

Baltray Little Tern Colony Report 2016

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Little Tern in flight © Kevin Delahunty

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Abstract

Wardening of the Little Tern (*Sternula albifrons*) colony at Baltray began on May 24th 2016 and was cut short, ending on June 27th 2016. Night wardening (thus 24 hour colony-coverage) did not occur with the exception of some lamping by volunteers on two to three nights over the project. Courtship displays were observed regularly over the course of the season. A number of copulation attempts were observed as well as nest scraping. However, no Little Tern nest attempts were made. Corvids were a significant problem and likely one contributing factor in the failure of the terns to nest. Other negative factors likely include a shortage of prey species such as sandeel and sprat. Furthermore, adverse weather experienced by birds along the migration route could have delayed their arrival or led to a loss of body condition making nesting difficult to achieve.

This is the first season the site has failed to support no nesting terns since the project began in 2007. The lack of nesting at Baltray, though disappointing, has to be considered in the context of an abnormal season across Ireland and Britain in general. We suggest beginning wardening of the site earlier in the season and concentrating efforts on discouraging corvids from foraging in this area before terns start arriving.

Tern numbers varied from a low of 3 individuals per day to a high of 89. However the larger numbers are likely due to birds leaving Kilcoole after the completion of nesting. Nocturnal predators at the Kilcoole colony displaced a number of birds with some individuals later being identified at Baltray. The lack of nesting behavior seen this season makes it imperative that every effort is made to reestablish nesting in 2017 in order to capitalize on the success of previous seasons and other sites, such as Kilcoole.

1. Introduction

1.1 Background

The Little Tern (*Sternula albifrons*) is the smallest of the five tern species which breed in Ireland. Having spent the winter off the west coast of Africa, Little Terns migrate to Europe to breed, arriving in Ireland from late April. Little Terns nest on shingle or sandy beaches, often adjacent to sources of brackish water. Access to brackish water is important as they prefer fresh water fish to feed their young during the first few days of their life. In Ireland the chief prey of Little Terns are small fish and crustaceans, especially sandeels. They feed by plunge diving into shallow water (Gochfeld and Burger, 1996). A clutch of one to three eggs is laid in late May or June. If their first nest fails a pair of Little Terns may breed again in June or July, exceptionally, early August. The Little Tern's nest is little more than a shallow scrape in the shingle in which they lay their eggs. They rely on the excellent camouflage of their eggs and chicks to protect them. The incubation period is around 18-22 days (Cramp, 1985). At about 14 days chicks make their first attempts at flight, but do not fully fledge until they are about 20-24 days (Gochfeld and Burger, 1996). Little Terns leave their colony in August, departing Ireland before September. Most Little Terns which breed in Western Europe winter in the Gulf of Guinea area (Gochfeld and Burger, 1996).

The Little Tern is the least numerous of the five tern species which breed in Ireland. Numbers of Little Terns declined nationally by 32% from 1984 when 257 pairs were found to 174 pairs in 1995 (Whilde, 1993; corrected in Hannon *et al.*, 1997). A similar decline in the overall population of Little Tern in Britain and Ireland was recorded by the Seabird 2000 census (1998-2002), where a 25% decline was noted since the Seabird Colony Register (SCR) census in 1984-1988 (Mitchell *et al.*, 2004). The European population has also undergone a long-term decline (Fasola *et al.*, 2002), although recent counts show increases in Belgium, Poland, the Netherlands, France, and Germany. Reduced breeding success and subsequent recruitment appears to be the main cause of this decline (Mitchell *et al.*, 2004). Threats to Little Terns include human disturbance, loss of suitable habitat and flooding from extreme tides and storms. Depredation by foxes, Hooded Crows, Magpies, rats and raptors is another significant threat to fragile breeding colonies. In some instances predation can reduce the breeding productivity to zero.

A major and long-standing cause of low breeding success in this species is human disturbance (Lloyd *et al.*, 1975; Fasola *et al.*, 2002, Ratcliffe *et al.*, 2008). Wardening schemes and the use of signs and fences to protect the breeding birds (regularly implemented since the mid-1970s in Britain and 1985 in Ireland) can effectively reduce this disturbance (Medeiros *et al.*, 2007). Recent increases at some Irish sites such as Illauntannig, Co. Kerry (O'Clery, 2007), and not least Kilcoole and

Baltray, indicate that nationally, the population has recovered somewhat. Seabird 2000 recorded 206 apparently occupied nests (AONs) in Ireland (Mitchell *et al.*, 2004). However, a co-ordinated national tern survey is needed to clarify this. To place the Irish breeding population in context, Seabird 2000 (1998-2002) found that 10% of the Little Tern population of Britain and Ireland breed in Ireland, which represents 1.0-1.2% of the European population, and 0.2-0.5% of the estimated world population (Mitchell *et al.*, 2004). The Little Tern is not considered to be threatened globally but many local populations are declining (Gochfeld and Burger, 1996).

The Little Tern is listed as an Annex 1 species in the EU Birds Directive (79/409/EEC), thus requiring member states to take special conservation measures to ensure the survival and breeding success of this species. It is also classified by BirdLife International as SPEC 3, that is, 'a species with global populations not concentrated in Europe, but which have an unfavourable conservation status in Europe' (Tucker and Heath, 1994). On a national level in Ireland it is classified as both a rare and localised breeder (Coveney *et al.*, 1993) and a vulnerable species (Whilde, 1993). It is currently amber listed by BirdWatch Ireland and the RSPB (Royal Society for the Protection of Birds) (Cummins and Colhoun 2013), indicating that this species is of medium conservation concern. The Little Tern is fully protected under the Irish Wildlife Act (1976, Amended 2000).

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 10 colonies on the mainland coast. On the east coast there are colonies from Wexford northwards to Louth, and on the west coast from Kerry to Donegal (Hannon *et al.*, 1997). The breeding population of Little Terns on the west coast is poorly known due to lack of regular coverage of key sites such as the Magharee Islands in Kerry and the highly dispersed distribution with small numbers in Connemara. It is thought that there may be 150 pairs on the west coast but little is known about their breeding success. Suddaby (2012) reported that only 3 young were fledged from 96 incubating adults on the Inishkea Islands in Co. Mayo due to heavy predation from Common Gulls (*Larus canus*).

Primary sites on the east coast that have recently supported colonies of breeding Little Tern are Baltray (Co. Louth), Kilcoole/Newcastle (Co. Wicklow) and the Raven and Wexford Harbour (Co. Wexford). The North Bull Island (Co. Dublin) had up to 80 pairs in 1987 but is no longer used by Little Terns due to high levels of recreational disturbance. Up to 20 Little Terns were present at the North Bull Island at the start of the 2013 breeding season however no breeding attempts were observed due to the continuing high levels of disturbance (Niall Harmey pers. comm.) A similar situation prevails at Buckronev (Co. Wicklow) and Portrane/Rogerstown (Co. Dublin). However, in 2011 five

pairs were seen prospecting at Buckronev but no exact details on nesting attempts or success were received (Richard Nairn, pers. comm.). This follows an anecdotal report from two members of the public that a pair of Little Terns bred successfully at here in 2010 raising two chicks. Successful breeding by a single pair has also taken place at Portrane/Rogerstown each year from 2009 to 2013 (Julie Roe and Niall Harmey pers. comm.). This year no pairs were present at the Portrane or Rogerstown Estuary Nature Reserve throughout the breeding season, most likely due to high levels of human disturbance and dog walking (S. Newton, pers. obs.).

The sandy beach at Cahore, north Co. Wexford, was also a traditional nesting site for the Little Tern, but was not thought to have been used for a span of 15-20 years (Anthony McElheron, pers. obs.). In 2005, approximately 40 nesting pairs were discovered at Cahore and that year breeding was successful with a minimum count of 80 adult birds and 10 fledglings on the last day the site was visited (Helen Boland, pers. comm.). Despite extensive searching between Cahore and Tinnaberna in 2010, no Little Terns could be found in this area, possibly as a result of the increased recreational use of quad bikes and horse riding along that section of coast (William Earle, pers. comm.). In 2012 a minimum of 65 Little Terns were found by the Kilcoole Little Tern wardens between Cahore Point and Ballinoulart on 28th June, however there was no breeding evidence and high levels of disturbance (Keogh *et al.*, 2012).

In 2009, 20 Little Tern nests (with 2 eggs each) were found incidentally at an apparently newly occupied site (grid ref. T119232, OS map 77) near Raven Point in southeast Wexford (Helen Boland, pers. comm.), the number of breeding pairs may have been greater than this, but it was not possible to search the whole area. Since then, the Marram Grass (*Ammophila arenaria*) covered sand bank island off Rosslare Backstrand (close to the site of the famous 'Tern Island') has become extensive enough to once again support a colony of breeding Little Terns. In July 2010, up to 30 adult Little Terns and 10 fledglings were seen on 'New Tern Island' (Paul Kelly, pers. comm.) but it is unclear as to whether these birds nested on the island in question or nearby at Raven Point. However, in 2011, flocks of up to 200 adult Little Terns were noted over 'New Tern Island' in June with a brief census of the colony there on 29th June revealing that approximately 70-90 pairs were indeed nesting with a mean clutch size of 1.95 from 27 nests sampled (Chris Wilson and Tony Murray, pers. comm.). In 2012, a record total of 124+ nests (mean clutch 2.27) on 'Tern Island' were washed away by bad weather during the first weekend in June (D. Daly & T. Murray, pers. comm.). Some of these may have attempted to re-nest on the Dogger sandbanks, just off Raven Point but it is thought that these were overwashed again a week or so later (D. Daly, pers. comm.).

The Little Tern has been recorded breeding at Kilcoole/Newcastle since at least 1879 (O'Briain and Farrelly, 1990). By the 1980s breeding success at the colony was consistently low due to predation and disturbance. In response to this, the Little Tern protection scheme was set up in

1985. The colony has experienced several years of high productivity as a direct result of the scheme, notably in 1989 when 68 fledglings were produced, and more recently 2003 – 2005, 2008 - 2010 and 2014-2015. Other years have not been as successful; despite a high number of breeding pairs (106) and high initial productivity (178 chicks hatched) in 2006, the colony was later devastated by foxes such that only 21 chicks fledged (Lynch *et al.*, 2006). Again in 2007 high levels of predation resulted in only 31 chicks fledging (O’Connell *et al.*, 2007). Since 2008 however, numbers of pairs and fledged chicks have been increasing despite initial heavy losses at times. In 2008, 74 breeding pairs fledged 130 chicks (Cockram *et al.*, 2008), 50 pairs fledged a total of 80 chicks in 2009 (Hall *et al.*, 2009) whilst in 2010, 66 pairs fledged 115 chicks (Keogh *et al.*, 2010). In 2011 99 pairs fledged 155 chicks (Keogh *et al.*, 2011). There was zero productivity at Kilcoole in 2012 due to the site being washed out by two severe storms in June and subsequently experiencing heavy Hooded Crow predation (Keogh *et al.*, 2012). There was some recovery in 2013 with 45 pairs fledging 75 chicks (Keogh *et al.*, 2013). A very good year was experienced in 2014 with 120 pairs fledging 219 young. 2015 saw the most successful year since the project started. Even with heavy losses from storms and high tides, a record breaking 155 pairs successfully fledged 219 chicks (Doyle *et al.* 2015). The success of the long term wardening effort at this site can be seen in the fact that Kilcoole/Newcastle is probably the only site on the east coast to have attracted nesting Little Terns every year since 1984 (Farrelly, 1993).

1.3 Little Tern Colony in Baltray

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, run by a team from the Louth Nature Trust spearheaded by Sandra McKeever and Margaret Reilly, with the help of 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). 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.

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.

1.4 Project Aims

The principal aim of the Little Tern Protection Scheme is:

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

Strategies employed by the Louth Nature Trust and BirdWatch Ireland 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 predators accessing nest sites, where possible.
- To maintain surveillance in order to achieve the early detection of predator threats, and take appropriate steps to prevent loss 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.

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 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 2016, the potential nesting area was considerably larger than in 2013 and 2014, approximately 850m long x 40m wide, the largest the nesting area has been since the project was initiated. The fencing had to be moved closer the water than in 2015 due to the changing topography, as the embryonic dunes have moved further down 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 portaloos was hired in each year 2013-2016. The day wardens resided onsite in caravans provided. These facilities are vital to the running of this project.

2.2. Monitoring

Regular day wardening was initiated on May 24th and continued until June 27th. The day wardens were responsible for wardening the beach from 06:00-22:00 and were relieved at intermittent periods during the course of each working week when possible by volunteers. The wardening role was undertaken by Kevin Delahunty and Shane Somers as day wardens with some voluntary night wardening by Maurice Conaghy and David Martin. 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 2016.

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 occasionally by volunteers over the course of the season.

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.

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.

Once chicks start to fledge, separate counts are made for 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 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. When 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) 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. Two elevated platforms were erected to facilitate monitoring this year. One was in front of the South part and the other one in front of the North part of the colony. These two towers were 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 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 entire site was observed for a week after the Little Terns began prospecting to see which areas they were favouring. They were using the entire shingle area, and it was decided to enclose most of it starting from close to the Boyne wall and stretching northward, to reduce the probability of breeding failure caused by mammalian predators and to protect them from human disturbance. The fencing was principally erected over two weekends in late April/early May by Dominic Hartigan and a team of volunteers.

A string cordon was put on the outside the expected nesting area, enclosing an area of approximately 850m 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. 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 shoveled onto it to partially bury it and deter digging predatory mammals. The mesh used was mostly saved from the 2015 project, with some new mesh. The northern zone was longer (c 470m) than the southern zone (c.330m). Both zones were c.40m wide. The walkway led out to the vicinity of the caravans, 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.

Both of 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 electric fence units and earthing rods. These were securely placed in waterproof boxes and buried beneath the sand. Over-ground switches were discretely wired from the fence 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. The bottom electric fence wire had to be dug up and retensioned after inclement weather as sand shifted by the wind buried it. When the voltage was seen to be dropping the warden replaced the appropriate fence unit battery.

Between June 25th and June 30th, with the help of volunteers, we began to pack up the fencing. 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 wardens and volunteers made every effort to scare away any potential predator away. The simple presence of humans at the colony helped keep most predators at bay. This year, predator management focused on Hooded Crows (*Corvus cornix*) and Rooks (*Corvus frugilegus*), Red Foxes (*Vulpes vulpes*) and Kestrels (*Falco tinnunculus*).

This year saw a notably large population of Rooks flying over and around the colony so this species had to be carefully monitored and constantly chased away by the wardens. 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 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 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). Therefore, noise was used as a deterrent to scare Kestrels from hunting in the vicinity of the colony.

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. 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.

The colony was visited by the Little Tern project wardens from the Gronant colony in Wales and we discussed the problems and low success of Little Terns this season.

2.4.2 Media Coverage

The project was featured on the RTE Radio 1 show, 'Mooney Goes Wild', on the 12th June. It featured an in situ interview at the Baltray colony by journalist Terry Flanagan, who interviewed the warden Kevin Delahunty as well as Dominic Hartigan, Breffni Martin and the volunteer Brendan Carthy. Over the course of the sequence we discussed the Little Tern colony at Baltray, how successful the colony has been in previous years and what could be causing the problems with the colony in 2016. The full interview can be heard at <http://www.rte.ie/radio1/mooney/programmes/2016/0612/794919-mooney-goes-wild-sunday-june-12th-2016/>

2.4.3 Website & social media

The Louth Nature Trust blog was regularly updated by the wardens 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 623 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

A daily synopsis of the weather for this season can be found in the daily logs, available on request from BirdWatch Ireland. In brief, the weather during 2016 was relatively warm and calm but with some strong winds. The conditions were better than in 2015, and seemed favourable for the Little Terns. Maximal temperatures remained between 12 and 20 most of the season, with 4 dates where it reached 21 and 22 °C. The overall average temperature was 17.9 °C. On most of the days easterly or southeasterly winds were recorded but wind speed rarely got above 15km/hour and so the fenced area of the colony was not flooded during spring tides. The season was a mainly dry with only 10 days of recorded rainfall, sea fog came in on one occasion but overall there were no weather extremes throughout the wardening period.

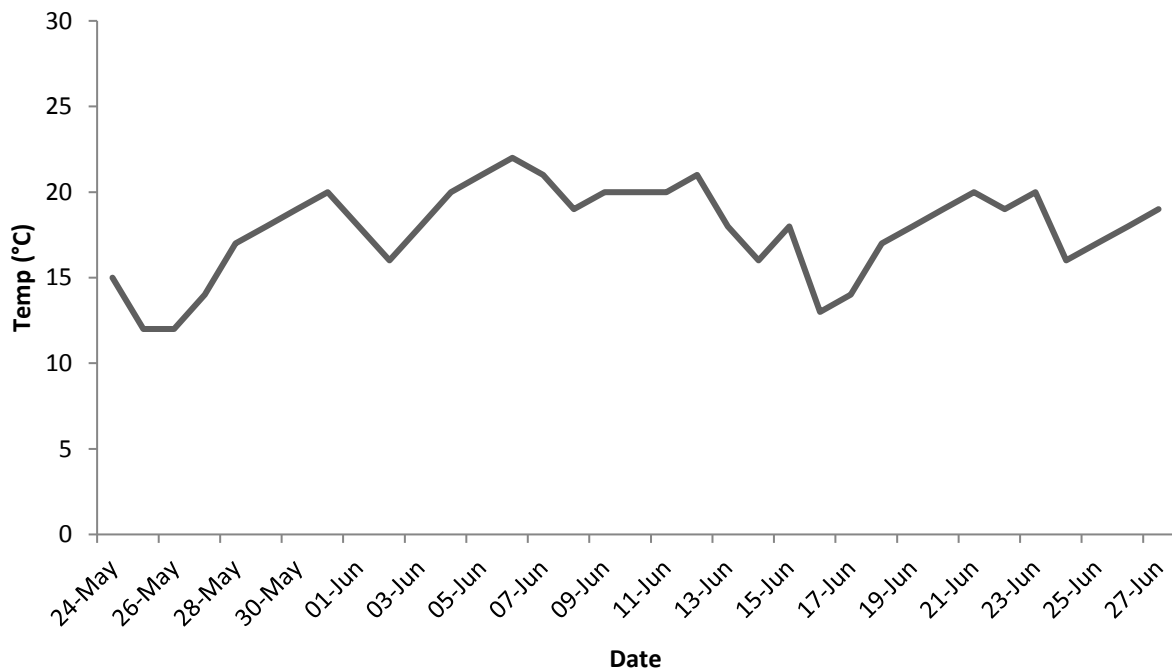


Figure 1: Temperatures recorded at Baltray from May 24th to June 27th 2016.

3.2 Colony size

Monitoring of the Little Terns began on the 24th May, However the first birds had already arrived during the setting up on the anti-predator fence. In early May up to 50 birds were recorded in the nesting area (Maurice Conaghy, pers. comm.). When the wardening started on 24th May, 10 birds were counted flying over the colony, appearing at high tide and disappearing in the evening. It was clear that they were roosting elsewhere. Unfortunately, this became a running theme throughout the five weeks of wardening. The main method of counting was dread counts, or as there was so few birds, counting while flying over the nesting area or roosting during high tide was also easily done. The average number of adults seen per day over the course of the season was 20, although for the majority of the season the flock size remained low with 6-15 birds being counted regularly up until June 20th (Figure 2.).

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. Some scraping by one pair was recorded on May 24th in the north of the colony but the Little Terns were chased off by Rooks. This happened quite a few times as the Rook population in the area was very high and the low numbers of adult terns present were not sufficient to chase them out. While every effort was made by the wardens to discourage Rooks from landing within the nesting area, the size of the enclosure made monitoring difficult. Furthermore, the low numbers of Little Terns meant the flock was unable to successfully chase Rooks away from the nesting area.

There was a slight increase in adult Little Tern numbers after June 20th and it is thought that this is mainly due to the heavy predation of nests by foxes at the Kilcoole colony on the night of June 17th. The wardens stopped monitoring the area on June 27th following discussions between Steve Newton from Birdwatch Ireland, Breffni Martin the Louth Nature Trust and Dominic Hartigan. It was agreed that due to the late date it was unlikely that any Little Terns would nest at Baltray this year. After June 27th, Little Tern counts were undertaken on a near daily basis by Maurice Conaghy and reported to the off-site wardens who were redeployed to other tern projects. The flock size greatly increased after the full day-wardening ceased at Baltray but it was thought that the new birds arriving were those that had either failed at Kilcoole or successfully fledged their chicks in Kilcoole and moved on. This was confirmed on the 18th July as 86 adult Little Terns along with three colour ringed fledglings were recorded on the beach at Baltray. These colour ringed fledglings would have travelled up from Kilcoole where the wardens there were colour ringing chicks re-trapped when aged 10-14 days old. The 89 individuals recorded on July 18th was the peak for the flock size count in Baltray this year with the minimum number (3) recorded on May 31st. The increase in Little Terns around Baltray in July coincides with the decrease of adult numbers in Kilcoole.

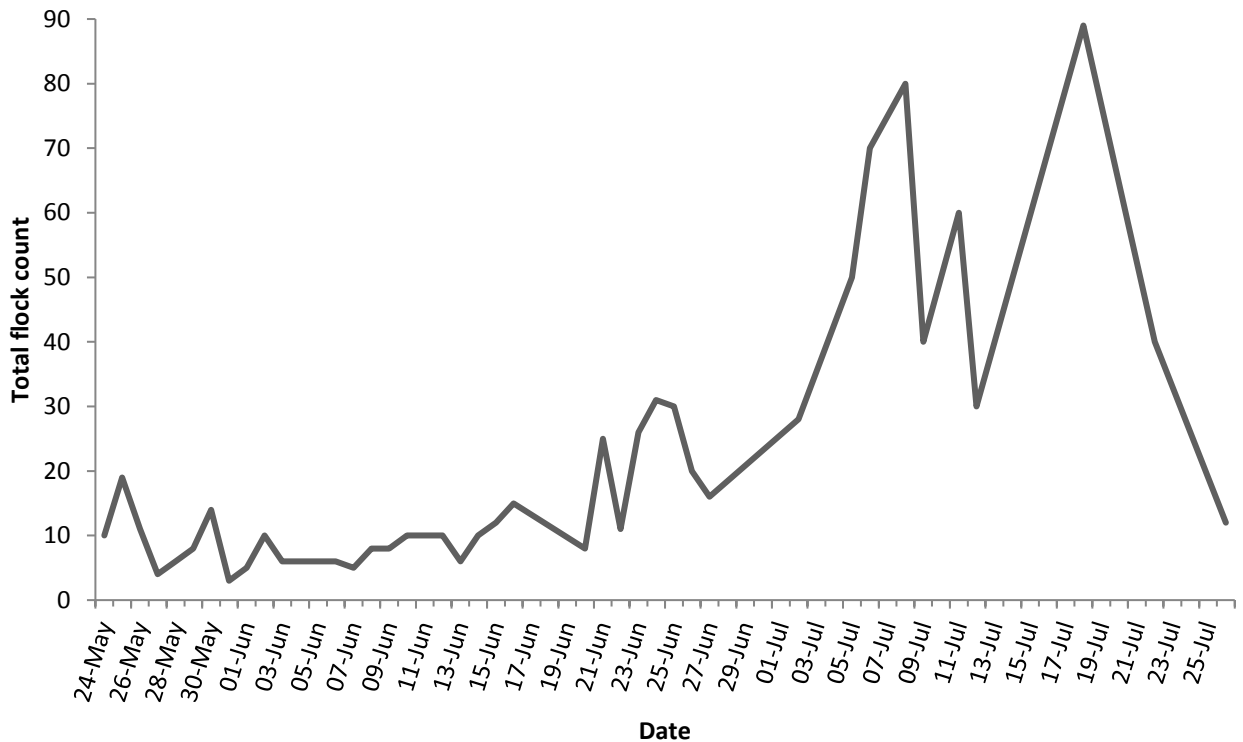


Figure 2: Little Tern flock size during the project. Counts were conducted by Maurice Conaghy after June 27th. (Note the increase in number after June 17th, when many nests were lost in Kilcoole.)

3.3 Breeding pairs

Although the flock size was very low this year and no successful nesting attempts were made, there were approximately 3 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. These attempts focused on the raised pebble bar in the south section and along the north eastern fence in the north section. Unfortunately, none of these potential breeding pairs went on to lay eggs.

3.4 Ringed Plover

Overall, 6 Ringed Plover nests were discovered by the wardens but all suffered from corvid predation within a few days of being found (Table 1.). This is an indication of just how prevalent the corvid problem was in Baltray and gives an indication of the size of the population of Rooks and Hooded Crows in the area.

Table 1: Ringed Plover breeding attempts for Baltray 2016. (Codes: knPR = known predation; the code is followed by the number of eggs (e)).

Nest No	Date Found	Clutch Complete	Clutch Size	Losses (Eggs)	Chicks Hatched	Final Outcome	Date	Other Outcome
RP1	29/05/2016	Unknown	2	2	0	knPR 2e	31/05/2016	Corvid
RP2	29/05/2016	Unknown	3	3	0	knPR 3e	31/05/2016	Corvid
RP3	03/06/2016	05/06/2016	3	3	0	knPR 3e	10/06/2016	Corvid
RP4	08/06/2016	09/06/2016	4	4	0	knPR 4e	12/06/2016	Corvid
RP5	09/06/2016	Unknown	1	1	0	knPR 1e	11/06/2016	Corvid
RP6	15/06/2016	Unknown	4	4	0	knPR 4e	17/06/2016	Corvid

3.5 Success of the Baltray Little Tern protection scheme

The 2016 season was not a successful year for the Little Tern colony, especially in comparison with 2013, 2014 and even 2015. The success of the 2013 and 2014 seasons was the culmination of the Little Tern protection scheme initiated in 2007 (Figure 3). Rigorous monitoring of the Little Terns at Baltray did not occur until the initiation of the Little Tern protection scheme but early attempts at monitoring the breeding success of the colony from 1984 give an indication of the health of the colony. The colony was in serious decline from the mid-1980s to the mid-1990s, with poor or no breeding success. From the late-1990s there was zero breeding success. A notable increase in breeding pairs and numbers of fledglings occurred from 2007 onwards, when fencing and wardening of the beach during Little Tern breeding season began. Numbers had generally continued to rise since that point, with the exception of 2012 which was a very poor year overall for Little Terns on the east coast due to inclement weather in the form of easterly storms combined with spring tides (Reilly, 2012; Keogh *et al.*, 2012). 2015 can be considered as an exception to the generally increasing trend and may have been more successful with more manpower. In 2016, a number of different variables may have caused the Little Tern desertion of the site and we will attempt to explain this outcome in the Discussion below.

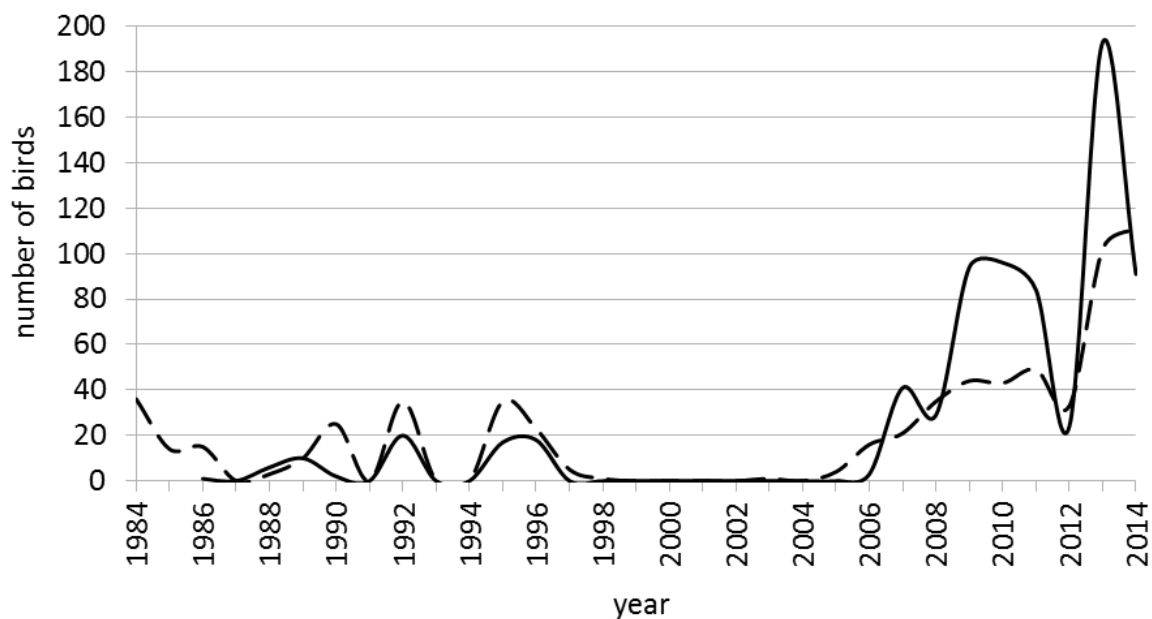


Figure 3: The number of breeding of Little Terns (- - -) and the number of Little Tern chicks presumed to have fledged (—) recorded at the Haven, Baltray from 1984 to present. (Data sources: Lenehan, unpublished data: 1984-2006; McKeever & Reilly, 2007-2012; Reilly: 2008-2012; Doyle *et al.*: 2013; Egerton & Newton: 2014).

3.6 Predators and disturbance

No Red Fox was 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. Lamping, done by voluntary night wardens showed no signs of Red Fox or any other nocturnal predator. A male Kestrel was observed on numerous occasions in the area but only once hovering directly over the colony. Two Short-eared Owls were recorded hunting over the dunes but they were not recorded flying over the fenced area. A Sparrowhawk was noted being mobbed by Meadow Pipits as it approached the colony and retreated. Otter footprints were observed on banks of the River Boyne, but the animal was not directly observed. The main threat from predators this year came from the large population of Rooks in the area. Nearly every morning at 06:00 am the warden on duty would have to chase large numbers of Rooks from the nesting area. Hooded Crow were also a problem but less so than the Rooks. This, together with the heavy corvid predation in 2015 may have been a reason why the Little Terns failed to nest in Baltray this year. Before wardening began,

the decision was made to remove some of the local population of Rooks and Hooded Crows. Forty Rooks were removed, and 30 Hooded Crows, with 20 being shot and the rest being removed via Larsen and Ladder traps. During the project Larsen traps were set up in areas around the colony and the Ladder trap remained in use but proved unsuccessful. One Short-Eared Owl was accidentally caught in a Larsen trap and quickly released by the warden. This owl was seen hunting later in the day.

Several seabirds, which pose a potential threat to Little Tern chicks and eggs were present throughout the season: the 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.

Flocks of up to 200 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). They were chased away whenever they entered the enclosure and a megaphone provided by Louth Nature Trust which had a function which played a starling alarm call was used with some success.

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 a polite chat about Little Tern conservation. A dog entered the colony on at least one occasion. It was eventually chased out of the fenced area by the wardens and no Ringed Plover nests were damaged. This local dog is often left free and unsupervised therefore proving a risk to ground nesting birds. A careful watch should be kept in future seasons for it as once it gets into the colony it is difficult to get back out without the wardens having to actually enter the colony and chase it.

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.

4. Discussion

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 chicks are fledged from these nesting attempts. This year approximately 3 pairs remained in the area for certain days through June but none successfully nesting. Therefore, the productivity at Baltray in 2016 is zero. Previous years have seen relatively large numbers of Little Terns breeding in Baltray so the question why did they not return to this area this year has to be asked?

Since the Louth Nature Trust took on the monitoring of the area in 2007, the number of breeding pairs at The Haven has increased and in 2013, 102 breeding pairs produced 193 fledglings (Doyle *et al.*, 2013). In 2014, the number of breeding pairs peaked with 111 pairs but the productivity was lower with 91 fledglings. In 2015, 25 breeding pairs produced 20 chicks which are presumed to have fledged in the breeding season at Baltray. Productivity that year was low with 0.80 fledglings per pair (Boué *et al.*, 2015). This is a much lower productivity than in 2010 (2.23 fledglings per pair), 2009 (2.18), 2011(1.73) and 2007 (1.95) and it was more or less the same productivity as 2014 (0.82), 2012 (0.73), and 2008 (0.82) (Doyle *et al.*, 2013; Egerton and Newton, 2014; McKeever and Reilly 2007; Reilly, 2008; 2009; 2010; 2011; 2012). The productivity of pairs of Little Terns at Baltray is in general very high (especially when 24-hour wardening is in place) underlining the suitability of this site for Little Tern breeding.

The 2015 season experienced heavy depredation from corvids but that does not explain the drop in the number of breeding pairs from over 100 in 2013 and 2014 to just 25 in 2015, although perhaps it explains the drop in breeding pairs between 2015 and 2016.

This year the Kilcoole colony had a maximum of 143 breeding pairs with the flock size peaking on June 2nd with 300 birds (P. Manley, pers. comm.). This is the second highest breeding pair count on record in Kilcoole and the highest flock count recorded on any day since the project began in 1985. It is possible that many of the Baltray Little Terns nested in Kilcoole this year after the high levels of corvid predation in 2015.

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.) 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 coincides with the idea that the terns just nested elsewhere this year.

One other possible explanation for the Little Terns not coming to Baltray this year is 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 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 which the Little Terns prefer to hunt in.

Overall, the low tern numbers in the area is 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 would 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 initiation of the Little Tern Protection Scheme at Baltray has seen a dramatic recovery of the colony at Baltray and the poor results in 2015 and 2016 are evidence that a complete 24/7 scheme is required in order to provide effective protection should the Little Terns return in 2017 and future years.

Between 1984 and 2006 even the most optimistic estimates showed that less than 80 chicks had fledged from the Baltray colony, with almost zero breeding success since the mid-1990s (L. Lenehan, unpublished data). In the ten breeding seasons since this project began 673 chicks are presumed to have fledged (McKeever and Reilly 2007; Reilly, 2008; 2009; 2010; 2011; 2012; Doyle *et al.*, 2013; Egerton *et al.*, 2014; Boué *et al.*, 2015). With the exception of 2012, 2015 and 2016, there has been an increase in breeding pairs of Little Terns each year since the project was initiated (Figure 3). During the 2012 season the number of breeding pairs dropped to 33, however 2012 was an exceptionally poor breeding season for Little Terns along the east coast due to strongly inclement easterly dominated weather (Keogh *et al.*, 2012; Reilly, 2012), and the fact that Baltray was the only major breeding site to fledge any chicks on the east coast in 2012 underlines the success of the project. 2015 was another exception, with very poor weather conditions, very high daytime depredation and reduced wardening on the ground.

There also had been a general increase in number of fledged young produced per year. However, this has been more variable, reflecting the vulnerability of this species to being washed

out by tides (2012) and heavy predation by corvids (2007 and 2015), gulls (2008) and foxes (2011 and 2012) (McKeever and Reilly 2007; Reilly, 2008; 2011; 2012; Boué and Newton 2015). Foxes are a particularly serious risk as they can wipe out large numbers of nests in one night, emphasizing the importance of protective fencing. The importance of 24-hour wardening is shown by the three peak years, 2009, 2010 and 2013, having 24-hour wardening. It was illustrated this year by the suspected depredation of the first three Ringed Plover nests by a fox early in the season before the fence was completed and 24-hour wardening had commenced. No Little Tern or Ringed Plover eggs were lost to mammalian depredation after the fence was completed and regular wardening initiated.

The growth in the number of breeding pairs of Little Terns at Baltray in 2013 and 2014 was impressive. In comparison, settlement was very low in 2015 and 2016. The movement of birds from Kilcoole to Baltray has been known for several years (Maljković *et al.*, 2003; Veldman *et al.*, 2004; Stringer *et al.*, 2005; Lynch *et al.*, 2006; O'Connell *et al.*, 2007; Cockram *et al.*, 2008; Hall *et al.*, 2009; Keogh *et al.*, 2010; Keogh *et al.*, 2011; Keogh *et al.*, 2012). Since the Baltray protection scheme began in 2007 the average number of breeding pairs had dropped at Kilcoole from the numbers present between 2003 and 2006. This year, and in 2015, Kilcoole had exceptional numbers of birds, which indicates that the birds that could not settle at Baltray, because of predator activity and poor conditions, and likely relocated to nest in Kilcoole.

Though this may just be a natural fluctuation it seems probable that some of the birds hatched in Kilcoole are recruited to the Baltray breeding flock. The discovery in 2013 at Baltray of a dead adult Little Tern ringed at Kilcoole in 2010 proves that this interchange is occurring. It is likely that the east coast population of Little Terns acts as a single meta-population, with individuals moving between sites assessing which site is the most suitable for breeding in any given year. Kilcoole birds have also been trapped at Rue Point, on the Isle of Man (Keogh *et al.*, 2012), and two Baltray birds reported in Wales, indicating that dispersal may extend even further afield. The colour ringing scheme will be extremely useful if it permits inter-colony movements to be monitored in the coming years.

5. Recommendations

5.1 Human resources

It is very important to provide two full time day wardens on Baltray site. The site is very long and it is not possible to assure full monitoring and complete protection from disturbances and predators with part-time wardens. The wardens should be on the site prior to mid May so that they could participate in the erection of fences and observation platforms, and meet the volunteers who help with this task. Ideally, one or more interns would be recruited to assist the wardens.

5.2 Predator management

The main predators were corvids this year. It is critical to control the corvid population early in the season, as was done in 2014. The loan, installation and operation of the ladder trap needs to be commenced prior to the arrival of terns.

Kestrel depredation was not an issue in 2016 or in 2015, but it is probably a reflection of the low number of terns present on the site.

5.3 Kestrel supplementary feeding project

A first attempt at supplementary feeding was conducted at Baltray by volunteer, Maurice Conaghy in 2015. Such projects had been successfully set up in Norfolk and Chesil Beach in England and have helped to mitigate this predation problem using non-lethal measures. This project was not needed in 2016 but is recommended for future seasons.

5.4 Trapping Adults

In 2014 the colony at Baltray was considered large and stable enough so that the trapping of adults using nest traps should be considered, especially as no adults which hatched at Baltray would have been ringed as chicks. This activity is carried out by the Manx Ringing Group (Scott, 2011), and others in Britain, with great success. If experienced ringers are available, it is likely that the trapping of adults should be considered if nesting numbers rise to former levels and the colony is able to protect itself by mobbing predators.

5.5 Observation Platform location

Much of the nesting area is not visible from the inland side of the protective fence. This made watching for new nests difficult. Often, nests in non visible areas could only be found by entering the colony and searching for nests, which was not ideal.

Basic scaffold platforms were erected in 2015 and 2016, one in front of the south enclosure and the other in front of the north enclosure. These platforms are useful but should be settled once the day wardens are on duty so that the location can be optimized (not too close to the fence, adapted to the site new topography). Also, the nesting site is now so large at Baltray that at least a third or a fourth platform would be useful to cover all non-visible areas.

5.6 Fencing

The fenced areas were extended in 2015 so that almost all the Little Terns nest were found inside the enclosure. This was very positive and almost all the nests were protected in 2015, or could be moved inside. The negative side of this was that the site was very hard to cover with only 1 or 2 people. The fencing covered the same area in 2016 and takes up a very large area. We recommend that either a smaller area is fenced to allow the wardens to focus their energy there or else increasing the manpower to look after the large area.

5.7 Signs

Signs asking people not to walk along the area in front of the colony and informing them that chicks are present on the foreshore once hatching begins would be helpful. Many people seemed to be under the impression that the Little Terns did not leave the fenced off area and would walk along the front of the string fence, endangering chicks.

5.8 Project Website

The blog informing the public of the progress of the Little Terns breeding at Baltray should be added to the website set up in 2011 to house the Kilcoole blog (www.littleternconservation.blogspot.com). This would greatly aid the dissemination of information about the project as this site is the number one result found by a Google search for "Little Tern". This was made evident by the fact that more visitors to the site had heard about the project through posts on the Kilcoole blog than through the Baltray blog. A Baltray page could be added to this website, allowing the public to follow the progress of the Baltray and Kilcoole sites from the same site, giving people a better idea of the progress of the Little Tern on a national level.

5.9 Education

An attempt should be made to invite local school groups to visit the site. This would help increase community involvement in the project in future years. If possible it would also be very beneficial to run an outreach program to the local schools of the area, talking to classes about the Little Terns, the project in Baltray and the other wildlife they have in County Louth.

5.10 Communication tools

In previous years a portacabin provided the site with an office, a place for volunteers to relax, chat and keep out of bad weather. A whiteboard or a blackboard would be an excellent tool in informing

the public of what is going on in the colony and the success of this is seen in Kilcoole. We would strongly recommend the use of these in future years again.

5.11 Water Pipe

If a water pipe could be extended from the field adjacent to the site this would remove the need for wardens to ferry water from Dominic Hartigan's yard, reducing wear on the track down to the site, which is needed for removing project equipment.

5.12 Emergency Phone Numbers

A series of special emergency contact numbers and protocols for dealing with incidents should be established for future projects.

5.13 Two-way Radios

A set of two-way radios for the project wardens would be a great advantage, making quick communication possible in the event of an emergency.

5.14 Relief Warden

The creation of a paid relief warden position would greatly aid the running of the project in future. This year the only way one of the wardens could get a day off was if the other warden worked a double shift. The relief warden could be hired on a part-time basis to cover one or two days a week. Alternatively, a full-time relief warden position could be created to cover all of the wardened tern sites, so that the relief warden would cover days in Baltray, Kilcoole and possibly Rockabill. This would be more challenging logistically, but full-time hours may make the position more attractive and the cost would be split between projects.

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Appendix 1: Site Biodiversity

AVES (54 SPECIES)

Shelduck	<i>Tadorna tadorna</i>	Black-headed Gull	<i>Chroicocephalus ridibundus</i>
Mallard	<i>Anas platyrhynchos</i>	Herring Gull	<i>Larus argentatus</i>
White Cheeked Pintail	<i>Anas bahamensis</i>	Common Gull	<i>Larus canus</i>
Gannet	<i>Morus bassanus</i>	Lesser Black-backed Gull	<i>Larus fuscus</i>
Cormorant	<i>Phalacrocorax carbo</i>	Great Black-backed Gull	<i>Larus marinus</i>
Shag	<i>Phalacrocorax aristotelis</i>	Stock Dove	<i>Columba oenas</i>
Little Egret	<i>Egretta garzetta</i>	Feral/Racing Pigeon	<i>Columba livia</i>
Grey Heron	<i>Ardea cinerea</i>	Woodpigeon	<i>Columba palumbus</i>
Sparrowhawk	<i>Accipiter nisus</i>	Collared Dove	<i>Streptopelia decaocto</i>
Buzzard	<i>Buteo buteo</i>	Cuckoo	<i>Cuculus canorus</i>
Oystercatcher	<i>Haematopus ostralegus</i>	Short-eared Owl	<i>Asio flammeus</i>
Ringed Plover	<i>Charadrius hiaticula</i>	Kestrel	<i>Falco tinnunculus</i>
Whimbrel	<i>Numenius phaeopus</i>	Magpie	<i>Pica pica</i>
Curlew	<i>Numenius arquata</i>	Jackdaw	<i>Corvus monedula</i>
Turnstone	<i>Arenaria interpres</i>	Rook	<i>Corvus frugilegus</i>
Knot	<i>Calidris canutus</i>	Hooded Crow	<i>Corvus cornix</i>
Sanderling	<i>Calidris alba</i>	Skylark	<i>Alauda arvensis</i>
Dunlin	<i>Calidris alpina</i>	Swallow	<i>Hirundo rustica</i>
Little Tern	<i>Sternula albifrons</i>	House Martin	<i>Delichon urbicum</i>
Sandwich Tern	<i>Sterna sandvicensis</i>	Wren	<i>Troglodytes troglodytes</i>
Common Tern	<i>Sterna hirundo</i>	Starling	<i>Sturnus vulgaris</i>
Roseate Tern	<i>Sterna dougallii</i>	Blackbird	<i>Turdus merula</i>
Kittiwake	<i>Rissa tridactyla</i>	Wheatear	<i>Oenanthe oenanthe</i>
Yellowhammer	<i>Emberiza citrinella</i>	Dunnock	<i>Prunella modularis</i>
Reed Bunting	<i>Emberiza schoeniclus</i>	House Sparrow	<i>Passer domesticus</i>
Linnet	<i>Linaria cannabina</i>	Pied Wagtail	<i>Motacilla alba yarellii</i>
Goldfinch	<i>Carduelis carduelis</i>	Meadow Pipit	<i>Anthus pratensis</i>

MAMMALIA (11 SPECIES)

Otter	<i>Lutra lutra</i>	Harbour Porpoise	<i>Phocoena phocoena</i>
Rabbit	<i>Oryctolagus cuniculus</i>	Grey Seal	<i>Halichoerus grypus</i>
Irish Hare	<i>Lepus timidus hibernicus</i>	Red Fox	<i>Vulpes vulpes</i>
Common Pipistrelle	<i>Pipistrellus pipistrellus</i>	Brown Rat	<i>Rattus norvegicus</i>
Soprano Pipistrelle	<i>Pipistrellus pygmaeus</i>		

ARTHROPODA (29 SPECIES)

Shore Crab	<i>Carcinus maenas</i>	Marmalade Hoverfly	<i>Episyriphus balteatus</i>
Edible Crab	<i>Cancer pagurus</i>	Common Earwig	<i>Forficula auricularia</i>
Common Carder Bee	<i>Bombus pascuorum</i>	22-spot Ladybird	<i>Psyllobora vigintiduopunctata</i>
White-tailed bumblebee	<i>Bombus lucorum</i>	7-spot Ladybird	<i>Coccinella 7-punctata</i>
Buff-tailed Bumblebee	<i>Bombus terrestris</i>	Ground Beetle	<i>Pterostichus madidus</i>
Garden Bumblebee	<i>Bombus hortorum</i>	Soldier Beetle	<i>Rhagonycha fulva</i>
Red-tailed Bumblebee	<i>Bombus lapidaries</i>	Bluebottle Fly	<i>Calliphora vomitoria</i>
Gypsy Cuckoo Bee	<i>Bombus bohemicus</i>	Centipede	<i>Cryptops hortensis</i>
Red-tailed Cuckoo Bee	<i>Bombus rupestris</i>	Red Ant	<i>Myrmica rubra</i>

LEPIDOPTERA

Small White	<i>Artogeia rapae</i>	Red Admiral	<i>Vanessa atalanta</i>
Large White	<i>Pieris brassicae</i>	Small Heath	<i>Coenonympha pamphilus</i>
Common Blue	<i>Polyommatus icarus</i>	Orange-tip	<i>Anthocharis cardamines</i>
Small Blue	<i>Cupido minimus</i>	Six-spot Burnet	<i>Zygaena filipendulae</i>
Green-veined White	<i>Artogeia napi</i>	Cinnibar Moth	<i>Tyria jacobaeae</i>
Painted Lady	<i>Cynthia cardui</i>		

REPTILIA (1 SPECIES)

Viviparous Lizard	<i>Lacerta vivipara</i>
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ACTINOPTERYGII (3 SPECIES)

Sea Trout	<i>Salmo trutta</i>	Sprat	<i>Sprattus sprattus</i>
Sea Bass	<i>Dicentrarchus labrax</i>		

CNIDARIA (2 SPECIES)

Beadlet Anemone	<i>Actinia equine</i>	Moon Jelly	<i>Aurelia aurita</i>
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ECHINODERMATA (2 SPECIES)

Common Starfish	<i>Asterias rubens</i>	Sea Potato/Heart Urchin	<i>Echinocardium cordatum</i>
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PLANTAE (21 SPECIES)

Sea Holly	<i>Eryngium maritimum</i>	Rosebay Willowherb	<i>Epilobium angustifolium</i>
Sea Sandwort	<i>Honkenya peploides</i>	Pyramidal Orchid	<i>Anacamptis pyramidalis</i>
Biting Stonecrop	<i>Sedum acre</i>	Wild Radish	<i>Raphanus raphanistrum maritimum</i>
Ox-eye Daisy	<i>Leucanthemum vulgare</i>	Viper's-bugloss	<i>Echium vulgare</i>
Sea Campion	<i>Silene maritima</i>	Birdsfoot Treefoil	<i>Lotus corniculatus</i>
Hare's-foot Clover	<i>Trifolium arvense</i>	Sea Rocket	<i>Cakile maritima</i>
Sea Spurge	<i>Euphorbia paralias</i>	Ragwort	<i>Senecio jacobaea</i>
Marram Grass	<i>Ammophila arenaria</i>	Sand Cat's-tail	<i>Phleum arenarium</i>
Sea Lyme Grass	<i>Elymus arenarius</i>	Couch	<i>Elytrigia repens</i>
Thongweed	<i>Himantalia elongata</i>	Eelgrass	<i>Zostera marina</i>
Serrated Wrack	<i>Fucus serratus</i>		

FUNGI (1 SPECIES)

Field Mushroom	<i>Agaricus campestris</i>
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