Baltray Little Tern Colony Report 2017:

A Long-running Conservation Project on the East Coast of Ireland

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The conservation of Little Terns at Baltray is a Louth Nature Trust project, with site management contracted to BirdWatch Ireland, and funding provided by the Heritage Council.

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Abstract

- Little terns have been nesting at the Boyne estuary mouth for decades, possibly millennia given the suitability of the habitat.
- The site can produce up to 100 nesting pairs with circa 200 fledglings in optimal conditions (e.g. 2013).
- 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 end 2016 and through the breeding season in 2017 is a likely cause.
- This finding requires further investigation as well as appropriate management of dredging operations so as not to adversely impact the favourability of the site for breeding little terns in compliance with the EU Birds and Habitat Directive and their transposition into national law.
- The Appropriate Assessment (AA) undertaken in support of the dredging conditions fails to assess the impact on little terns and contains several important factual errors.
- The level of dredging exceeded the level assessed in the AA.

1. Introduction

1.1 Background

Little Terns *Sternula albifrons* are the smallest and scarcest of the five tern species breeding in Ireland. They are long distance migrants wintering in West Africa and returning to Irish coasts in late April and early May and depart in late July or August. They differ from the other four species in that they regularly, and the majority of the population, nest on mainland sandy or shingle beaches rather than islands. This means that they are highly vulnerable to human recreational disturbance and sea level rise and, exposed to the complete suite of terrestrial mammalian carnivores. Conservation action, i.e. wardening, electric fencing and predator management is thus required at all sizeable east coast mainland colonies, particularly Baltray (Louth) and Kilcoole (Wicklow).

1.2 Little Tern colonies in Ireland and the Irish Sea

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 10 colonies on the mainland. On the east coast there are colonies from Wexford to Louth, and on the west coast from Kerry to Donegal (Hannon *et al.*, 1997). The number of breeding pairs of Little Terns on the west coast is less well known than the east, but in 2016 a minimum 100 pairs were 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, this report), Wexford Harbour and Tacumshin (Co. Wexford), and Portrane/Rogerstown (Co. Dublin).

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. Additionally, there are reports of nesting at Cahore in recent years. Other sites on the east coast supported significant colonies in the past, but have had only intermittent breeding success in recent years. North Bull Island (Co. Dublin), and Buckroney (Co. Wicklow) are sites no longer used by Little Terns due to high levels of recreational disturbance. At Portrane, just a single pair successfully bred in the years 2009 to 2012. Two pairs were seen prospecting the site in May 2013 but no birds were noted on a subsequent visit in July. A pair was seen feeding an unringed fledgling there on July 30th, but the likelihood of these birds having dispersed from another colony cannot be discounted. In 2014 and 2015 one or more pairs may have nested successfully but in 2016 an untypically 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. Despite the success at sites such as Baltray (up to 2014) and the apparent expansion to former breeding locations, Kilcoole is probably 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 depredation 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 this year. Tony Murray and NPWS colleagues attempted to monitor the colony in Wexford Harbour opportunistically (details extracted from the Irish Sea Tern Colony Network Facebook Page); their first visit on 9th June yielded a total of about 200 adults and 64 nests were located of which 20+ contained only a single egg. Their best estimate was of ca. 150 pairs; a brief visit two weeks later (22nd June) had the same number of adults 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 two Little Terns were seen at Tacumshin Lake on 9th April, and a Little Tern nest with 3 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). At Portrane, north Co. Dublin, Paul Lynch reported about 25 Little Terns at the end of June and 3 or 4 pairs may have made scrapes or laid eggs. Unfortunately, these nesting attempts probably failed due to disturbance from dogs off the lead on this popular beach.

In Wales, the Gronant colony had a good year with 161 pairs fledging 202 chicks, a productivity of 1.25 [via Facebook, Jack Slattery (EU LIFE+ Gronant Dunes People Engagement Officer) and George Candelin (RSPB Senior Research Assistant, EU Life+ Little Tern Project)]. We have not been able to ascertain the status of the Point of Ayre, Isle of Man Little Tern colony in the 2017 breeding season.

1.3 Little Tern Colony in Baltray

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 nesting site, a phenomenon well known in the ecology of Little Terns (Cabot & Nisbet, 2013)

There are no detailed records of the site during the 1960s and 70s, but reliable observes noted them flying up and down the estuary, apparently nesting on both the beach and on sandbanks/mudbanks further up the estuary than the present day site (Dominic Hartigan, pers. comm. 2013).

During the 1960s and '70s, Irish people started to frequent beach areas in unprecedented numbers (O.J. Merne reported Little Terns at Clogherhead in 1967). The site at Baltray is relatively inaccessible with 2 km 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, despite the fact that 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.

Table 1. Little Tern population per structured national surveys 1970 – 2000. [*adults; 14 nests]

Year	**1970**	**1984**	**1995**	**2000**
Britain / Ireland	1917	2857	No data	2153
Louth	0	36	33*	0

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 effort was 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. 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 the foundation of the Louth Nature Trust with others, which enabled funding from the Heritage Council and 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 depredation 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 depredation of 37 eggs, mostly between 11 pm and 4 am 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 lead to the loss of 41 eggs to spring tides and 45 eggs were depredated 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 they 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 wardening 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 (hitherto there may have been some confusion between reported chick and fledgling numbers etc). The 2013 and 2014 seasons were very successful years with respectively 102 breeding pairs, 203 hatched chicks and 193 fledglings, and 150 nesting attempts, 170 hatched chicks and 91 successfully fledged Little Tern chicks. Due to a reduction of funding only one day time warden was in place in 2015 and this had an impact in mitigating corvid depredation. 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 warden no chick was seen to be depredated and all 20 chicks successfully fledged.

The 2016 season was not a successful year for the Little Tern colony, especially in comparison with 2013, 2014 and even 2015. 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 3 colour ringed fledglings (ringed in Kilcoole). Possible reasons for this relate to a late start in wardening, a large corvid presence, and sustained easterly winds early in the season (see appendix 2).

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. On meeting with the wardens from the Gronant colony, we were informed that they had recorded two adult Little Terns that had been ringed in Baltray indicating that the species will move between sites and are not necessarily loyal to just one breeding site. This reinforces the idea that the terns just nested elsewhere this year.

One other possible explanation for the Little Terns not coming to Baltray in 2016 may have been a food shortage. Food shortages have been reported as causing major mortality in both the Kilcoole nesting site and for the Common and Roseate Terns on Rockabill (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 with the local anglers in the Baltray area, we were informed 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 was 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 them 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.

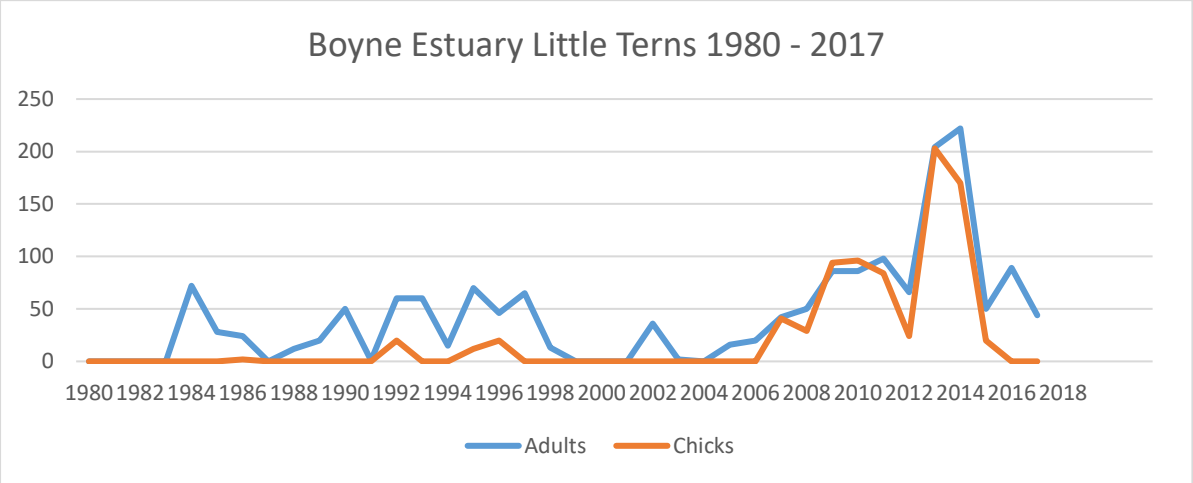

Figure 1 Little Terns aboslute numbers observed - Baltray

1.4 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 in order 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 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 Protected 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 2017 the potential nesting area extended from the wall next to the Boyne river ca. 900m northwards to the shingle area adjacent to the pump house. The area was considerably larger than in previous years, approximately 900m long x 40m wide, close to the largest the nesting area has been since the project was initiated. This area is constantly changing due to the effects of weather, primarily the direct of the wind, which redistributes the sand along the beach.

The Baltray site is subject to very large tides, with a tidal range of c.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). In some sections of 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.

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 life on site, a portaloo was hired in each year 2013-2017. A caravan was made available to day wardens during the later part of the breeding season. These facilities are vital to the running of this project.

2.2 Monitoring

Due to the low numbers of volunteers engage in the project, day wardens were present intermittently from the start of May to the end of June. Due to the low numbers of terns present and the lack of confirmed nesting behaviour it was decided not to employ a warden. Regular visits to the site were made by Jennifer Lynch from July 10th and 25th to determine if any nesting attempts took place in the later part of the season. Visits to the site usually occurred within 2 hours either side of high tide. When day wardens were present the beach was monitored for as many hours as possible between 06:00-22:00. No night wardens were present in 2017. In the following sections we outline the normal duties of wardens and volunteers. However, as no nesting took place, many of the actions did not occur in 2017.

The warden's daily routine in 'normal' years comprise searching for new nests and monitoring existing nests for the presence or absence of incubating birds. Nest visits were made to check the number eggs

and/or chicks present. In addition to 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 are kept outlining the progress and expected hatching dates for each nest. However, as entering the colony (beyond the string fence) causes disturbance which may result in nests being abandoned, every effort was made to coordinate activities so that visits into the colony were minimized. The colony was never entered in adverse weather conditions (during rainfall, high winds or fog). In addition to these duties, the wardens are responsible for erecting and maintaining the electrified colony fence.

There was no full-time night wardening at Baltray this year as this usually commences with the discovery of the first nests. The project area was lamped on a number of occasions by volunteers (Maurice Conaghy and David Martin) over the winter before the breeding season began (between October and February). The value of 24 hour protection is shown by the huge success of the 2009 and 2010 breeding seasons (Reilly, 2009; 2010). The night wardens' duties are focused on monitoring nocturnal predator activity and implementing control measures, if necessary.

A pilot survey of breeding passerines was conducted in The Haven area in mid-July to estimate the numbers of breeding pairs of Meadow Pipit, Skylark and Reed Bunting. The survey was carried out within four hours of sun rise. During a walk over of the site, using the main established paths, birds displaying evidence of breeding behaviour (singing males, adults carrying food or displaying territorial behaviour) were recorded and mapped.

2.2.1 Tern Numbers

The number of adult Little Terns present at the colony was recorded as often as possible by the wardens, 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 counted roosting at high tide along sandbars in front of the colony using a telescope during good weather; 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 (in years where nesting attempts took place and were successful), separate counts are made of fledglings to give an idea of productivity. This estimate decreases in accuracy after the first 2 weeks however, as fledglings begin to leave the colony around 2 weeks after fledging (Keogh et al., 2011). 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 depredated. Survey methods for fledglings consisted of counts at high tide when the majority of the Little Terns roost together along sandbars in front of the colony. These counts were undertaken during calm and clear weather when fledglings can easily be distinguished in amongst a flock of adults.

2.2.2. Nest Locations and Observations

Binoculars and telescopes were used to monitor Little Tern and Ringed Plover activity and locate nests within the colony. Birds observed courtship feeding, courtship displaying, aerial displaying, copulating, making nest scrapes or incubating were noted. If it became apparent a bird was incubating, an

exploratory visit was made to locate the nest. Nest contents (i.e. number of eggs), approximate distance along the fence-line and approximate position in the colony were noted. The nest substrate was categorised as either soft open sand, fine shingle (that where particle size average is less than 2cm) or coarse shingle (shingle and/or shells with particle sizes average of 2cm or more in width up to the size of small rocks).

If any nests were located, the nest was marked by writing an ID code on a stone which was then placed upright 1m in front (inland) of the nest. Nests were coded as follows: Little Tern (B n, where n is the number of the nest in the order found) and Ringed Plover (RP n). In addition to this, a marker stone showing the nest ID was also positioned along the electric fence. Furthermore, a crude judgment of distance of the nest from the warden's path to the seaward section of fencing, using a Close (C), Middle (M) or Far (F) denotation, was noted along with whether the nest was visible (V) from the path or not visible (NV). This allowed the nests to be coded (e.g. B48, MV), thus the approximate location of the nest could be estimated to facilitate nest check and nest observations.

For nests that were not visible straight out from the path a second marker stone was placed in 1m from the nest facing an angle from which it could be viewed. An elevated platform in front of the south part of the colony was used to make observations. The tower was very useful and gave a much better view over the area to observe terns and detect predators more efficiently.

All nests were observed daily for presence or absence of an incubating bird, thus allowing identification of abandoned or depredated nests. Viewpoints were set up in the dunes and on the seaward side of the colony in locations from which multiple nests could be viewed to minimise disturbance by removing the need to view each nest individually from the electric fence. Twelve of these viewpoints were set up during the project. When a clutch does not increase in size over three consecutive days, or once a third egg is laid, the clutch is considered complete.

To minimise disturbance nests were are not visited after clutch completion unless the incubating adult is absent. Some nests are very hard to view incubating from any angle, but if its scrape is still being maintained this indicates that the nest is still active. Hatching dates are predicted when clutch completion is known, and daily nest visits are resumed at this point to check for hatching. All details are recorded on the individual nest history sheets. In order to keep track of active nests a summary table is compiled to record daily nest visits and chicks re-trapped. The data recorded here is the number of eggs or chicks per nest, and whether any predation incidents have taken place. These details were confirmed each evening and allowed the warden on duty to identify which nests needed to be checked without having to go through the individual nest record sheets.

2.3 Conservation Measures

2.3.1. Use of Fences

The fencing was erected approximately one week before the arrival of the terns at the end of April by Dominic Hartigan and a team of volunteers. Additional fencing was obtained in 2017 through support from the National Parks and Wildlife Service. The area of shingle enclosed stretched from close to 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.

A string cordon was put on the outside the expected nesting area, enclosing an area of approximately 650m by 75m. To make the cordon pigtail stakes were used along with blue baler twine on the inland side and 8' wooden posts were used on the seaward side, as the latter could withstand immersion during high tides. Coloured streamers were attached at intervals to make it more visible to the public. The string cordon went well further north than the actual nesting enclosure, this was very useful as it acted as a buffer zone so that people and dogs were well away from the nesting terns when they approached from the north side of the beach.

As in previous years, the nesting area was divided into two zones and each zone was enclosed separately, leaving a walkway between them. These zones were created using 5’ posts and 1m high plastic mesh cable tied to the fence posts. The mesh was curved outwards and had sand loaded onto it to partially bury it and deter digging predatory mammals. The mesh used was mostly saved from the 2016 project, with some new mesh. The northern zone was longer (c 370m) than the southern zone (c.230m). Both zones were c.40m wide. The walkway led out to the vicinity of the caravan, approximately 75m away.

Green plastic mesh was used on the all but the east (seaward) sides of the enclosure. This made repair of storm damage easier and also allowed chicks to leave the fenced area. To prevent avian predators using the wooden posts as perches, inverted cut plastic bottles were attached on top of each post. Consequently, if a bird attempted to land, the bottles would not support their weight. This worked very well as a deterrent.

Electric fencing was prepared for use and ready to set up if a nesting attempt was observed. However as no confirmed nesting attempts were observed, the electric fence was not deployed in 2017. In previous years the enclosed zones were fenced with electric fencing, using four circuits of six strand wire. Plastic electric fence posts were used and these were easily inserted into the sand immediately outside the plastic mesh. Three strands of electric fence wire were placed on the three lowest rungs of the posts and one was placed on the highest rung. The plastic posts were attached to wooden posts at intervals to strengthen them. Both of the zones had separate electrics fencer units and earthing rods. These were securely placed in waterproof boxes and buried beneath the sand. Over-ground switches were discretely wired from the fencer to wooden posts and these were used for turning them on and off. The electric fence was on at all times over night and during the day when a warden had to leave the area. If any debris was earthing the electric fence wires it was removed. When the voltage was seen to be dropping the warden replaced the appropriate fencer unit battery.

The fencing was removed by a team of volunteers in mid-August. Dominic Hartigan’s assistance to the project in helping take up the fence, removing the material and storing all fencing material and the project caravans in his yard was invaluable.

2.3.2. Use of Signs

Several types of information signs were available for deployment. 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 1m x 1m full colour interpretative signs were erected, one at the end of Baltray village at the approach to the Haven and the second further on at the main parking area beside the locked gate. Signs were also placed on stakes by the entrance to the colony site and by the warden's caravans. 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.

2.3.3. Predator Management

Little Terns are very vulnerable to predators when breeding. In addition to the protection afforded by the fencing, the volunteers made every effort to scare away any potential predators away. The simple presence of humans at the colony helped keep most predators at bay. In 2017 predator management focused on Hooded Crows (Corvus cornix).

Although Rooks (Corvus frugilegus) were present in and around the colony in 2017, their presence did not pose a large threat due to the lack of nesting attempts. Hooded Crows were major predators of Little Tern nests in 2007 (Reilly, 2007) and Red Foxes were major predators in 2011 and 2012 (Reilly, 2011; 2012), so where possible the vicinity of the colony was closely monitored for these species. Hooded Crows or Red Foxes which were considered a threat to the colony were removed under licence.

Kestrels (Falco tinnunculus) are noted predators of Little Tern chicks and have taken a large number of fledglings at Kilcoole and Baltray in certain years (Hall et al., 2009; Keogh et al., 2010, Egerton & Newton, 2014). In 2017 Kestrel were observed at the site at a lower frequency that in previous years. This may be due to the relocation of the nesting pair (normally nesting near the village of Baltray) to the woodlands surrounding An Grianan in Termonfeckin.

2.4 Public Awareness

2.4.1 Interaction with beach users and group talks

A daily effort was made to increase public awareness and appreciation of the Little Tern. This was carried out by talking to 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 in front of the colony, or were in danger of entering the colony, they were approached by wardens, informed about the Little Tern colony and politely directed away from the colony.

2.4.2 Media Coverage

The Louth Nature Trust blog was updated and uploaded to the Little Tern section of the Louth Nature trust website (www.louthnaturetrust.org) to provide updates of the events at the project site. Louth Nature Trust (LNT) also 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 654 followers and is a great resource for inviting new volunteers to join the project in future years. Long term volunteer Matt Byrne was very involved in taking photographs and posting them on LNT's Facebook page. He is also an administrator of the page.

3. Results

3.1 Weather

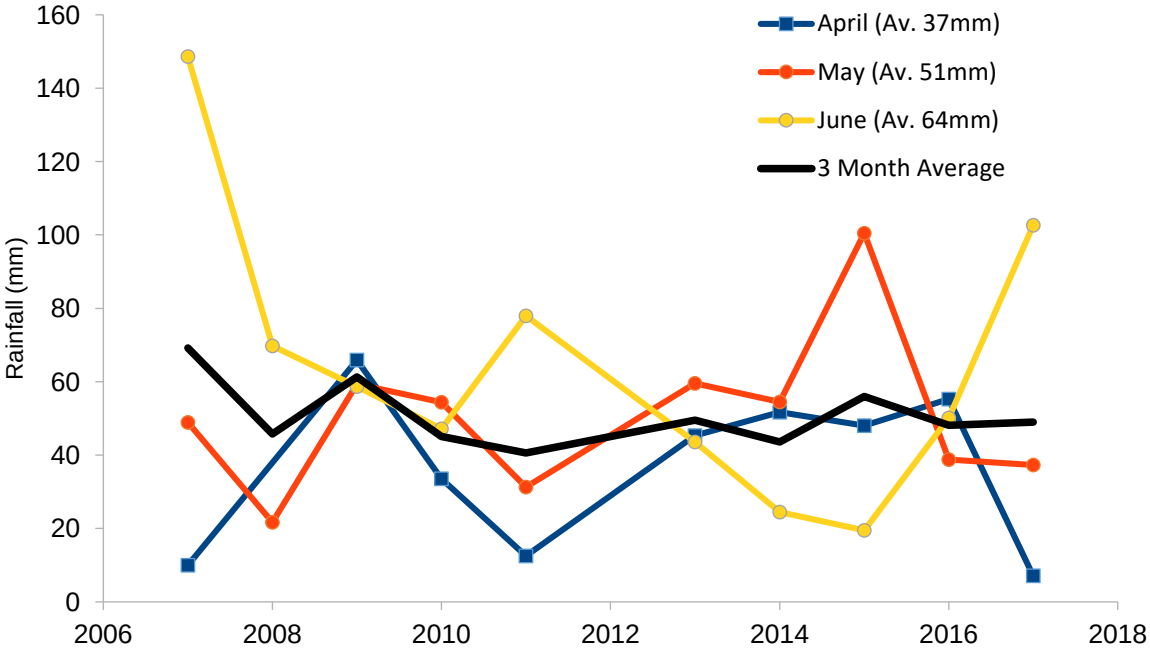

Figure 1. Average monthly rainfall (April-blue, May-red and June-yellow) and combined 3 month average rainfall (dashed line) at Clougherhead (Port) weather station ca. 8 km north of The Haven at Baltray between 2007 and 2017. Contains Met Éireann Data licensed under a Creative Commons Attribution.

Similar to 2016 the weather during 2017 was relatively warm and calm but with some strong winds. The conditions were better than in 2015, and seemed favourable for the Little Terns. The monthly rainfall in both April and May was low compared to previous years (see Figure 1: April 7.1mm, May 37.3mm). Both months were below the 10 year average (2007 to 2017, 37mm and 51mm respectively). However the monthly rainfall for June 2017 (102.7mm) was almost double the 10 year average (64mm). No information on temperature or wind speed was recorded during the 2017 breeding season. The fenced area of the colony was not flooded during spring tides, but one spring tide was reported to have come close to the nesting areas. There was no notable weather extremes during the 2017 breeding season.

3.2 Colony Size

At the end of April, 15 to 20 adult Little Terns were observed in the vicinity of the nesting area (Maurice Conaghy, pers. comm.). The main method of counting was direct counts, or as there was so few birds, counting while flying over the nesting area or roosting during high tide. For the majority of the season the flock size remained low, fluctuating between 5 and 20 birds during May and June. Although during this time there were some observations of flight displays, courtship feeding and nest scraping, no nesting attempts occurred and eggs were not laid.

From July 10th to July 25th Little Tern counts and observations were undertaken on a near daily basis by Jennifer Lynch. There was an increase in Little Tern numbers observed at the colony during July.

The increases in the flock size observed were due to an influx of birds (both adults and juveniles) from the Kilcoole colony. In the second week of July at least 50 birds were observed on 2 occasions (July 10th and 12th) roosting at high tide close to the colony. On the 10th of July a peak of 57 Little Terns, including 42 adults and 8 juveniles was observed. In the third week of July numbers dropped to 46 individuals on the 18th of July, but the proportion of juveniles increased, with 11 reported on this date.

Details of the birds present with colour rings are presented in Table 2. At least 9 colour/ringed individuals were observed during the period from 12th - 20th of July. Adult birds hatched in Kilcoole in 2014 and 2015 were observed along with recently fledged juveniles. On the 12th of July an adult bird ringed in Baltray in either 2014 or 2015 was also observed, however it was not possible to read the inscription. Information about the histories of colour ringed birds observed at Baltray were entered in the LNT Blog. Observations at the colony ceased on the 25th of July.

Table 2. Colour-ringed Little Terns observed at Baltray in July 2017 at high tide roosts.

Species	Darvic Position	Darvic Colour	Inscription	Age	Date Observed	Ringing Details
Little Tern	Left	Green	IVD*	Adult	12/07/17	Kilcoole 2015
Little Tern	Right	Green	???	Adult	12/07/17	Baltray 2014 / 2015
Little Tern	Left	Green	IVH	Adult	18/07/17	Kilcoole 2015
Little Tern	Left	Green	IVD*	Adult	18/07/17	Kilcoole 2015
Little Tern	Left	Green	12K*	Juvenile	18/07/17	Kilcoole 2017
Little Tern	Left	Green	IX?	Adult	18/07/17	Kilcoole 2015
Little Tern	Left	Green	???	Juvenile	18/07/17	Kilcoole 2017
Little Tern	Left	Green	???	Juvenile	18/07/17	Kilcoole 2017
Little Tern	Left	Green	???	Adult	18/07/17	Kilcoole 2014 / 2015
Little Tern	Left	Green	I2C	Juvenile	19/07/17	Kilcoole 2017
Little Tern	Left	Green	(I8P)	Juvenile	20/07/17	Kilcoole 2017
Little Tern	Left	Green	(IAT)	Adult	20/07/17	Kilcoole 2014
Little Tern	Left	Green	12K*	Adult	20/07/17	Kilcoole 2017
Little Tern	Left	Green	??H	Juvenile	20/07/17	Kilcoole 2017

*Indicates that individual was observed on more than 1 occasion. "?" indicates the observer was unable to read the full inscription. An inscription in brackets (IAT) indicates that this is the most likely inscription, based on the information provided by the observer.

3.3 Breeding Pairs

3.3.1. Little Terns

Although the flock size was very low in 2017 and no successful nesting attempts were made, there were approximately 5-10 breeding pairs seen on a regular basis around the nesting area. The males of these pairs were observed courtship feeding, usually with sandeels, and some nest scraping. Unfortunately, none of these potential breeding pairs went on to lay eggs.

3.3.2. Ringed Plover

Ringed Plover numbers appeared to be lower than in previous years. However at least two breeding pairs of Ringed Plover hatched chicks in 2017, but it is not known whether any young survived to fledging. It is possible that Ringed Plover nesting success in the colony area is linked to Little Tern nesting success.

3.3.3. Passerines

The main results of the passerine survey carried out on July 13th are summarized in Table 3. Meadow Pipits were the most commonly observed passerine, with a total of 11 pairs or territories observed in the enclosed fields and a further 18 observed in the unenclosed areas (see Map 1). Skylark were less common, with only 1 pair observed in the enclosed area and 6 in the unenclosed area. Reed Bunting were observed in small numbers in both areas, primarily associated with small areas of scrub. A singing male Sedge Warbler was observed on a number of occasions at the gate between field 1 and 2 and a Willow Warbler was heard singing in an area of scrub in the centre of field 2. Other passerine species recorded during the survey included Blue Tit, Blackbird, Sand Martin, Swallow, Linnet and Starling.

Table 3. Results of passerine survey in the enclosed (fenced) and unenclosed areas. See Map 1 for overview of areas.

Area	Meadow Pipit	Skylark	Reed Bunting
1	3	0	1
2	3	1	0
3	5	0	1
Enclosed	11	1	2
A	3	0	0
B	3	0	0
C	7	4	1
D	4	2	0
E	1	0	0
Unenclosed	18	6	1
Total	**29**	**7**	**3**

3.3.4 Other Tern Species

During observations in July a number of other tern species were recorded in the area including Sandwich Terns and smaller number of Common/Arctic Terns and a single Roseate Tern.

Sandwich Terns were regularly reported in small numbers (less than 10 individuals) roosting with Little Terns during high tide observations in July. In mid-July a large flock of Sandwich Terns were observed roosting on the exposed sand at high tide close to the ship wreck ca. 500m north of the Little Tern breeding area. On the 14th of July a total of 71 individuals were counted, including 38 juveniles and on the following day, 110 individuals were counted, including a total of 54 juveniles. Four colour-ringed birds were observed (Table 4), with at least one juvenile (KKB) originating from a colony on Lady's Island Lake in Wexford this year. It has not been possible to get information on the other birds to date.

On the 15th of July 13 adult Common/Arctic terns were observed roosting with the Sandwich terns. The following week numbers increased to 20 adults observed roosting with Little Terns next to the

breeding area (18th of July). In the same week 17 individuals, including 16 adults and 1 juvenile were reported roosting with the Little Terns (20th July).

Table 4. Colour ringed Common and Sandwich Terns observed at Baltray in July 2017.

Species	Darvic Position	Darvic Colour	Inscription	Age	Date Observed	Ringing Details
Common Tern	Left	Yellow	PCP	Adult	15/07/17	Dublin Port – TBC
Sandwich Tern	Left	Yellow	KKB	Juvenile	15/07/17	Wexford 2017
Sandwich Tern	Left	Yellow	???	Juvenile	15/07/17	TBC
Sandwich Tern	Left	Green	(AJJ)	Juvenile	15/07/17	TBC
Sandwich Tern	Left	Green	???	Adult	15/07/17	TBC
Commic Tern	Left	Green	???	Juvenile	19/07/17	Outside Leinster – TBC

"?" indicates the observer was unable to read the full inscription. An inscription in brackets (AJJ) indicates that this is the most likely inscription, based on the information provided by the observer. "Commic" is used to denote Common/Arctic Terns that were not possible to determine at species level.

3.4 Predators and Disturbance

No Red Foxes were seen in the vicinity of the colony this year. This could be due to the fact that there were no Little Tern eggs or chicks or due to the fact that the golfers at County Louth Golf Club feed the foxes of the area and so it is feasible that this habit is keeping them away from the colony. No night wardening took place at the colony in 2017 so little is known about the presence of nocturnal predators in the vicinity of the colony. There were occasional reports of a single Kestrel in the vicinity of the colony, but not as regular as in previous years. An otter was observed on at least one occasion close to Baltray village, but not close to the Little Tern breeding area.

The main threat from predators this year came from the Hooded Crows. During the season 41 Rooks and 40 Hooded Crows were removed by the predator controller, with 4 being shot and the rest being removed via Larsen and Ladder traps. It is possible that corvid predation in recent years may be contributing to the continued failure of Little Terns at the Baltray site.

Several seabirds, which pose a potential threat to Little Tern chicks and eggs were present throughout the season: Lesser Black-backed Gull, Great Black-backed Gull, Herring Gull, Black-headed Gull, and Grey Heron. Gulls were thought to have been responsible for heavy predation of Little Tern eggs in 2008 (Reilly, 2008) but this year any gull species flying over the colony were undisturbed by the small number of Little Terns present.

Anecdotal reports suggest that hare numbers in the area are down, although hare footprints were regularly observed inside the fenced colony area. It is possible that the hares are using this area as a refuge and bringing their young to this area. This may cause additional problems if it attracts foxes in the future, when terns are actively nesting.

Small flocks of up to 30-40 Starlings were observed throughout the season. They were considered a potential threat to the Little Tern eggs as they are thought to have depredated two nests in 2011 (Reilly, 2011). Whenever possible they were chased away whenever they entered the enclosure.

Although a lot of dog walkers frequent the beach around the colony, the majority are happy to keep their dogs on the lead and abide by the rules the wardens set out. Thankfully, during the periods of good weather, the more popular recreational beach was to the south of the River Boyne on the sandy beach at Mornington. The difficulty in accessing The Haven by car meant that there was less human presence that one would expect in such weather. Some of the public walked inside the buffer zone and were asked to move outside by the wardens following an informal conversation about Little Tern conservation.

As in 2016 fan powered paragliders flew very low over the colony on several occasions and caused considerable disturbance for all the birds present on the beach, including Little Terns. Jet skis regularly coursed the river and estuary. These may cause disturbance to Little Terns foraging over the Boyne. A drone was also flown in the area on at least one occasion.

During 2017 dredging works were observed at the mouth of the river on multiple occasions. During one instance, it was possible to observe the plume of silt/sand stretching ca. 200m from the vessel along the shoreline, southwards on the falling tide. A focused observation of 5 adult Little Terns feeding along the edge of the river Boyne close to the colony during the breeding season on a mid-tide (rising), indicated a low success rate, with only 2 successful dives in a 60 minute period. It is possible that a reduction in the clarity of the water, due to an increase in suspended sediment may affect the tern's ability to forage in the estuarine area, which has been an important historic feeding area.

Map 1. Overview of the Little Tern nesting area and enclosed fields (1-3) and unenclosed areas (A-E)

3.6 Recoveries and Resightings of Baltray-ringed Little Terns 2017

Recoveries

A decomposed ringed adult was washed up on the beach at the Kilcoole colony on 27th June; the BTO ring number NW38638 indicated that the bird had been ringed as a chick at Baltray, Co. Louth on 27th June 2013. It was not ascertained whether or not the bird had attempted to breed at Kilcoole before it died but that is plausible as no confirmed nesting occurred at the Baltray colony this year.
A recovery ('fresh dead within about a week') of a Baltray chick ringed in 2013 (NW38651) reported from Crimdon Park, near Hartlepool, Durham, northeast England.

Resightings

A colour ringed adult, green 'I41' was read by Susan Rendell-Read of the RSPB at Hamford Water, Essex, southeast England on 29 July 2017. This individual was close to, but not apparently part of, the Horsey Island colony and had been ringed as a chick (NW45225) at Baltray on 20th July 2015.
Two 2015 Baltray hatched birds (2-year old breeding adults ?) were reported from the Gronant colony in North Wales : 'I44' metal ringed (NW45215) on 8th July and colour ring added 21st July ; 'I50' metal ringed (NW45214) on 4th July and colour ring added 21st July.

This batch of records demonstrate that Little Terns from Baltray have dispersed/relocated to a variety of sites/colonies, not only in the Irish Sea (Kilcoole and Gronant, Wales) but also in the English North Sea. Perhaps this is further evidence that some environmental factor is really 'amiss' at Baltray and this has led to the desertion of the colony in recent years.

4. Discussion

4.1 Potential Causes

The virtual non-appearance of Little Terns early in the season and their failure to establish a colony for the second successive year indicates that something is seriously wrong at the Baltray site. The beach configuration is not markedly different to previous years. Very large numbers of avian predators such as gulls or corvids present at the start of the season could put birds off but no abnormal predator activity was noted. Weather in 2017 did not produce significant easterly winds during May and June (12 days of easterly winds in May and June with no major gales; the reference year of 2013 also had 12 days of easterly winds but crucially only one in May), unlike in 2016 when easterly winds and gales (33 days of easterly winds in May and June) caused the failure of many little tern sites with easterly exposure; 2016 was a poor year for other tern species also equally impacted by unusual weather. This was not seen in 2017 which was a typical year overall. See Appendix 2.

Other possible causes such as unusual human activity or atypical presence of ground predators (foxes, rodents, hedgehogs etc) or avian predators (corvids, gulls) can also be discounted. Like other tern species little terns are notably philopatric: they are very faithful to their natal nesting site, but are known to occasionally abandon sites, typically because of habitat changes or disturbance, which again can be discounted in this instance.

The possibility that events during migration and at wintering grounds may have had an unknown impact, though it seems unlikely that this would only affect the cohort of birds using Baltray. Baltray-

origin birds have apparently relocated to sites elsewhere in the Irish Sea and further afield (North Sea); in recent years there has been a certain degree of 'shuffling about' of young birds reared at Baltray and Kilcoole and passing through or recruiting to breed the other location or at other Irish Sea sites (e.g. Isle of Man and Gronant). This would suggest birds have relocated and that there is a problem with the site not hitherto seen.

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. Major dredging operations were carried out in the 19th century leading to the channelling of the river and the creation of several "polders" in fact walled off intertidal areas backfilled with dredge material. 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 "the bar" 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. In some years some accretion may be observed at the Haven, the nesting site. 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).

Figure 2 Dredger at mouth of Boyne

During the 2017 nesting 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). Also observed was large amounts of material being piled on the quay wall presumably for beneficial reuse. 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 month 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 30,000m^3 or 48,000 tonnes, for the seaward approaches 90,000m^3 or 144, 000 tonnes, with an additional annual contingency of 100,000m^3 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.***

Finally a review of the actual number of days of dredging (as well as quantities of dredged material recovered or dumped) was undertaken. This information was provided by Drogheda Port on foot of an Information request under the AIE Directive and is reproduced in an appendix. 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 metres cubed. The port therefore reports that 165,000 metres cubed were dredged up to September 2017 (against the predicted maximum of 120,000 metres cubed excepting contingency for exceptional events). In addition to this a further 75,000 metres cubed was removed/dredged from the river mouth in November 2016 so that the amount from November 2016 to September 2017 is a remarkable 240,000 metres cubed!
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 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 20 cm 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, hitherto unprecedented.

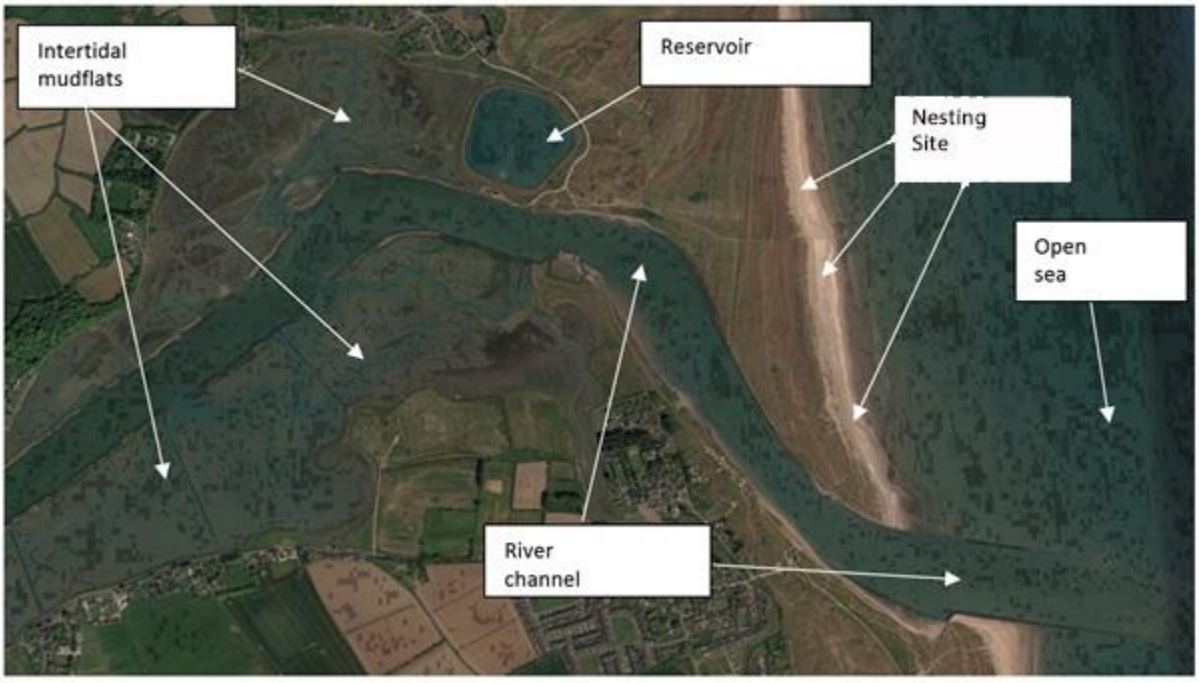

Figure 3 Boyne Estuary Habitats

5. Conclusions

Breeding Success

The 2017 season represented the worst year for little tern reproductive success at the Boyne estuary. Specifically there was virtually no attempt at nesting and the lowest peak number of visiting adults the site over the season since the start of systematic site management in 2008. Furthermore there was almost no sign of display, courtship, or nest scraping, the first time that this has occurred since 2008. An analysis of other little tern colonies in the Irish sea and east coast of Britain did not reveal anything exceptional about the year in terms of breeding success. However dredging of the estuary was exceptional in 2017 both in terms of anecdotal observations and data reported by Drogheda Port.

Dredging

The exceptional level of dredging both in terms of volume, number of days and dates in the year undoubtedly impacted on the reproductive success of various benthic fauna, particularly sandeels and this is likely to have had a knock-on effect on food availability for little tern as discussed above. For the colony to succeed in future years, and to realise the huge investment The State has made in the site (120,000 Euros over 10 years from HC and NPWS, as well as thousands of hours of volunteer time and community effort) it is critical that the impact of dredging be further assessed, and pending that, that it be limited both in time and in space, in line with the appropriate scientific advice from the Competent Authority and elsewhere, to reduce the probable impact on Little Tern prey species in future years.

Appropriate Assessment

The appropriate assessment contains a number of errors and misinterpretations of both Little Tern ecology and the impact of dredging; it is suggested that the AA needs to be reviewed and appropriately remediated if found necessary. A meeting with the relevant ecologist may facilitate this.

Foreshore License

There may be scope for the modification of Foreshore License conditions to limit the number of dredging days, however there is no clear regulatory pathway for this that the present authors are aware of (short of contacting the European Commission). However it should be possible to come to an agreement between the various patties to ensure optimal conditions for the colony in 2018.

Future of the Colony and Site

The season has proven the exceptional biodiversity value of the site not just in relation to little terns but to many other species and shows the value of the conservation work at the site for the benefit of the species and habitats as well as locals and visitors to the site.

6. Recommendations

- Establish an agreement between the various parties 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.
- Continue efforts to ensure Baltray colony is managed and available for Little Tern in April/May 2018 including marshalling of volunteers, funding, and collaboration with the various interested parties including NPWS, Drogheda Port and the Heritage Council
- Conduct further studies into the potential impact of dredging on the site including more extensive monitoring of both dredging activities and their impact on various species impacted on the food chain.
- Extend the conservation activities on site to include the other species and habitats in the area.

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Appendix 1

Dredging dates

TSD Argus Log Sheet 2017	TSD Sospan Dua Log Sheet Feb 2017
Date	**Date**
19/04/2017	15/02/2017
20/04/2017	15/02/2017
20/04/2017	16/02/2017
21/04/2017	16/02/2016
21/04/2017	16/02/2017
24/04/2017	17/02/2017
24/04/2017	17/02/2017
25/04/2017	17/02/2017
26/04/2017	17/02/2017
26/04/2017	17/02/2017
27/04/2017	17/02/2017
27/04/2017	18/02/2017
28/04/2017	18/02/2017
09/05/2017	18/02/2018
09/05/2017	18/02/2017
10/05/2017	18/02/2017
10/05/2017	18/02/2017
11/05/2017	19/02/2017
11/05/2017	19/02/2017
12/05/2017	19/02/2019
16/05/2017	19/02/2019
17/05/2017	19/02/2017
17/05/2017	19/02/2017
18/05/2017	20/02/2017
18/05/2017	20/02/2017
22/05/2017	20/02/2017
23/05/2017	20/02/2017
23/05/2017	20/02/2017
24/05/2017	20/02/2017
29/05/2017	20/02/2017
29/05/2017	21/02/2017
30/05/2017	21/02/2017
30/05/2017	21/02/2017
01/06/2017	21/02/2017
02/06/2017	21/02/2017
05/06/2017	21/02/2017
06/06/2017	22/02/2017
12/06/2017	22/02/2017
13/06/2017	22/02/2017

TSD Argus Log Sheet 2017

Date
15/06/2017
15/06/2017
16/06/2017
22/06/2017
22/06/2017
23/06/2017
23/06/2017
26/06/2017
03/07/2017
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30/08/2017
31/08/2017
01/09/2017
01/09/2017
04/09/2017
05/09/2013
06/09/2017
07/09/2017
08/09/2017

TSD Sospan Dua Log Sheet Feb 2017

Date
22/02/2017
24/02/2017
24/02/2017
24/02/2017
24/02/2017
25/02/2017
25/02/2017
25/02/2017
25/02/2017
25/02/2017
25/02/2017
26/02/2017
26/02/2017

TSD Argus Log Sheet 2017

Date
13/09/2017
14/09/2017
18/09/2017
19/09/2017
19/09/2017
21/09/2017
21/09/2017
25/09/2017
26/09/2017
28/09/2017

Appendix 2

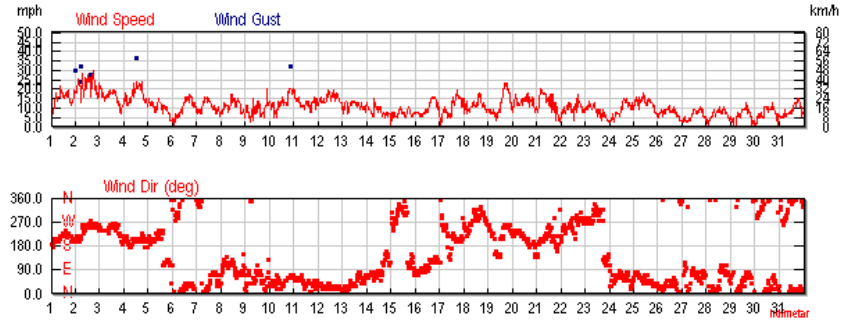

Figure 4 May 2016

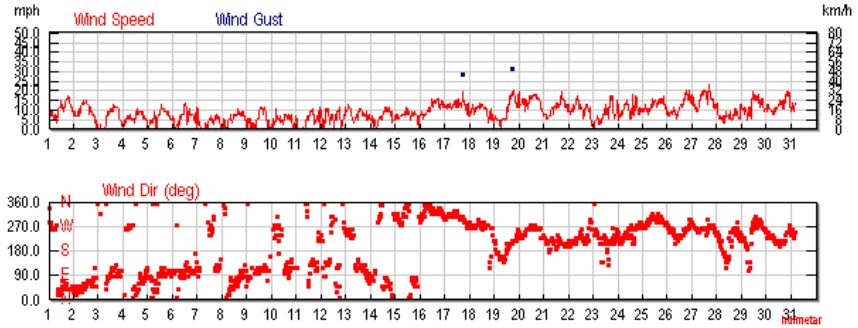

Figure 5 June 2016

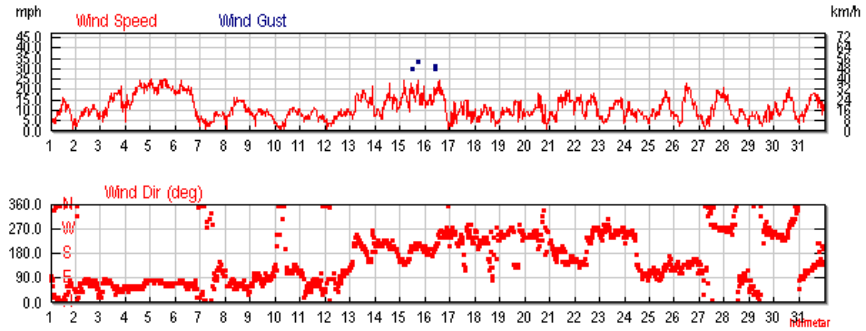

Figure 6 May 2017

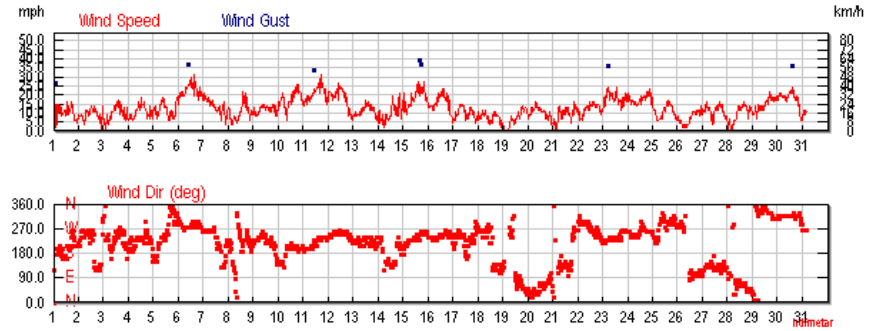

Figure 7 June 2017