaining fresh air and exercise in a natural setting and thus there was a daily presence of people in the vicinity of the Little Tern colony. Many recreational walkers had to be guided away from the colony by the wardens. Most of these people had missed seeing the information signs about the project, or ignored them and were unaware of the exact risk their proximity posed. It was noted that walkers following the outer posts caused terns within the pens to flush, leaving their nests unprotected.

On regular occasions throughout the season wardens had to move swiftly to intercept walkers who veered in between the outer posts (on the foreshore) and the pens. These walkers often came within inches of treading on nests that lay outside the pens, or vulnerable young chicks that were hidden amongst the pebbles and shells of the shingle. One newly hatched chick was found squashed in its nest scrape on the 28th July, most probably as a result of being walked on in such an incident.

Dogs were often let off their leads at the beach by their owners. Many of these dogs made a habit of chasing the birds that foraged and/or roosted along the tideline or across the foreshore. Given the size of the foreshore at low tide, it was not practical for wardens to intercept all dog walkers and their loose dogs, however particular effort was made to target those walkers and dogs closer to the colony that posed more of a direct threat, and request that their dogs be put back on the lead on that part of the beach. On several occasions dogs chased after Little Terns running up the foreshore before wardens could reach them, and only stopping when they reached the pens. At least two of these incidences endangered both unhatched nests and pre-fledged chicks, however owing to good fortune no casualties occurred.

Drones were known to be present in the vicinity of the colony on seven occasions. On the 20th May a drone was operated from the Mornington side of the estuary in unsuitably high winds and crashed into the dunes. On the 6th June and 24th June flights were observed over the colony, with the operator being located and informed of the risk on the latter date. Of the four incidents in July, one operator was not located (the drone flew off towards the Mornington side of the estuary), one was approached and made aware before the flight took place, one operator obliged by stopping the flight when informed of the risk, while the remaining flight took place to the north of the enclosure and was focussed solely on the beach activities of a family. While no direct impact was observed during the season, drones may be considered as a major threat to the safety of breeding adults, as they may view the drone as a predator and try to drive it off which could result in serious injuries to the birds.

Recreational and Air Corps training aircraft flew relatively low over the area on numerous occasions. The Coastguard helicopter frequently crossed the bay but in general kept out over the water. Paramotors were also recorded flying over the dunes and beach area on three different occasions. None of these aviation incidents resulted in observed disturbance at the colony as all were deemed to be sufficiently high above, however it could be assumed that operators and/or pilots are unaware of the colony and potential risks posed by lower flights

On at least two occasions in May, riders on horseback rode down along the tide line at low tide. At this time there was no disturbance to the colony, although any traffic along the tide line does disturb waders and roosting seabirds. During June and July they avoided the foreshore in front of the colony. On 2nd August they appeared again along the tide line at low tide and were entering the foreshore in front of the colony when they noticed a warden heading in their direction, whereupon they made a U-turn before any interaction could take place. While the frequency of horse transits is very low, there is a chance that chicks could be crushed under their hooves.

Two Quads entered the foreshore in front of the colony for a distance of about 150m on the 23rd July. The warden did not see them as it was during a leg ring reading session and the Quads made no noise – presumably they were electric models. The speed at which these vehicles move offers no chance to any chicks that might be in the way. On the evening of 6th August, about two hours after the final fences had been removed from the site, two petrol engine Quads drove down the middle of the foreshore.

Jet skis regularly went through the river and estuary, principally on weekends, Bank Holidays and long summer evenings. Up to nine such vessels were observed at a time, though typically between two and four could be seen traveling up and down the estuary, doing circles outside the last beacons of the rivermouth, and occasionally transitting the bay towards Clogherhead area. These may cause disturbance to Little Terns feeding in the estuary, which seems to be their main feeding ground. They were also noted to regularly disturb a 60-strong roost of Great Cormorants along the outer river wall.

3.7.4 Dredging

As in previous years, dredging continued at the mouth of the river Boyne in 2021 (a dredger registered under the name of Argus). It was recorded dredging on at least 47 occasions between the 19th May and 3rd August (77 days). It is assumed that this dredging activity involved dredge for beneficial reuse since it is not reported in Drogheda Port Dumping at Sea report for 2021. The volumes reported are as follows:

Dates:

TSD Sospan Dau, commenced 19.02.21, completed 01.03.21 (1st campaign).
TSD Sospan Dau, commenced 09.12.21, completed 19.12.21 (2nd campaign).

Quantity of material dumped at sea:
1st campaign, 66,031 tonnes.
2nd campaign, 60,099 tonnes
Total: 126,135 tonnes

In comparison to previous years dredging during 2021 was reduced vis-à-vis 2017, 2018 and 2020 based on reports from Drogheda Port. However only quantities dumped at sea are available; dredging for the purpose of beneficial reuse may not be included.

In 2020 dredging took place on at least 26 occasions between the 8th June and 31st July (54 days). The area of operations was limited, and it did not move greatly north of south of the river mouth. Dredging typically took place at low tide, and an took an average of 3.5 hours (the start and end time of 27 of the 47 dredging operations were recorded).

In 2019, observations of foraging terns during dredging operations were carried out in Baltray which found that the terns did not actively forage in the wake or plume of the dredger and seemed to actively avoid it.

3.8 Other Tern Species

A Least Tern (*Sternula antillarum*) was observed on site on the 21st, 24th, and 25th of July. This is a north American species closely related to little terns. This particular bird had been primarily associating with the little terns breeding at Portraine in north Dublin.

Small numbers of common tern, Roseate Tern and Arctic Tern were a constant throughout the season with numbers building significantly post breeding:

3.9 Ringed Plover and other species

Alongside the Little Terns, 6 Ringed Plover (*Charadrius hiaticula*) nests were recorded inside the fenced area. The first three nests discovered were lost soon after discovery, two (four and two eggs respectively) to an unknown predator and one nest with a solitary egg to wind-blown sand. Of the remaining three nests within the fenced area, two, both with a full clutch of four eggs, successfully hatched out, while the remaining nest with three eggs was abandoned, or the eggs were infertile.

Seven further Ringed Plover nests were discovered outside the fenced area, along the shingle bank and upper foreshore to the north and south of the pens. Of these, six nests each containing four eggs successfully hatched out, with the seventh nest containing two eggs being predated.

The first successfully hatched chicks appeared on the 19th June, with the last successful hatching occurring on the 20th July. Ringed plovers have two (occasionally three) clutches per year, so the later nesting attempts may be second clutches for earlier pairs (Robinson, 2005).

In summary, Ringed Plovers made a total of 13 nesting attempts in and around the fenced area, which resulted in the hatching of 32 chicks from 44 eggs. Eight eggs were lost to an unknown predator, one covered by wind-blown sand and three abandoned/infertile. (Figure 17).

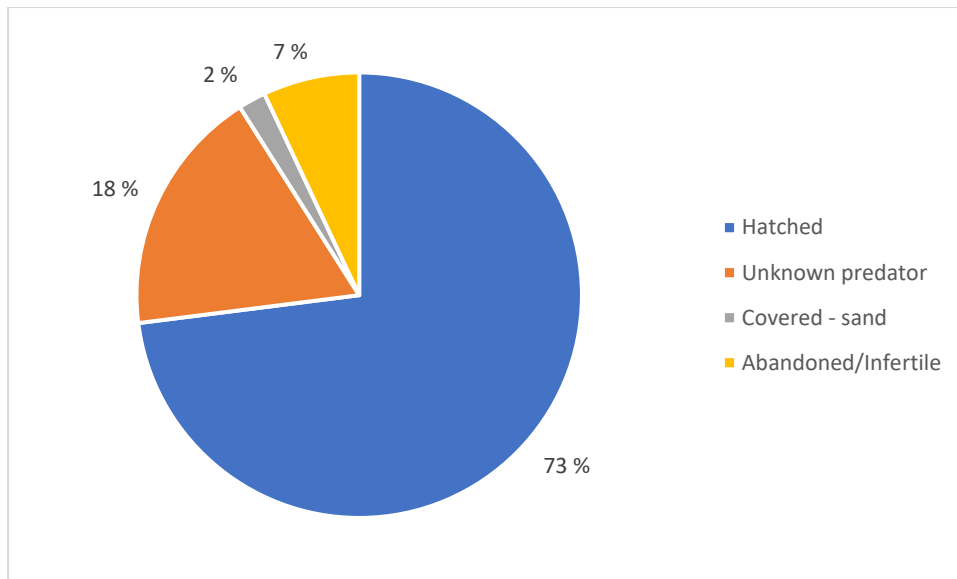


Figure 17: Outcome of each Ringed Plover egg recorded in Baltray in 2021 (n = 44)

A dead Ringed Plover chick was discovered above the high water mark outside the pens on 28th June. It appeared to be a couple of days old and may have died due to starvation or exposure. This is the only recorded mortality of a ringed plover chick or fledging this year, which suggests a good rate of chick survival.

A member of the public located a nest containing four eggs in the vicinity of the wreck of the Irish Trader vessel, to the north of the monitored site. This incident highlights the vulnerability of ground nesting species on beaches that are used as public amenities, and the value of fencing off areas of beach to protect them from areas of human activity.



Figure 18: Ringed Plover chick (left) and adult (left) on Baltray beach (photos by Billy Clarke)

One Eurasian Oystercatcher made a nest to the north of the fenced pens, near some of the outlying tern nests. The pair were incubating a single egg until the night of the 28th/29th June when a fox predated the nest along with two nearby tern nests. A Ringed Plover nest with four eggs and lying mere metres away somehow escaped predation.

One European Skylark nest was discovered inside the green mesh fence. One of the three eggs was observed to hatch, however the hatchling and the remaining two eggs all disappeared within several days. Given the thick vegetation present in the enclosure, and the continual comings and goings of Skylarks, it is likely that several more nests were present.

3.8.1 Waders

A mixed flock of waders, containing predominantly Dunlin (*Calidris alpina*) and Sanderling (*Calidris alba*) and with small numbers of Red Knot (*Calidris canutus*) were present along the tide line of Baltray Beach or to the north, every day during the observed period (10th May – 4th August). Initially the flock contained approximately 500 birds, but during June and the first half of July numbers dropped to less than 100, before increasing again through the second half of July as breeding birds returned from the high Arctic. By the 31st July approximately 250 Dunlin and 300 Sanderling were present. On the same day the highest count of Ringed Plover was obtained; 120 were counted on the foreshore in front of the fenced pens. Red Knot were present until the end of May, then absent until the middle of July. The highest count, 16, occurred on the 19th July. Approximately six Ruddy Turnstone (*Arenaria interpres*) were recorded regularly from the beginning of June. Between 250 and 300 Eurasian Oystercatchers foraged along the tide line of Baltray Beach all summer. Small numbers (max 6) of Eurasian Curlew (*Numenius arquata*) also frequented the foreshore, particularly from the middle of June onwards (up to 30 were counted further up the estuary off the village of Baltray during the same time).

These waders, along with the various species of gulls were frequently disturbed by members of the public throughout each and every day of the monitored period.

Sanderling are typically considered a winter visitor (by Birdwatch Ireland) so the presence of birds throughout the summer suggests that sites like Baltray are now used as feeding grounds for non-breeding adults that do not travel all the way north to the Arctic breeding grounds. It is possible that the presence of a summer flock of waders may have provided some protection for the terns from birds of prey, such as visiting Sparrowhawks and Peregrine Falcons. Curlew are of national conservation importance having seen declines of 96% in their Irish breeding population in the last 40 years.

Other records from Irishbirding.com are presented below:

Date	Species	Scientific name	Number
29-Apr-21	Whimbrel	Numenius phaeopus	1
07-May-21	Whitethroat	Sylvia communis	1
13-May-21	Eider	Somateria mollissima	4
16-Jun-21	Cuckoo	Cuculus canorus	1
23-Jun-21	Short-eared Owl	Asio flammeus	1
30-Jun-21	Short-eared Owl	Asio flammeus	1
01-Jul-21	Sanderling	Calidris alba	3
01-Jul-21	Roseate Tern	Sterna dougallii	2
01-Jul-21	Sandwich Tern	Sterna sandvicensis	2
01-Jul-21	Arctic Tern	Sterna paradisaea	100
29-Jul-21	Whimbrel	Numenius phaeopus	1
08-Sep-21	Curlew Sandpiper	Calidris ferruginea	1
16-Sep-21	Curlew Sandpiper	Calidris ferruginea	1
16-Sep-21	Pintail	Anas acuta	3

4. Discussion

4.1 The 2021 Breeding Season in Baltray

The success of any breeding season at a Little Tern colony can be primarily judged by the number of pairs that attempt to breed in that year and how many fledglings are produced from these nesting attempts. This year an estimated 75 breeding pairs produced 151 chicks, 142 of which are presumed to have fledged. This is the most successful season for numbers of pairs since 2014, and fledglings since 2013. This year's estimated productivity of 1.89 fledglings per breeding pair is a positive reflection on the conservation measure undertaken. The mean incubation period was 19.82 days, within the standard incubation period for Little Terns, cited as 18-22 days (Cramp, 1985). The longest incubation period for a nest in 2021 was 22 days, whilst the shortest incubation period recorded was 18 days.

The largest loss of eggs in 2021 related to 8 eggs from 7 nests which were lost to an unknown overnight or crepuscular predator (no obvious tracks were present). On the night in question, the scheduled night watch was taken ill at the last minute, and so the period from 2130 to 0435 hours the following morning was not covered. This highlights the importance of overnight and twilight wardening, as these are times when many predators can more easily avoid detection.

Corvid depredation was not confirmed as the cause for the loss of any eggs in 2021, however they are a likely candidate for those eggs lost to the unknown overnight/crepuscular predator. Given the abundance of corvids and the size of the site, these opportunistic birds are a significant threat to Little Tern nests, particularly in the early part of the season before tern numbers nesting in the colony build up. They are more likely to predate nests at the extremities of the nesting area where they could operate before the wardens can get close enough to scare them away. Once the numbers of nesting terns begins to build up, the aggressive response by those terns to all intruders is sufficient to keep corvids away, and for the remainder of the season they were not considered to be of significant threat.

Seven eggs failed to hatch due to infertility and a further seven from abandonment (five nests). Egg abandonment could be due to inexperienced parents or disturbance.

Two nests with a total of four eggs were washed away during two incidences of high tides. One of these nests had been moved incrementally over the course of a day by the warden but strong northeasterly winds pushed the tide higher up the beach inundating the nest.

Little by way of natural mortality was recorded at the site this year: six chicks were predated by a Sparrowhawk; one by a Great Black-backed Gull; and one died from suspected starvation/abandonment. An additional chick was found squashed, most likely by a human foot. Dry and warm weather in June and July meant that no mortality from exposure was recorded.

A total of 49 Little Tern chicks were metal ringed this year (32.5% of chicks). Re-trapping was carried out as often as possible in order to collect data on growth rates, however since ringing only took place on three occasions, very few chicks with a known hatch date were ringed, thus the probability of locating and re-trapping these chicks was considerably limited. Across years, these could be used as an indicator of feeding rates, and hence the availability of prey to Little Terns at Baltray as well as providing some insight into the growth of chicks. It appears that Little Tern chicks are approaching their final adult weight at about 2 weeks old, but their wing length continues to increase. Thirty-five chicks also received green Darvic colour bands (23.2% of chicks). Of these 35 chicks, 20 were resighted along the coast of north Co. Dublin and Co. Meath, a positive sign for the survival of Little Terns in Baltray after fledging. A ringed juvenile from Kilcoole (AA2) was spotted in Baltray on the 15th July – highlighting the mobility of Little Terns once fledged. In 2021 61 colour-ringed adults were identified in Baltray, comprising of 50 green Darvic rings (fitted in Ireland) and 11 yellow Darvic rings (fitted in the UK) – the colour ring does not confirm the hatching site of the bird, however the majority of ringing is carried out on chicks meaning it broadly corresponds to where the bird hatched. Of the 50 green Darvic rings observed, 10 were fledglings from this season in Baltray. Of the remainder, 40, 22 were known to have hatched in Kilcoole (including one 2021 fledgling) and

one each from Portrane and Baltray (the latter an adult ringed in 2014). Of the 11 yellow Darvic ringed birds, two were from Gronant in Wales. One additional yellow-ringed individual (ACA) was ringed with a metal band as a chick in Kilcoole in 2005, making it 16 years old. It was subsequently retrapped at Rue Point in the Isle of man in 2016 when it was fitted with a yellow Darvic ring on its left leg. In July 2018 it was recorded in Gronant, Wales and in 2020 in Baltray. These observations show the connectedness of the Irish Sea Little Tern population.

Baltray saw a second successive season of productivity in 2021, with a very successful Little Tern breeding season. Combined with high numbers in Kilcoole (over 300 chicks fledged) and a record of 24 chicks fledged from the relatively new colony in Portrane, over 450 chicks have fledged from the east coast of Ireland. This is a significant contribution to Irelands population of Little Terns, and a positive sign for the future of this species on Irelands east coast.

4.2 Dredging

Dredging has been ongoing along at the Boyne estuary to a greater or lesser extent for at least a few hundred years. Dredging has probably increased in recent decades in line with increased activity at the port and larger ships. Capital dredging is typically carried out to maintain shipping berths and the estuary channel, where silt builds up over time carried down by the river, and mouth of the river, where sand builds up thanks to the south to north longshore drift in the Irish Sea. This drift causes sand to be conveyed south to north and build up along the south training wall, onto the bar and so on northwards. To prevent the build-up of both silt and sand, dredging is carried out under a Foreshore Licence issued by the Department of the Marine. The licence specifies how much material can be removed, how it can be removed, at what frequency it can be undertaken (in terms of days per year) and where it may be disposed of (dumping at sea or beneficial reuse). During the 2017- 2019 nesting seasons, several wardens and other regular visitors to the site made anecdotal observations that dredging had apparently significantly increased, with plumes of material constantly visible in the water column, and almost daily activity by one or two suction dredgers (Argus and Sospan Dau). In 2019 and 2020 the work was carried out solely by the Argus.

To gain an understanding of this phenomenon the Foreshore Licence was checked. Because the whole area is designated under both the Birds and Habitats Directives, dredging requires an Appropriate Assessment (AA) to be carried out (Habitats Directive Article 4). The AA is the mechanism whereby impact on the Natura 2000 site is assessed; if any likely or uncertain impact is identified an Environmental Impact Assessment must be undertaken. Therefore, from the point of view of the Habitats Directive, the AA is the key permitting document since the dredging permit is dependent on it. An examination of the AA document under the heading Little Terns states as follows:

“3.5 Future Maintenance Dredging Requirements

Dredging at the river mouth and approaches generally takes place twice yearly, although in some years over the previous decade there have been three annual campaigns. The dredging at this location is generally in response to weather events. The time of year for dredging is dictated by the weather and weather events. A typical campaign takes about three weeks, working each tide, twice daily, generally from three hours before the high water to about 1 hour after the highwater.

Over the previous maintenance licence periods the port has accumulated a good deal of data and experience on the performance of the river and bar and the effects of weather. This coupled with mathematical modelling see reports by Kirk McClure Morton and RPS enclosed at Attachments B1 and D6 to this Dumping at Sea Permit application) allow realistic figures of annual maintenance dredging predictions. Monitoring of the bar/river mouth and the most sensitive area of the river in dredging requirement terms is now carried out by the port internal hydrographic unit, thereby maintaining a good check on depths particularly after easterly wind storm events.

The estimated annual quantity of maintenance dredging for the commercial channel, berths & swing basins from Drogheda town quays to the sea at Mornington is 30,000m³ or 48,000 tonnes, for the seaward approaches 90,000m³ or 144, 000 tonnes, with an additional annual contingency of 100,000m³ to allow for the unexpected and unplanned events that may impede the navigation channel. This is to cover an unexpected weather event or where the river retaining walls that created the estuarine polders collapse (as occurred in 2000) and the material contained within a polder flows out into the main navigation channel. This can occur due to a differential in the water pressure between the retained waters in the polder and the river falling tide levels. The river walls were constructed in the 1850s and their construction and current condition leave them susceptible to the effects of ship wash and hydrodynamic action. The contingency also allows for unexpected weather events at the river mouth and seaward approaches.

A detailed breakdown of historic figures upon which this annual estimate is based on is provided in the main application. The majority of the material will come from the bar mouth and approach channel with much smaller quantities arising from the channel from the town to sea including all berths and ship turning areas."

The same document assesses the impact of the above activity on little terns nesting in the area as follows:

"4.3 Boyne Estuary SPA 4080 Disturbance to birds

Little Terns are breeding on the beach at Baltray. The dredging activities will be remote from this location and will have no impact on this species.

The wintering bird populations in this SPA use the polders which are behind the training walls that define the river channel. These polders become exposed at low tide and are used for feeding and roosting by wintering bird species which the SPA is designated for. There will be no dredging activity within the polders and so there will be no direct impact on wintering birds.

Given that the waterfowl populations in the Boyne estuary currently tolerate a high volume of shipping through the SPA, it is considered highly unlikely that the additional barges, which will be in operation for 2 – 3 weeks at a time on a number of occasions during the year, associated with the disposal of the dredged sediments will have any significant impact on waterfowl populations for which the SPA is designated.

Impact Prediction: No significant impact."

Source: Provision of Information for An Appropriate Assessment For A Maintenance Dredging Plan For The Drogheda Port Company, Co. Louth 2012, Scott-Cawley

The above paragraphs contain a factual error, in that Little Terns breed in an area immediately adjacent to the dredging activity, and their foraging area is directly coincident with it. A review of available literature on the impact of dredging on Little Terns would suggest that the statement that dredging will have no impact is also erroneous:

"4.2.19 Little Tern

As Little Terns tend to feed close to the shore, they are at a low exposure to the disturbance and impacts on the benthos and associated fish species associated with marine aggregate dredging operations. Consequently, their vulnerability to these issues has been assessed as being low. As they are relatively insensitive to issues related to shipping, their vulnerability to the shipping associated with marine aggregate dredging operations has also been assessed as being low. Little Terns are highly exposed to the turbidity and increased sedimentation associated with marine aggregate dredging operations. Little Terns may be sensitive to increased sedimentation as the deposition of re-suspended sediment may smother the eggs and larvae of key prey species. Consequently, Little Terns have been assessed as being moderately vulnerable to the effects of increased sedimentation. As vision is an important part of Little Tern foraging ability, and Little Terns are highly exposed to changes in turbidity, Little Terns have been assessed as being very highly vulnerable to changes in turbidity associated with marine aggregate dredging."

Source: A Review of the Potential Impacts of Marine Aggregate Extraction on Seabirds, Cook *et al.* British Trust for Ornithology, 2010.

A review of the actual number of days of dredging (as well as quantities of dredged material recovered or dumped) was undertaken in 2017 (Lynch *et al.*, 2017). This information was provided by Drogheda Port on foot of an Information request under the AIE Directive. Note that in some instances dates appear as duplicates; this represents where operations were undertaken on two tides in the same day. According to Drogheda Port, overall 152 sailings were undertaken over 80 days up to end September in three campaigns, one lasting from 15/02/2017 to 26/02/2017 (10 days; 91,000), the second lasting from 19/04/2017 to 28/07/2017 (99 days) and the third from 30/08/2017 to 31/10/2017 (60 days); the quantity from 19/04/17 is 74,000 m³. The port therefore reports that 165,000m³ were dredged up to September 2017 (against the predicted maximum of

120,000m³ excepting contingency for exceptional events). In addition to this, a further 75,000m³ was removed/dredged from the river mouth in November 2016 so that the amount from November 2016 to September 2017 is a remarkable 240,000m³! Taken together the licence conditions, the actual level of dredging, the appropriate assessment, and the BTO study on the likely impacts, it is clear that there is a possible adverse impact on Little Terns, both as a result of turbidity and as a result of the knock-on impact on the reproduction and availability of a key prey resource, sandeels and sprats.

Sandeels (*Ammodytes* spp. mainly *Ammodytes tobianus*) are a major prey item for Little Terns. 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 (Source: A Students Guide to the Seashore - Fish and Fish 2011). Other less important prey include sprat (*Sprattus sprattus*), young herring (*Clupea sp.*), butterfish (*Pholis sp.*) and others, may also be adversely affected by dredging. Given the timing and reported locations of 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.

As with previous years it is difficult to assess the impact of dredging based on records because firstly the records are out of date by the time they are published, precluding any remedial action. Furthermore only dredging which results in dumping at sea is recorded. Other dredging involving “beneficial reuse” for either beach nourishment or recovery for construction activities, may be undocumented.

5. Recommendations

5.1 Dredging

Going forward it would be beneficial to establish an agreement between the various parties (Including Drogheda Port and Louth County Council) for a dredging regimen in the Boyne estuary that will result in compliance with the Habitats Directive and ensure the favourable status of little terns into the future in accordance with the Irish and EU legislation. It would be of particular interest if all dredging could be limited during the key months of April to July, including dredging for “beneficial reuse”. It would also be useful if this could be recorded, since the dumping at sea records do not report it. Finally a full appropriate assessment should be carried out in relation to all dredging activities, including beneficial reuse, the current NIS being clearly inadequate.

5.2 Monitoring

5.2.1 Scientific monitoring and student interns

The presence of one or more research assistants to help the full time warden would be of considerable benefit, both to the project and to the professional development of the assistant. Ideally such assistants would be a college student studying a biological science course, and with an interest in conservation. Their addition to the project would allow for better scientific monitoring of the breeding birds, in particular increasing scientific coverage to seven days a week (covering the full time warden’s day(s) off). The presence of an additional person at the site would also help with the protection of the terns from natural predators, encroachment/disturbance by members of the public, and also public engagement. Both the full time warden and the research assistant(s) could adopt some flexibility in their timetabling to help cover gaps in the roster, on the occasions that volunteers aren’t available.

5.2.2 Warden/volunteer protocols

The project relies heavily on volunteers giving their spare time to help protect the Little Terns from predation and disturbance, as well as promoting the conservation work to the public. Throughout the season new recruits are welcomed into the project, more experienced hands drop out for periods of time, and then return. The challenge is to ensure that there is consistency when engaging with members of the public. It would be worthwhile to develop a set of basic guidelines that volunteers could work to, to ensure fair treatment of all beach users.

5.2.1 Coloured Darvic Rings

An increased focus was made in 2021 to read coloured Darvic rings. Sustaining this increased effort would provide more information on the birds breeding and visiting Baltray. This could involve training interested volunteers to read rings, however it would be reliant on the provision of additional telescopes on site.

GoPro style cameras were trialled with considerable success on nesting adults. Nine rings were read in this manner. Footage can also provide insight into the diet and foraging success of the birds. It is recommended to continue using these cameras in this manner. Of 28 attempts, only one adult bird was observed to be nervous when reapproaching the nest in the presence of a camera. The camera was swiftly retrieved and the bird resettled without issue.

This year 35 chicks were ringed with coloured Darvic rings. While this was a considerable improvement on the previous year, it only accounted for 32.5% of the total. Increasing this figure will give a greater indication of fledging success, survival of juveniles and also result in more identifiable adults at the various breeding sites. While the training involved is lengthy in duration, it would be worthwhile to have trained ringers onsite to ring chicks whenever they are found. Metal ringing the chicks within a day or two of hatching i.e. before they leave the nest scrape, would also allow for improved growth rate data, as more retrapped chicks of a known age would be encountered.

5.2.2 Night Wardening

Employing a full-time night warden during the Little Tern breeding season would relieve volunteers of what is a very demanding role. Night wardening should ideally be provided from late May. As earlier clutches typically have three eggs while renesting attempts have fewer, focussing on protecting the first clutches will result in higher numbers hatching and hopefully higher numbers fledging.

5.2.3 Nest labelling

In some of the previous seasons the nests in Baltray were labelled with the nest code on a marker at the nest. In the last couple of years this was not done as it has been suggested that corvids can more readily locate nests with written markers. In seasons with higher numbers of nests, or in particular areas of the colony where nesting density is high, the chances of confusion over nest identification increases. During the 2021 season, when marking nests, every effort was made to make the marker unique, and a description of it was often recorded as part of the key to the nest map. Alternatively, colour-coded stones could be placed in a repeating fashion as co-ordinates in each pen before nesting began. This would help with the location of the nest (as the sitting bird departs as soon as the warden approaches), as well as accurate recording of the nest, which would help reduce the chance of later confusion e.g. supporting notes on a nest location might read as being two metres west of the blue stone and three metres east of the yellow stone in pen 4. This would also allow volunteers to record suspected nest locations for the warden to subsequently verify.

GPS marking of the nests could also be useful, to later analyse parts of the site that are more favourable as nesting areas.

5.2.4 Fencing

Separating the fenced area into pens should be repeated next year. The numbered pens made it easier to note nest locations, and the separation may prevent foxes from continuing through the whole nesting site should they breach a stretch of fence and gain access to a pen.

5.3 Equipment

5.3.1 Telescope

Telescopes for the accurate monitoring of the site are to be considered vital equipment given the sensitivity of the Little Terns to disturbance and also the size of the site. As part of the continued support for the project provided by NPWS, one telescope and tripod is provided. An additional telescope and tripod would be beneficial by allowing volunteers to familiarise themselves with it, and use it to read coloured Darvic rings. It would also be useful to increase the possibilities of showing members of the public nesting birds and chicks to foster support for the project.

5.3.2 Two-way Radios and megaphone

A set of two-way radios has been suggested in the past for the project wardens and volunteers on site. This would make it easier to manage the large stretch of beach. With the prevalence of modern-day mobile phone communication these radios are less crucial. There would also be additional work involved in their charging and maintenance (sand would invariably enter the working mechanisms of the radios and damage them).

A megaphone has also been suggested in the past as a means to get people's attention from distance, particularly if they have missed the signs and are at risk of entering the nesting area. However this would seem to be a very authoritarian method of communicating with members of the public and would undoubtedly cause some ill-will. Where possible, engaging with the public before they approach the site is the better method of limiting disturbance, however this relies on adequate volunteers/wardens being on site, which is not always possible.

5.4 Community Engagement

5.4.1 Blackboard

Large slates used as blackboards were placed at either end of the site and deemed successful in engaging beach walkers and keeping them updated on the project. It is recommended that they are used again next year.

5.4.2 Group visits

When possible, groups should be encouraged to visit the site and given a talk on the project, current status of the breeding season and if possible shown nesting birds through telescopes, photos of chicks, and other points of interest to foster a connection with the Little Terns and highlight the importance of the site. Face-to-face engagement is a wonderful opportunity to raise awareness of the project, demonstrate conservation in action and to recruit new volunteers.

5.4.3 Signage

The current signage about Little Terns used at approach points to the site is very informative, however it does not make clear the critical areas to be avoided at certain times during the season and during particular stages of the tide. It is recommended that some research is carried out into other similar projects to ascertain the best possible methods to guide/persuade members of the public so that they don't disturb the terns (or other roosting birds) but at the same time prevent them from feeling like they are being heavily policed.

The improvement of signage should proceed in tandem with other parties who are responsible for the management of the SPA and SAC. At entry points to the beach e.g. the Boyne riverwall, Baltray dunes (northern limit of the Little Tern project), Seapoint and Clogherhead, signs should have maps that identify the key areas that are (theoretically) protected by law. These signs should also indicate how best to avoid disturbing the various populations of birds e.g. not walking along the tide line where flocks of waders etc are feeding or roosting, not walking in front of the Little Tern colony when the tide is high, avoidance of beach areas where high numbers of birds are present, control of dogs in the presence of birds.

With increased awareness of the needs of the various bird populations and the risks posed to them, it could be expected that members of the public will be more willing to accommodate those needs.

5.4.4 Winter/Spring Public Relations campaign and volunteer recruitment

A concerted effort should be made to raise awareness for the project during the off-season. This could be by various means such as community talks/slideshows, newspaper articles and radio interviews. These would not only raise awareness as mentioned and remind the public of the upcoming season, but also increase exposure in terms of volunteer recruitment.

More volunteers are needed to adequately monitor and protect the site. An advertisement was placed with Louth Volunteers and their sister organisations in surrounding counties. This proved quite successful and in future should be instigated before the season commences. Reminders that volunteers are needed could also be broadcast on local radio before and during the season.

References

- Baker, K. (1993) Identification guide to European non-passerines: BTO guide 24. British Trust for Ornithology, Thetford.
- BirdLife International (2018) *Calidris canutus*. The IUCN Red List of Threatened Species 2018: e.T22693363A132285482. (<https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22693363A132285482.en>, accessed on 12th August 2020)
- Boué, A. & Newton, S.F. (2015) Baltray Little Tern Colony Report 2015. Final Report from BirdWatch Ireland to Louth Nature Trust.
- Cabot, D. & Nisbet, I. (2013) Terns. Collins New Naturalist, London.
- Cramp, S. (Ed.) (1985) Handbook of the birds of Europe, the Middle East and North Africa: the birds of the Western Palearctic. Volume 4: Terns to Woodpeckers. Oxford University Press, Oxford.
- Cullen, C. & Smiddy, P. (2012) Diet of Short-eared Owls *Asio flammeus* over Seven Winters in County Cork, Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*, vol. 112B, no. 2, Royal Irish Academy, 2012, pp. 217–23, <http://www.jstor.org/stable/41714033>.
- Delahunty, K., Somers, S. & Newton, S.F. (2016) Baltray Little Tern Colony Report 2016. Final Report from BirdWatch Ireland to Louth Nature Trust.
- Doyle, S., O'Connell, D.P. & Newton, S.F. (2013) Baltray Little Tern Colony Report 2013. Final Report from BirdWatch Ireland to Louth Nature Trust, Louth County Council & the Heritage Council.
- Doyle, S., P. Manley, C. Macey, J. Wray & S.F. Newton (2015) Tern Colony Management and Protection at Kilcoole 2015. Final Report from BirdWatch Ireland to National Parks & Wildlife Service.
- Egerton, S. & Newton, S.F. (2014) Baltray Little Tern Colony Report 2014. Final Report from BirdWatch Ireland to Louth Nature Trust.
- Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991. T&AD Poyser, London.
- Hannon, C., Berrow, S.D. and Newton, S.F. (1997) The status of breeding Sandwich *Sterna sandvicensis*, Roseate *S. dougallii*, Common *S. hirundo*, Arctic *S. paradisaea* and Little Terns *S. albigrons* in Ireland in 1995. *Irish Birds*, 6: 1-22.
- Holt, D. W. (1994) Effects of Short-Eared Owls on Common Tern Colony Desertion, Reproduction, and Mortality. *Colonial Waterbirds*, vol. 17, no. 1, Waterbird Society, pp. 1–6, <https://doi.org/10.2307/1521375>.
- Hutchinson, C.D. (1994) Birds in Ireland. T&AD Poyser, Calton.
- Johnson, G.C., Sullivan, I. & Newton, S.F. (2017) Tern Colony Management and Protection at Kilcoole 2017. Final Report from BirdWatch Ireland to National Parks & Wildlife Service.
- Kennedy, P.G., Ruttledge, R.F. & Scroope, C.F. (1954) The Birds of Ireland. Oliver and Boyd, Edinburgh.
- Keogh, N., Lynch, J., Hartigan, D., Conaghy, M. & Martin, B. (2019) Baltray Little Tern Colony Report 2019. Final Report to Louth Nature Trust
- Keogh, N.T., C. Macey, A. Porter, & Newton, S.F. (2013) Tern Colony Management and Protection at Kilcoole 2013. Final Report from BirdWatch Ireland to National Parks & Wildlife Service.
- Keogh, N.T., C. Macey, L. McNaughten & Newton, S.F. (2012) Tern Colony Management and Protection at Kilcoole 2012. Final Report from BirdWatch Ireland to National Parks & Wildlife Service.
- Lynch, J., Hartigan, D., Conaghy, M., Martin, B. & Newton, S.F. (2017) Baltray Little Tern Colony Report 2017. Final Report to Louth Nature Trust
- Manley, P., Witcutt, E., Delahunty, K., Macey, C., Butler, A. & Newton, S.F. (2016) Tern Colony Management and Protection at Kilcoole 2016. Final Report from BirdWatch Ireland to National Parks & Wildlife Service.
- McKeever, S. and Reilly, M. (2007) 2007 Report for the Little Tern Conservation Project at Baltray, Co. Louth. Unpublished Louth Nature Trust Report.
- O'Connell, D.P., C. Macey, A. Power, J. Wray & S.F. Newton (2014) Tern Colony Management and Protection at Kilcoole 2014. Final Report from BirdWatch Ireland to National Parks & Wildlife Service.

Reilly, M. (2008, 2009, 2010, 2011, 2012) unpublished Annual Baltray Little Tern Reports, 2008-2012. Louth Nature Trust.

Robinson, R.A. (2005) BirdFacts: profiles of birds occurring in Britain & Ireland. BTO, Thetford (<http://www.bto.org/birdfacts>, accessed on 12th August 2020)

Ussher, R.J. & Warren, R. (1900) The Birds of Ireland. Gurney and Jackson, London.

Whilde, A. (1985) The All Ireland Tern Survey 1984. Unpublished IWC/RSPB Report.

Appendices

Appendix 1: Avian Biodiversity in Baltray

Bird Species observed at the Baltray site from 10th May to 4th August. Species were recorded from the within and the immediate area of beach around the colony (BCH), offshore (OFF), on the river (RIV), in the adjacent sand dunes (DUN) and on the track (TRK) leading to the site.

CHARADRIIFORMES: SHOREBIRDS AND RELATIVES

Little Tern (*Sternula albifrons*) – present throughout and breeding, BCH
Common Tern (*Sterna hirundo*) – 1 or 2 pairs throughout season; ~10-30 present from mid-June including juveniles; ~250+ present early August in loafing flocks with juveniles, BCH
Roseate Tern (*Sterna dougallii*) – 1-2 non-breeders from mid-June; 20-30 present late-June to July including juveniles; ~250+ present early August in loafing flocks with juveniles, BCH
Sandwich Tern (*Thalass sandvichenis*) – present throughout season; 1-10 June, passing over colony; 60-80 July loafing flocks including juveniles; 120 August in loafing flocks with juveniles, BCH
Arctic Tern (*Sterna paradisaea*) – 1 or 2 present from July including 1st summer immature, increasing to 3-4 in mixed flocks of loafing terns, BCH
Common Ringed Plover (*Charadrius hiaticula*) – breeding throughout season; 120 roosting flock end July, BCH
Eurasian Oystercatcher (*Haematopus ostralegus*) – ~250-300 present throughout, BCH, RIV
Ruddy Turnstone (*Arenaria interpres*) – max 7 present from June, BCH, RIV
Sanderling (*Calidris alba*) – present throughout; 200-300 May; 20-40 June-mid July; 300 July BCH
Dunlin (*Calidris alpina*) – present throughout, ~100 May; 10-50 June – mid-July; ~250 thereafter, BCH
Redshank (*Tringa totanus*) - present occasionally, one or two individuals, BCH
Red Knot (*Calidris canutus*) – 1-10 May; absent June – mid-July; 16 thereafter, BCH
Eurasian Curlew (*Numenius arquata*) – 1 to 6 present throughout, BCH
Whimbrel (*Numenius phaeopus*) – 1-3 early May, thereafter absent, BCH, DUN
Black-tailed Godwit (*Limosa limosa*) – occasional individual from mid-July BCH
Lesser Black-backed Gull (*Larus fuscus*) – up to 20 regularly present throughout, BCH
Great Black-backed Gull (*Larus marinus*) – up to 50 present throughout, BCH
Herring Gull (*Larus argentatus*) – 100-300 present throughout with juveniles, BCH
Black-headed Gull (*Chroicocephalus ridibundus*) – up to 10 present throughout, BCH
Common Gull – (*Larus canus*) – on occasion, BCH

PELECANIFORMES: CORMORANTS AND RELATIVES

Comorant (*Phalacrocorax carbo*) – 20-150 present throughout, BCH, RIV
Gannet (*Morus bassanus*) – occasionally present throughout, OFF

CICONIIFORMES: HERONS AND RELATIVES

Grey heron (*Ardea cinerea*) – 1 to 2 present throughout, BCH
Little Egret (*Egretta garzetta*) – 1-2 frequently seen throughout, BCH, RIV

PASSERIFORMES: PERCHING BIRDS

European Starling (*Sturnus vulgaris*) – juvenile flocks of several hundred present throughout, DUN, BCH
Meadow Pipit (*Anthus pratensis*) – present throughout, DUN, BCH
Skylark (*Alauda arvensis*) – present throughout and breeding DUN, BCH
Blackbird (*Turdus merula*) – occasionally seen throughout, TRK

Reed Bunting (*Emberiza schoeniclus*) – occasionally seen throughout, DUN
Stonechat (*Saxicola torquata*) – present throughout and breeding, DUN
Pied Wagtail (*Motacilla alba yarrellii*) – present throughout, BCH, DUN
Linnet (*Carduelis cannabina*) – present throughout, DUN
Goldfinch (*Carduelis carduelis*) – 2-6 present throughout June & July
Wheatear (*Oenanthe oenanthe*) – occasionally seen in late-July, TRK
Barn Swallow (*Hirundo rustica*) – occasionally seen throughout, DUN
Sand Martin (*Riparia riparia*) – occasionally seen throughout, DUN
Hooded Crow (*Corvus cornix*) – 2 to 10 present throughout. RIV, DUN
Rook (*Corvus frugilegus*) – 30 present throughout RIV, DUN
Jackdaw (*Corvus monedula*) – 3 present 24th and 25th May, DUN

APODIFORMES: SWIFTS AND RELATIVES

Swift (*Apus apus*) – 2/3 present on occasion

COLUMBIFORMES: DOVES AND PIGEONS

Woodpigeon (*Columba palumbus*) – occasionally seen throughout, DUN, TRK

CUCULIFORMES: CUCKOOS AND RELATIVES

Cuckoo (*Cuculus canorus*) – audible May, juvenile seen July 25-30th

FALCONIFORMES: BIRDS OF PREY

Sparrowhawk (*Accipiter nisus*) – 1 hunting in colony between the 9th and 14th July, BCH, DUN

Kestrel (*Falco tinnunculus*) – 1 seen over colony 20th July, BCH, DUN

Peregrine Falcon (*Falco peregrinus*) – hunting in colony 22nd and 26th May, BCH, DUN

Appendix 2: Nesting Data

The table below is an account of the outcome of each nesting attempt at the Baltray colony in 2021. A total of 98 Little Tern nests were found.

Nests are coded as follows: Little Tern (L X.n, where X is the pen number in which the nest occurs (see Figure 3) and n is the number of the nest in the order found) and Ringed Plover (RP X.n). Initially if a nest was discovered outside a pen, it was given the number of the pen closest and labelled with an 'o' before the pen to indicate that it is outside. However, as many terns began nesting outside the original pens, supplemental fencing was used to enclose the majority of these nests. Rather than re-name these nests as enclosed, it was decided to leave the name as it was. Nests remaining outside fenced areas are marked with an asterisk.

Note: In addition to the chick found dead in the nest scrape, one (approx.) three-day old unringed chick was found dead in Pen 6, one unringed fledgling was taken by a Great Black-backed Gull and six older chicks, all considered pre-fledging were lost to a Sparrowhawk, one of which was ringed as NW55037.

Nest No.	No. Eggs	Egg Outcome	Date Found (<) or Clutch Completed	Date Lost	Date Hatched	Chicks Lost in Nest	Chicks Survived
L6.1	2	Unknown predator	<21/05/2021	22/05/2021			
L6.2	1	Unknown predator	<25/05/2021	03/06/2021			
L7.3	1	Unknown predator	<28/05/2021	31/05/2021			
L4.4	1	Unknown predator	<28/05/2021	03/06/2021			
L6.5	2		31/05/2021		19/06/2021		2
Lo8.6	1	Unknown predator	<31/05/2021	03/06/2021			
L2.7	2	Unknown predator	<01/06/2021	03/06/2021			
L2.8	1	Unknown predator	<02/06/2021	03/06/2021			
L3.9	3	Hatched (1) Infertile (2)	05/06/2021		24/06/2021		1
L3.10	2	Hatched (1) Infertile (1)	03/06/2021		24/06/2021		1
L4.11	1	Unknown predator	<02/06/2021	03/06/2021			
Lo6.12	3		05/06/2021		25/06/2021		3
L7.13	3		05/06/2021		24/06/2021		3
Lo7.14	1	Unknown predator	<02/06/2021	04/06/2021			
L2.15	1	Unknown predator	<02/06/2021	03/06/2021			
L8.16	2		05/06/2021		26/06/2021		2
L4.17	3		05/06/2021		25/06/2021		3
L4.18	3		05/06/2021		24/06/2021		3
L4.19	2		05/06/2021		25/06/2021		2
L3.20	1	Unknown predator	<03/06/2021	04/06/2021			
Lo3.21	3		<03/06/2021		26/06/2021		3
Lo2.22	1	Abandoned	<04/06/2021	10/06/2021			
Lo1.23	3	Hatched (2) Infertile (1)	<04/06/2021		25/06/2021		2
L6.24	2		<04/06/2021		25/06/2021		2
L6.25	2		05/06/2021		26/06/2021		2

Lo8.26	2	Abandoned	<04/06/2021	08/06/2021	
Lo8.27	3		<04/06/2021	25/06/2021	3
L8.28	2		<04/06/2021		2
Lo2.29	1	Infertile	<05/06/2021	02/07/2021	
Lo2.30	1	Abandoned	<05/06/2021	10/06/2021	
Lo7.31	1	Unknown predator	<05/06/2021	08/06/2021	
L2.32	2		09/06/2021	28/06/2021	2
L2.33	2		<06/06/2021		2
L2.34	2		<07/06/2021	28/06/2021	2
L8.35	2		<07/06/2021	27/06/2021	2
L2.36	2		<07/06/2021		2
L4.37	2		08/06/2021	28/06/2021	2
Lo4.38	2	Hatched (1) Infertile (1)	09/06/2021	29/06/2021	1
L8.39	2		<07/06/2021	26/06/2021	2
L3.40	2		11/06/2021	27/06/2021	2
L2.41	2		10/06/2021	30/06/2021	2
L4.42	2		10/06/2021	29/06/2021	2
Lo4.43	3		<09/06/2021		3
Lo8.44	2		<09/06/2021	30/06/2021	2
Lo8.45	2		<09/06/2021	27/06/2021	2
L8.46	2		<09/06/2021	26/06/2021	2
Lo1.47*	2		<09/06/2021	02/07/2021	2
Lo6.48	2		<09/06/2021	20/06/2021	2
L2.49	2		11/06/2021	01/07/2021	2
Lo7.50*	3		<11/06/2021	02/07/2021	3
L3.51	2		12/06/2021	01/07/2021	2
L2.52	3		15/06/2021	03/07/2021	3
L4.53	2		12/06/2021	02/07/2021	2
L2.54	2		<12/06/2021	01/07/2021	2
Lo5.55*	2		<12/06/2021	30/06/2021	2
L4.56	2		<12/06/2021	03/07/2021	2
Lo8.57	2		<12/06/2021	01/07/2021	2
Lo8.58	2	Abandoned	<12/06/2021	17/06/2021	
Lo8.59	3		<12/06/2021	02/07/2021	3
Lo8.60	2		<12/06/2021		2
L8.61	2		<13/06/2021	02/07/2021	2
L8.62	2		<14/06/2021	07/06/2021	2
L8.63	2		16/06/2021	06/07/2021	2
Lo8.64*	2	Fox predation	<15/06/2021	28/29 June	
Lo6.65	2		<15/06/2021	02/07/2021	2
Lo2.66	2		<15/06/2021	05/07/2021	2

L5.67	2		16/06/2021	07/07/2021	2
Lo7.68	2		18/06/2021	10/07/2021	2
L7.69	2		<16/06/2021	05/07/2021	2
L8.70	1	Abandoned	<16/06/2021	19/06/2021	
Lo1.71	2		<16/06/2021	05/07/2021	2
Lo8.72*	2		<16/06/2021	01/07/2021	2
Lo8.73*	3		<16/06/2021	25/06/2021	3
Lo8.74*	2	Fox predation	<17/06/2021	28/29 June	
Lo7.75	3		<17/06/2021	09/07/2021	3
Lo8.76	2		<18/06/2021	07/06/2021	2
Lo8.77	3		21/06/2021	08/07/2021	3
Lo8.78*	2	Washed out by tide	<21/06/2021	26/06/2021	
Lo8.79	2		<22/06/2021	14/07/2021	2
L4.80	2		<24/06/2021	14/07/2021	2
L2.81	2		<25/06/2021	01/07/2021	2
Lo7.82*	2		<26/06/2021	07/06/2021	2
Lo8.83	2		<28/06/2021	17/07/2021	2
Lo1.84	1		29/06/2021	17/07/2021	1
Lo4.85*	2		<01/07/2021	21/07/2021	2
L4.86	2	Hatched (1) Infertile (1)	<02/07/2021	22/07/2021	1
Lo1.87*	1		<05/07/2021	26/07/2021	1
Lo1.88*	2	Fox predation	<05/07/2021	19/07/2021	
Lo1.89*	1	Unknown predator	<05/07/2021	5 or 6 July	
Lo1.90*	2		<05/07/2021	27/07/2021	1 1
Lo2.91	2		<05/07/2021		2
Lo2.92*	2		<05/07/2021	25/07/2021	2
Lo8.93*	1		<05/07/2021	13/07/2021	1
Lo8.94*	2		<05/07/2021	23/07/2021	2
Lo7.95*	2	Washed out by tide	<21/07/2021	24/07/2021	
L8.96	2	Unknown predator	<21/07/2021	03/08/2021	
Lo7.97*	1		<22/07/2021	23/07/2021	1
L2.98	2		<23/07/2021	26/07/2021	2