Baltray Little Tern Colony Report 2013

S. Doyle, D.P. O'Connell and S.F. Newton*

Seabird Conservation Team, BirdWatch Ireland, 20D Bullford Business Campus, Kilcoole, Co. Wicklow
* snewton@birdwatchireland.ie

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Abstract

Wardening of the Little Tern (*Sternula albifrons*) colony at Baltray began on May 13th 2013 and ended on August 9th 2013. Night wardening (thus 24 hour colony-coverage) was initiated on May 30th. A total of 106 nesting attempts were made by 102 breeding pairs of Little Tern in 2013, the highest total of pairs recorded since the project began in 2007. 90 nesting attempts occurred within the protective colony fence, with 16 occurring in the buffer area between the protective fence and the outer string fence.

The first eggs were found on May 30th. The last eggs were found July 18th, which was one of four late nests suspected to be re-lays of early failed nests. A total of 229 eggs were laid, 228 eggs in active nests and one randomly laid 'egg dump' which was not was not part of an active nest and was never incubated. The mean clutch size was 2.15 eggs per nest. The largest loss of eggs related to 9 eggs from 7 nests where the egg was infertile or the chick did not survive to hatching. Other losses included 8 eggs from 4 nests which were washed out during the June and July spring tides, 4 eggs from 3 nests which were abandoned and 4 eggs from 2 nests which were presumably depredated by corvids (probably Hooded Crows). A total of 203 chicks were known to have hatched out of 97 nests from June 22nd to July 28th. The modal incubation period was 20.96 days. 169 chicks were ringed this season, the first to be ringed at Baltray, and extensive re-trap data were collected to construct average growth rates. Also the diet of Little Tern chicks was studied for the first time at Baltray, showing the range of fish species and size caught by adults for their young and how it changed as they develop.

Of the 203 chicks hatched, a total of 10 young were known to have died. 8 fledged chicks were known to have been killed by a pair of Kestrels (*Falco tinnunculus*) between July 15th and 28th. Two chicks died from natural causes (cold or starvation), one near the nest scrape aged day 3 and one older chick aged day 18. Thus, 193 chicks were presumed to have fledged (the highest total recorded since the project began in 2007), which equates to productivity this year of 1.89 fledglings per breeding pair. This is likely to be an overestimate; however it gives a good indication of the success of the 2013 breeding season, which produced its highest number of breeding pairs and chicks presumed fledged since the initiation of the Little Tern protection scheme at Baltray.

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 beaches adjacent to sources of brackish water. Access to brackish water is important as they require 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 July or, 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) (Lynas *et al.*, 2007), 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 largely unknown due to the inability to survey key sites such as the Magharee Islands in Kerry (Tony Murray, pers. comm.). 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 Buckroney (Co. Wicklow) and Portrane/Rogerstown (Co. Dublin). However, in 2011 five pairs were seen prospecting at Buckroney 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 3 pairs were present at the Rogerstown Estuary Nature Reserve throughout the breeding season, however only one pair bred successfully and were seen with a single fully fledged chick (Niall Harmey pers. comm.).

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 and 2008 - 2010. 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 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). 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

[to be completed]

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 fulfil Ireland's legal obligations under the EU Birds Directive".
Strategies employed by 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.

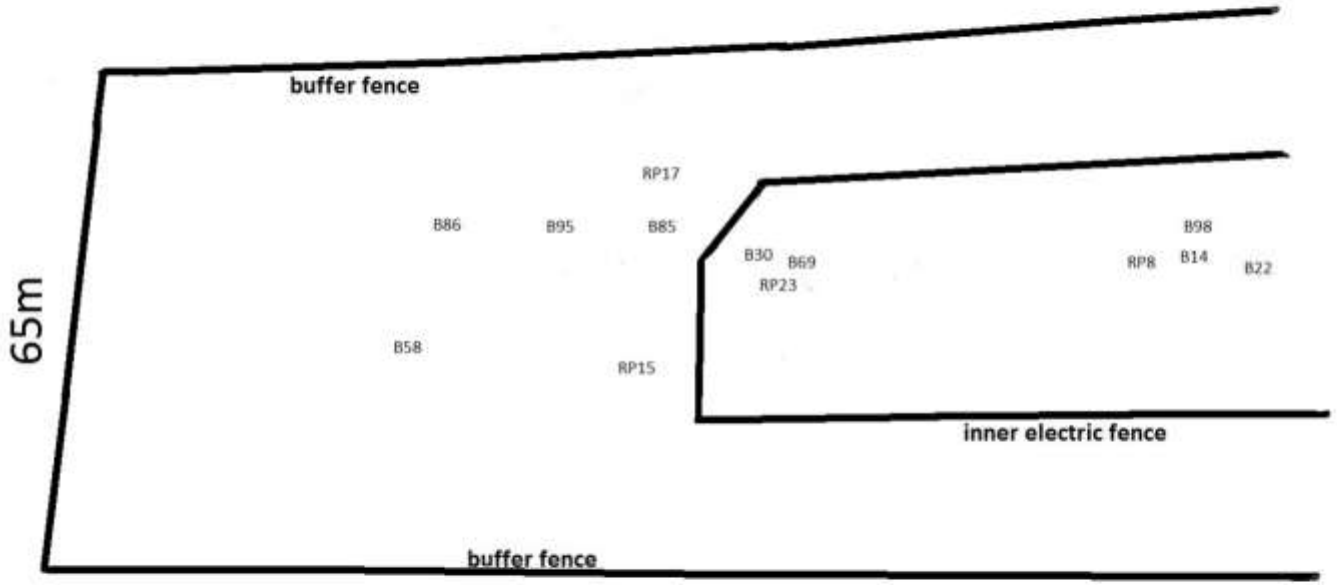
Colony Map -location of nests

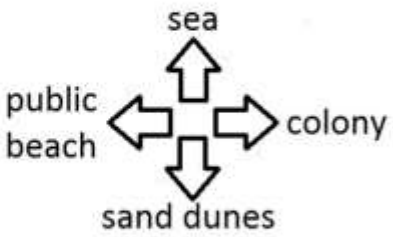
North Colony

(north end)

N

B: Baltray Little Tern nests
RP: Ringed Plover nests
nests numbered in order
of recording by warden

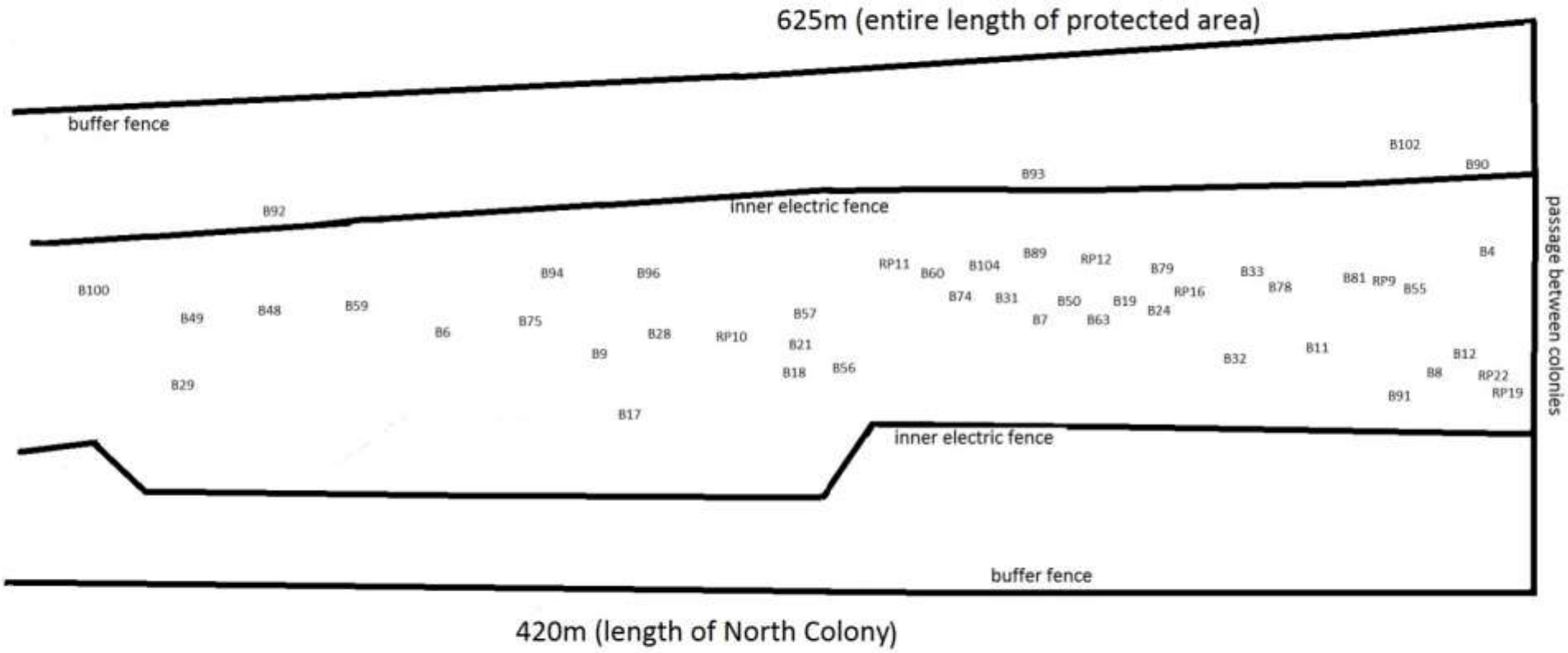




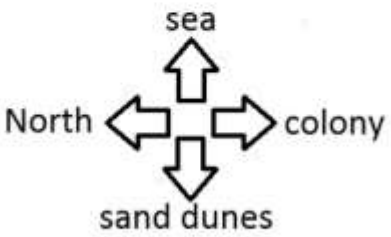
10m

North Colony

(south end)

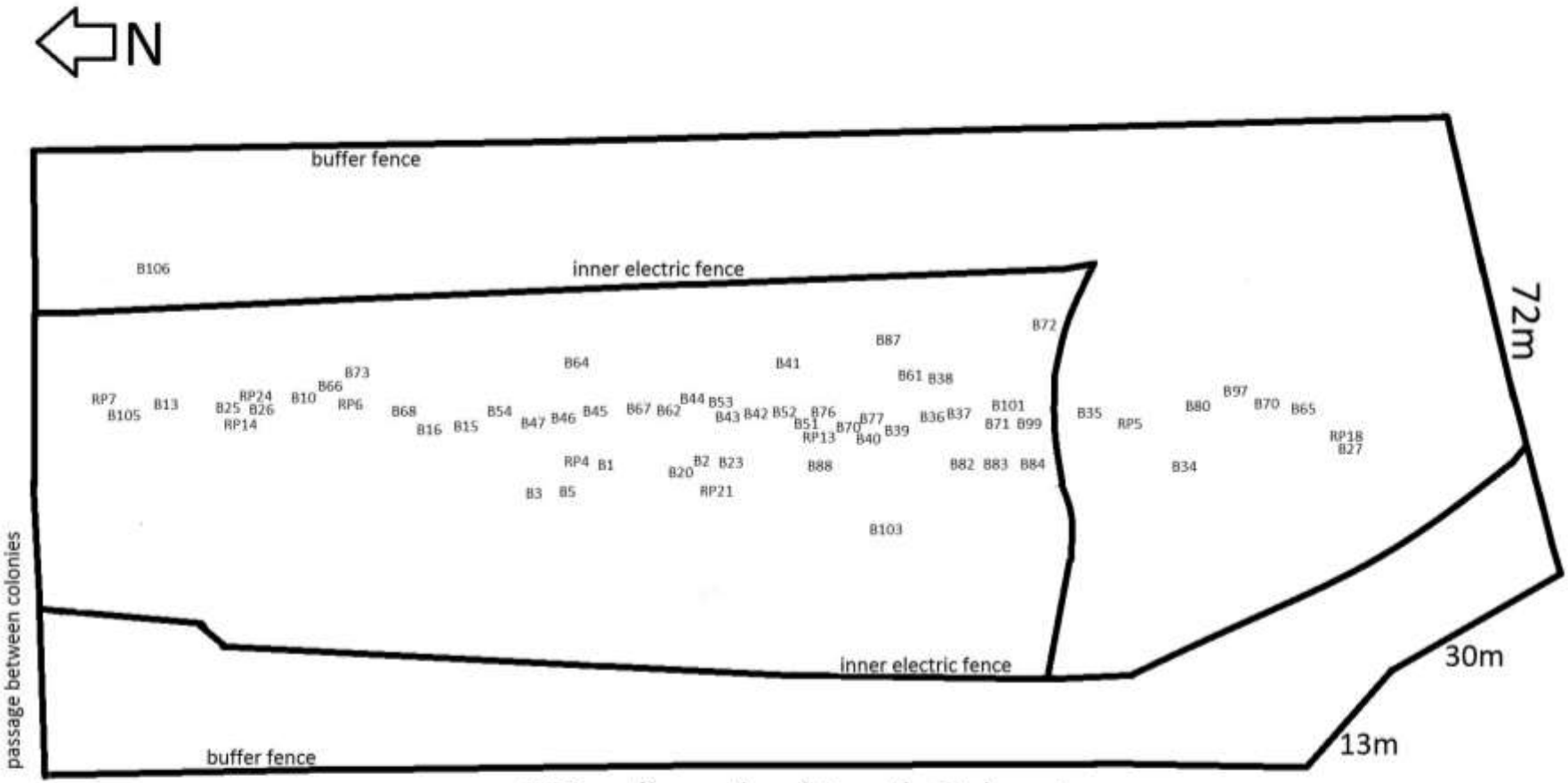


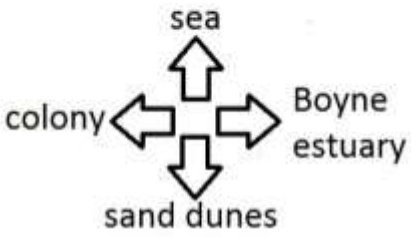
420m (length of North Colony)



10m

South Colony





10m

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. The nesting site was considerably larger than in 2012, approximately 625m long x 50m wide, the largest the nesting area has been since the project was initiated (see colony map, page 5).

The Baltray site is hugely tidal, 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 colony the nesting area extended another c.20m into an area of large shingle mixed with patches of vegetation, though in much of the colony the vegetation was too thick. 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, a portacabin and portaloo were rented in 2013. A storage container was also rented for storing valuable equipment. The day wardens lived onsite in a caravan provided. These facilities are vital to the running of this project.

2.2. Monitoring

Continuous day wardening was initiated on May 13th and continued till the end of the project on August 9th. 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. This role was filled by Domhnall Finch from May 13th to May 27th. When Domhnall left the project to take up a permanent position elsewhere, Andrew Power, one of the wardens from Kilcoole, took on the Baltray position from May 27th to June 9th until permanent replacements could be found. Due to the size of the colony and the large number of nests which had already set up the decision was made to install two replacement day wardens, Susan Doyle and Darren O'Connell, who wardened the site from June 10th to August 9th.

The warden's daily routine consisted of locating new nests and monitoring existing nests for the presence or absence of incubating birds. Nest visits were made to check the number eggs and/or chicks present. As well as Little Terns, Ringed Plovers (*Charadrius hiaticula*) which nested within the colony were monitored in the same way (Appendix 2: Table 6). A daily log was kept, where details of personnel present, weather, tides, work done, tern activity, nest status, disturbances, visitors and all wildlife observations were recorded. Nest data tables were kept outlining the progress and due hatching dates for each nest. However, as entering the colony (beyond the 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 minimised. The colony was never entered in adverse weather conditions (during rainfall, high winds or fog). In addition to these duties, the wardens were responsible for erecting and maintaining the colony fence.

Night duty was initiated when the first Little Tern eggs were found on May 30th and continued until the end of the project. This was conducted by Tony Glass (Sunday-Thursday) and Maurice Conaghy (Friday-Saturday). The night wardens covered the hours between 22:00 and 06:00. This provided 24 hour protection to the Little Terns. The value of 24 hour protection was shown by the huge success of the 2009 and 2010 breeding seasons (Reilly, 2009; 2010). Both of the night wardens are experienced gamekeepers and they were responsible for monitoring nocturnal predator activity.

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 started to fledge, separate counts were made for fledglings to give an idea of productivity. This estimation 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 tern 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 diameter of each nest was measured and the substrate the nest was made on was recorded. 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 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 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 judgement 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 checks

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. A map of the colony was drawn and hung in the project portacabin, to which the location each new nest was added. This greatly facilitated nest checks and observations.

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 did not increase in size over three consecutive days, or when a third egg was laid, the clutch was considered complete. To minimise disturbance nests were not visited after clutch completion unless the incubating adult had not been observed incubating. Some nests were very hard to view incubating from any angle, but if its scrape was still being maintained this indicated that the nest was still active. Hatching dates were predicted where clutch completion was known, and daily nest visits were resumed at this point to check for hatching. All details were recorded on the individual nest identification sheets. In order to keep track of active nests a summary table was compiled to record daily nest visits and chicks re-trapped. The data recorded here was the number of eggs or chicks per nest, and whether any predation incidents had taken place (Table 1). These details were confirmed each evening and allowed the warden on duty to identify which nests needed to be checked without having to go through the individual nest record sheets.

Table 1: Example of a nest summary sheet where the number of eggs (e), number of eggs showing cracks indicating that they are near hatching (cr), number of chicks (y), number of ringed chicks (R) and predation events (X) were recorded.

Nest no.	**10-Jul**	**11-Jul**	**12-Jul**	**13-Jul**	**14-Jul**	**15-Jul**
B48	2e	2e	2cr	1y+1cr	2R	2R (retrap)
B49	3e	3e	X (corvid)	X	X	X
Etc.	...	...	...	...	...	...

2.2.3. Biometrics and Ringing

Chicks were fitted with a British Trust for Ornithology (BTO) ring (size B+) on their left leg. Baltray chicks were ringed on their left leg to distinguish them from Kilcoole chicks which were ringed on their right leg. Most Little Tern chicks were ringed in or near the nest scrape meaning that their nest of origin and exact ages were known when they were subsequently re-trapped on the foreshore. Day of hatching was allocated as Day 0, such that a 1 day old chick was one that hatched on the previous day.

The wing length of each chick was measured (maximum wing chord) to the nearest 0.5 mm using a stopped rule (Redfern and Clark, 2001). All chicks were weighed using an electronic balance to the nearest 0.1g. These measurements were used to study the growth of the Little Tern chicks. Once the majority of chicks had left their nest scrapes, the area of foreshore along the colony was searched most days (weather permitting) for chicks. Re-trapped chicks were identified by ring number and measured. Re-trap data was used to create average growth curves and monitor chick development.

2.2.4. Diet Study

The aim of the dietary observations was to investigate the food types and the size of food items that were offered to Little Tern chicks of varying ages. Hatchlings through to fully fledged chicks were targeted. The date, time, chick age, food type, food item size and whether the chick accepted the proffered food were recorded for each feeding event. Each event was recorded as "food offered" whether the chick accepted it or not. By recording the time, the approximate number of feedings per hour could be estimated.

Chicks up to seven days old could be observed at or nearby the nest using a telescope. The chick age was known from its nest. Each nest/nest area was observed for one hour at a time. The food type was identifiable by eye and the food length was deduced by comparing it to the length of the bill of the adult Little Tern. Thus food size was measured in "bill-lengths", with one unit equivalent to the length of a bill. It was possible to observe several nests during one observation period.

When the chicks moved away from the nesting area, it became necessary to search the colony area by sweeps with the telescope. Once they had been located, however, observing the diet was done using the same method as with younger chicks. Chicks aged 10 to 15 days could be aged by identifying their ring number before or after the observation period. This involved re-trapping the chick due to the difficulty in reading the rings on mobile chicks. Because chicks of this age are quite mobile, only one or two sets of siblings could be observed simultaneously.

Chicks within the age bracket 15 to 20 days and bracket 20 to 28 days were identified by the progression of their juvenile plumage, particularly the growth of the black cap. These chicks were observed with the same methods as before and also remained in sibling groups. Fully fledged chicks aged 28 days or older were easily recognisable by their plumage, size, behaviour and posture. These chicks were located by sweeps with the telescope on the sandbars. They were observed in the same way as before, although observation periods were often cut short if they flew.

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 fence was put up between the May 14th and May 23rd by the warden and a team of volunteers.

A string cordon was put on the outside the nesting area, enclosing an area of approximately 625m by 75m. To make the cordon 5’ wooden posts were used along with blue baler twine and 8' posts were used on the seaward side as these could endure the 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 posts. The mesh was curved outwards and had sand shovelled onto it to partially bury it and deter burrowing predatory animals. The mesh used was mostly saved from the 2012 project,

with some new mesh. The northern zone was almost three times as long (c.350m) as the southern zone (c.120m). Both zones were c.50m wide. The walkway led straight out from where the portacabin was situated, facilitating wardens and volunteers in quickly reaching beach goers on the foreshore. Green plastic mesh was used on the all but the east side 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 rows 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 fencers and 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 and checked at least once every day. If any debris was earthing the electric fence wires it was removed. The bottom electric fence wire had to be dug up and re-tensioned after inclement weather as sand shifted by the wind could bury it. When the voltage was seen to be dropping the warden replaced the battery.

An extension was made of green mesh fence from the southern closure to bring it to within 5m of the sea wall. This was done to protect several nests which had set up in the buffer zone to the south of the colony. The electric fence was not extended.

The spring tides in May (26th to 30th) and particularly in July (23th to 27th) damaged the fence, knocking segments of the east electric fence and causing it to become tangled in lumps of seaweed. This put the electric fence out of action for several days on both occasions (27th-31st May and 23rd-29th July), leaving the colony exposed. However no predation occurred during these time periods and the majority of fence materials were recovered undamaged.

Between August 6th and 9th the wardens, with the help of volunteers, 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 caravan in his yard was invaluable. All the equipment was removed from the site by August 9th.

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 people, 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 project portaloo.

As the use of the beach increased during the warm weather in July, a line of stakes with additional signs were placed along a sandbar (which protected them from the tides) to the north 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. Nest Moves

Nests in danger of being washed out by the tides were moved further inland. At least a day before a nest was moved conspicuous rubbish (blue glove etc.) was placed behind and on either side of the nest to give the parents something to orientate themselves by. When the nest was moved the rubbish was moved in relation to it. The eggs were placed in a new scrape less than one meter away from the original scrape. A picture was taken of the nest site and every effort was made to exactly mimic the arrangement of shells etc. around the nest. If a parent bird failed to relocate its newly positioned nest within 20-45 minutes (depending on the weather conditions) the nest was moved back to its original position.

2.3.4. Chick Shelters

A total of 14 chick shelters were provided this year, consisting of plastic piping half-buried in the shingle, camouflaged with pebbles, seaweed & debris. They were placed throughout the colony when the first chicks began to hatch, concentrated where clusters of nests were present. The majority of chick shelters were located on the mid-section of the beach or near the seaward fence as most chicks were moved towards the foreshore by their parents after a few days. Several chick shelters were utilised regularly by some of the older chicks from mid-June onwards, particularly during periods of inclement weather or when the mid-day sun was at its most intense.

2.3.5. 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. Just the presence of humans at the colony helped keep most predators at bay. This year the predator management focused on Hooded Crows (*Corvus cornix*), Red Foxes (*Vulpes vulpes*) and Kestrels (*Falco tinnunculus*) for which specific preventative actions had to be taken.

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 danger to the colony were removed under license. Kestrels are noted predators of Little Tern chicks and have taken a large number of fledglings at Kilcoole in certain years (Hall *et al*., 2009; Keogh *et al*., 2010). Therefore noise deterrence was used to disturb Kestrels hunting in the vicinity of the colony.

2.4. Public Awareness

2.4.1 Interaction with beach users

A daily effort was made to increase public awareness and appreciation of the Little Tern. This was carried out by talking to 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.

2.4.2 Group Talks & Outings

The colony was visited by a delegation of County Heritage Officers from the Heritage Council on June 18th. The national meeting of County Heritage Officers had been held in Drogheda and this proved an opportune time to show them what the funding provided by the Heritage Council had achieved. The wardens, assisted by a group of volunteers, gave the group a talk outlining the importance of the project, a tour of the colony and were able to show them Little Terns incubating through binoculars. The continued support and funding provided by the Heritage Council is essential to the running of this project.

Aine Walsh, a volunteer and former director of the Louth Nature Trust, brought a group of work colleagues and their children to visit the colony on June 26th. The warden gave a talk to the group outlining the importance of the project and gave them a tour of the colony. The children were shown incubating Little Terns through a telescope and shown pictures of tern eggs. Two bird watching groups from Northern Ireland, one from Newry on June 12th and the other from Belfast on July 7th, visited the site. They were given a talk outlining the Little Tern protection scheme. All of the above talks were well received and much appreciated by all of those who attended.

2.4.3 Media Coverage

The Irish Little Tern protection scheme featured as a segment on the Mooney Goes Wild radio show on RTE Radio 1 on July 12th. Dr Stephen Newton of BirdWatch Ireland outlined the importance of the Little Tern protection scheme and the efforts being made to protect Little Terns at Baltray and Kilcoole. It also featured Kilcoole warden Andrew Power outlining the tasks undertaken by the wardens to protect the Little Terns.

The project was featured in a local newspaper, the 'Drogheda Leader', on July 3rd (Appendix 3). It featured an outline of the project, an interview with warden Susan Doyle and an appeal for further volunteers. This proved very successful, with several people subsequently contacting the wardens about volunteering. The project also featured in the autumn edition of 'Wings' magazine, BirdWatch Ireland's quarterly magazine. This included a summary of the success of each of the tern colonies managed by BirdWatch Ireland (including Baltray). Also included was a segment written by the Baltray wardens entitled 'Haven on Earth', detailing the wildlife of Baltray as well as taking a light hearted look at life as a Little Tern warden (Appendix 3).

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. At the beginning of the season, weather was generally showery with variable wind direction. Occasional heavy rain and strong winds occurred. Temperatures were typically mid-teens in the daytime and became cool at night. In mid-June, weather became warm and sunny. A moderate west wind during the June spring tide (24th-28th) helped keep damage to a minimum. A heatwave followed, during which the temperature on the beach often exceeded 20 degrees Celsius and wind was light and westerly. The high pressure continued for several weeks, including during the full moon. Little rain fell and the area became very dry with a possible risk of grass fire, which has occurred on similarly dry summers in the past (Dominic Hartigan, pers. comm.). Weather became increasingly humid through July, still with little rain, until breaking in thunderstorms for several days around the time of the July spring tide (23rd-27th). A moderate east wind resulted in a higher tide than the previous months' and some damage to the colony fence. At the end of July, the temperature began to drop notably at night and heavy, frequent showers and persistent rain became typical. Weather in August was quite cool with dull mornings and clear afternoons.

3.2 Tern Numbers

An average count of approximately 60 adult Little Terns was recorded daily in the colony. The main method of counting was dread counts. Dreads typically consisted of 50 to 100 Terns. These numbers are considerably lower than what would have been expected given the number of breeding pairs present. A peak count of 228 adult Little Terns roosting on a sandbar occurred on the 11th of July.

The number of adult Terns increased throughout May and June (Figure 1). The first egg was discovered on May 30th and the number of active nests continued to increase for the rest of May and through June (Figure 1). The first nest hatched on June 22nd. The number of active nests decreased from this date as they hatched. As chicks fledged, there was a drop in Little Tern numbers as some of the population began to move around the eastern coastline. In July, the population increased once again as large numbers of adult Little Terns began to gather in loafing flocks before migration. In mid-July, numbers decreased as Terns began migration. Less than 10 Little Terns were present by the start of August.

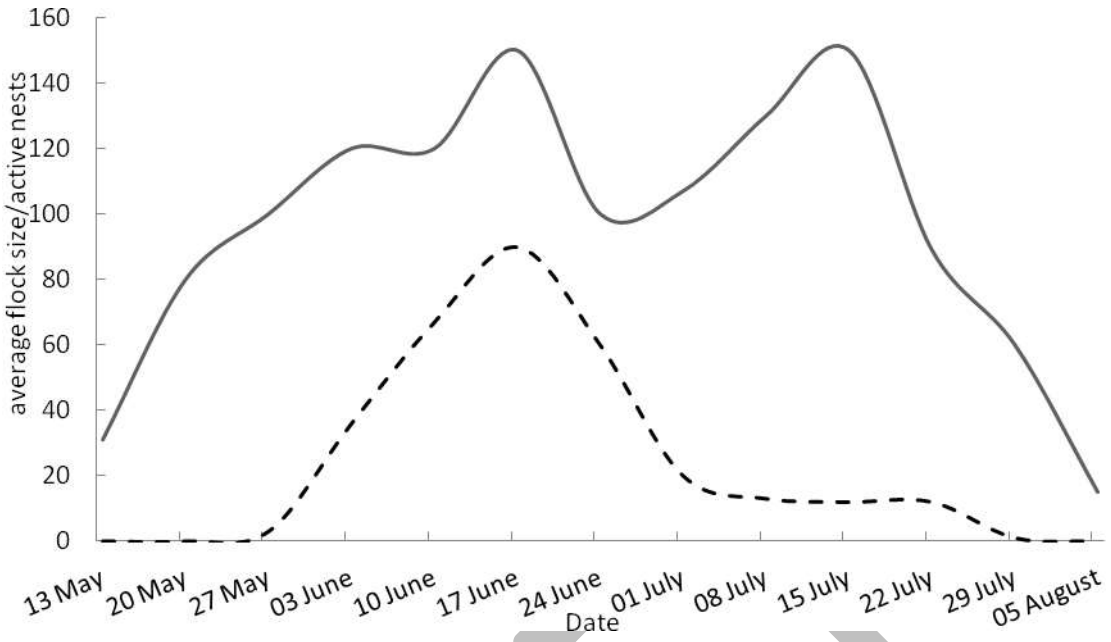


Figure 1: Average Little Tern flock size (——) and the number of active nests (- - -) per week at the Baltray colony from 13th May to 9th August 2013.

3.3 Nesting

3.3.1 Number of Breeding Pairs

102 pairs of Little Terns laid 106 nests at Baltray in 2013 (Figure 5 and Table 5). The number of breeding pairs is put at 102 as it seems probable that nests B102, B103, B104, and B106 were re-lays of four nests that were lost early in the season to corvid predation (B20 and B53) and the June spring tide (B92 and B93). These nests were found very late in the season and each had only 1 or 2 eggs, which is characteristic of re-lays. Also B103 and B104 hatched a full week after any other nest. B102 and B106 were washed out by the July spring tide.

3.3.2 Pattern of Nesting

Scrapes occurred throughout the northern and southern enclosures, with 42 found within the northern enclosure and 48 found within the southern enclosure (see colony map). The density of nests in the southern enclosure was much higher as it was only a third of the size of the northern enclosure. A huge concentration of nests was found in the southern third of the South enclosure where 22 nests were found. Most scrapes were on the flat beachfront, but some were further up the beach into embryonic sand dunes. At the south end of the southern enclosure seven nests were discovered outside the colony fence. Extra fencing was added for their protection on June 13th, extending the green mesh fence to within 5m of the sea wall. Similarly, four nests were outside the protective fence at the north end of the northern enclosure, but it was decided that it would not be practical extend the fence any further north. These nests suffered no extra damage than those within the colony fence. Five nests were situated between the electric fence and waterline, four in front of the northern enclosure and one in front of the southern enclosure. Though attempts were

made, these could not be successfully moved to the landward side of the fence and all but one was damaged during spring tides.

The largest scrape diameter was 9.5cm and the smallest was 6cm, with the average being 8.1cm. 40 nests were made soft open sand, 28 scrapes were made on coarse shingle and 26 scrapes were found on fine shingle (Figure 2). 9 nests were made on a bed of small pale coloured shells collected with the beak from the immediate surrounding area (Plate 1). One nest was laid inside a sheltered patch created by a plastic bag filled with sand (Plate 2).

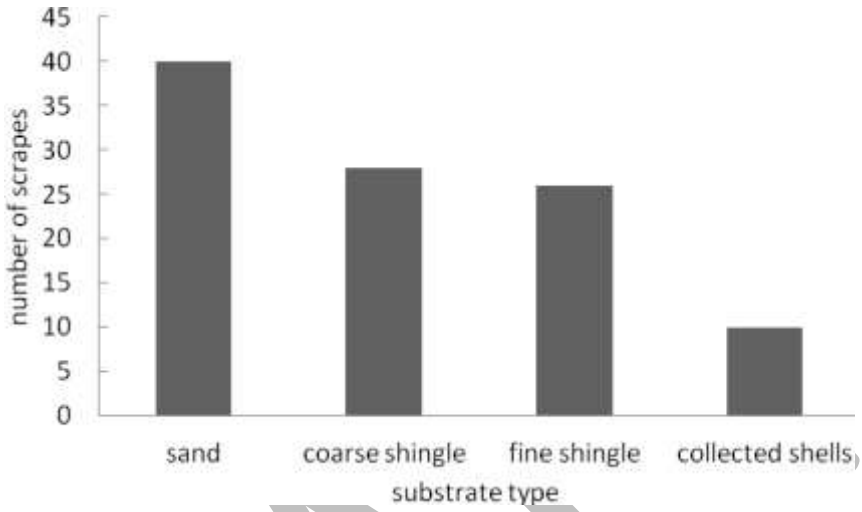


Figure 2: number of scrapes per substrate type.

Plate 1: nest on collected shell substrate

Plate 2: nest in shelter of plastic bag

3.3.3 Cutch Size and Incubation Period

Out of 106 nesting attempts 20 had 3 eggs (18.87%), 82 had 2 eggs (77.36%) and 4 had 1 egg (3.77%) (Appendix 2: Table 5). The mean clutch size was 2.15 eggs per nest. The Little Tern pair B49 was found to be incubating a grey stone and B91 was found to be incubating a pink spiral shell. Both were incubating these objects in addition to their two eggs. It is unknown why they did this as neither object was in any way similar to a Little Tern egg. The exact incubation period is known for 31 nests (Table 2). The mean incubation period was 20.96 days.

Table 2: incubation period of Baltray Little Terns in 2013 breeding season. Data only available for nests discovered before reaching full clutch. Incubation period covers time from full clutch until first chick hatches. n = 31

Nest ID	Incubation period	Incubation length
B1	01 - 22 June	21 days
B2	03 - 24 June	21 days
B3	02 - 23 June	21 days
B4	03 - 24 June	21 days
B5	03 -24 June	21 days
B6	04 -24 June	20 days
B7	04 -25 June	21 days
B8	04 -25 June	21 days
B10	04 -28 June	24 days
B12	04 -24 June	20 days
B13	05 -27 June	22 days
B14	05 -25 June	20 days
B17	06 -27 June	21 days
B18	06 -28 June	22 days
B19	06 -26 June	20 days
B21	06 -28 June	22 days
B22	06 -27 June	21 days
B25	08 -29 June	21 days
B26	06 -28 June	22 days
B28	10 -30 June	20 days
B29	09 -30 June	21 days
B30	10 -30 June	20 days
B35	09 -28 June	19 days
B41	08 -29 June	21 days
B44	09 -30 June	21 days
B47	10 -30 June	20 days
B49	09 -30 June	21 days
B58	12 June - 04 July	22 days
B61	13 June - 03 July	20 days
B83	19 June - 11 July	22 days
B85	19 June - 10 July	21 days

minimum incubation period: 19 days
maximum incubation period: 24 days
mean incubation period: 20.96 days

3.3.4 Hatching Success

In total were recorded 229 eggs laid throughout the season, 228 eggs in 106 nests and 1 egg was randomly dumped. Of these eggs 26 did not hatch due to the following causes (Figure 3): dumped egg (1 egg), corvid depredation (4 eggs), washed away by spring tides (8 eggs), infertility (9 eggs) and abandonment (4 eggs). The remaining 203 chicks successfully hatched from 97 nests. Hatching commenced on June 22nd and continued until July 28th.

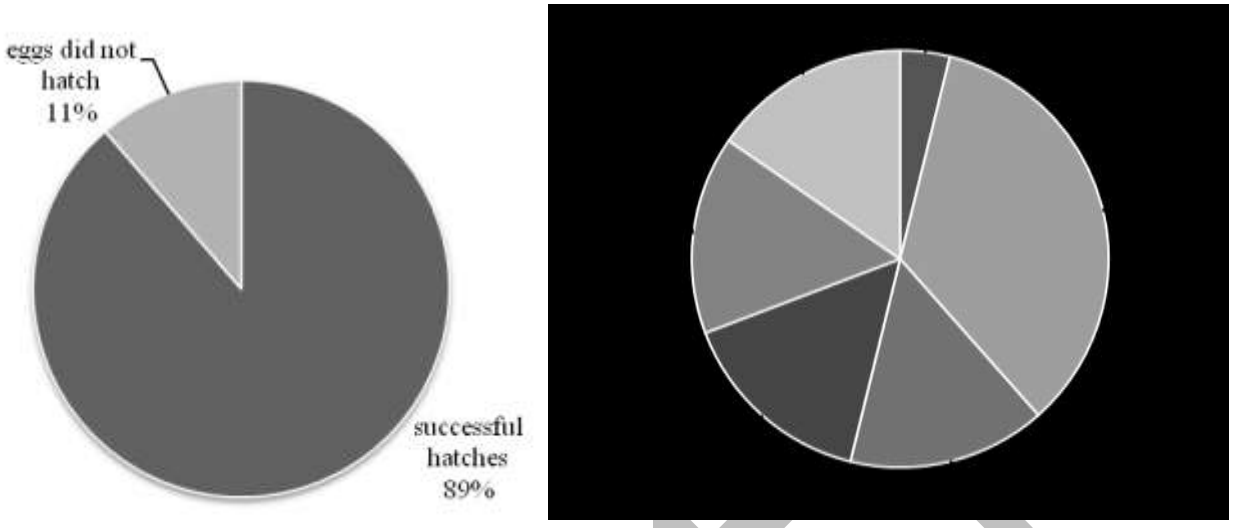


Figure 3: **(a)** the percentage of Little Tern eggs successfully hatched and the percentage of eggs that did not hatch; **(b)** the various factors that led to eggs not hatching and the percentage to which they contributed to egg loss.

3.3.5 Fledgling Success

The survival rate for chicks was high. Just 2 chicks were discovered dead from natural causes (most likely exposure or exhaustion). The first was found dead inside the scrape at three days old on June 25th. It was one of two chicks from nest B1 and may have been incubated by the parent bird even after death had occurred. The second was found on July 18th in the extended section of the southern enclosure. Its ring number (NW38576) identified it as one of three chicks from nest B65 that died at 18 days old. Kestrel predation led to the loss of eight fledged chicks. A pair of Kestrels possibly raising a brood hunted in the colony regularly. The number of chicks taken by the Kestrels was estimated through the number of piles of plucked feathers found in the surrounding sand dunes. These piles of feathers were used to identify the birds which were taken as fledged chicks, as they lacked full adult colouration (Baker, 1993). No rings were found in the piles of plucked feathers.

Once chicks had become fully mobile, the colony became clearly divided into two sub colonies. The larger sub colony roosted in the south corner of the beachfront, with terns found at

the base of the estuary wall and on a large sandbar in front of the colony. Fledgling counts in this sub colony were typically between 30 and 50 birds. The smaller sub colony was to the north and the terns generally roosted on a small sandbar in front of the fenced area. Fledgling counts in this sub colony were 20 or less birds. High counts of fledglings occurred on July 22nd with 89 individuals across the whole colony, and later on July 31st with 92 fledges. However fledgling counts only provide an indication of the survival rates of the chicks, as fledged chicks generally leave the colony within two weeks of fledging (Keogh *et al*., 2011), a large number of older chicks would have left the colony by the time of the highest counts. Also several chicks were yet to fledge by late July and fledged chicks may roost in different areas at Baltray making counts more difficult. Because of this, any fledgling count will have been an underestimate of the total number of fledglings for 2013. However, the counts still serve as an indicator of productivity.

Thus any chick not known to have died is assumed alive. 193 chicks (95%) are assumed alive and fledged (Figure 4). This is likely an overestimate, but as the colony was observed on a 24 hour basis, and frequent searches were undertaken within the colony for chicks, it is thought that the majority of depredations events and other chick deaths were accounted for, so this should be close to the true figure.

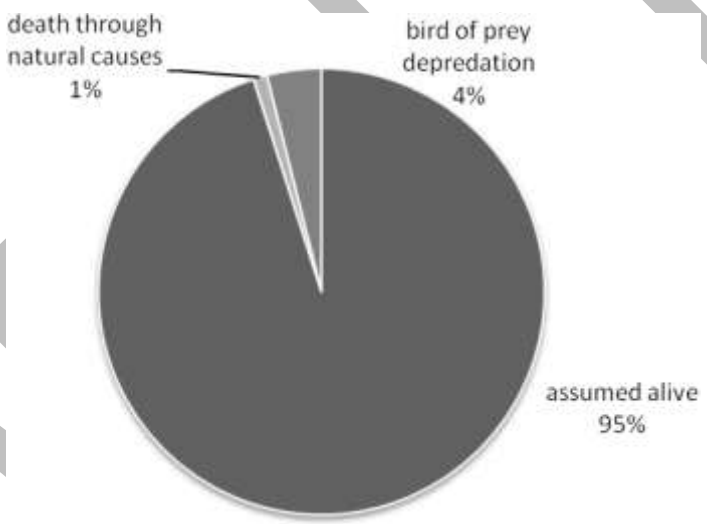


Figure 4: outcome of each successfully hatched chick

3.3.6 Productivity

102 pairs of Little Tern bred at Baltray in 2013. This is more than double the previous high point of 49 pairs in 2011 (Reilly, 2011). Estimating the number of fledged chicks is difficult for terns. An estimate based on highest fledgling count (92) puts productivity at 0.9 fledged chicks per nesting pair. However this is known to be an underestimate, as outlined above. Basing the estimate on number of chicks re-trapped at least once (96) gives a productivity at 0.94 fledged chicks per nesting pair. This is certain to be an underestimate as re-trapping chicks at Baltray is made difficult by the huge tidal range of the beach, meaning chicks were widely spread during the day. Also a chick being re-tapped in its first few days is no real indication that it will survive to fledge.

Therefore the productivity for this season is based on chicks assumed alive. As outlined above this is likely an overestimate but is thought to be the closest to the real figure. 102 pairs produced 193 fledglings, giving a productivity of 1.89 fledglings per pair.

3.3.7 Success of the Baltray Little Tern protection scheme

The success of the 2013 season is the culmination of the Little Tern protection scheme initiated in 2007 (Figure 5). 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 little or no breeding success. From the mid-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 have generally continued to rise since that point, with the exception of 2012 which was a very poor year for Little Terns on the east coast due to inclement weather (Reilly, 2012; Keogh *et al*., 2012).

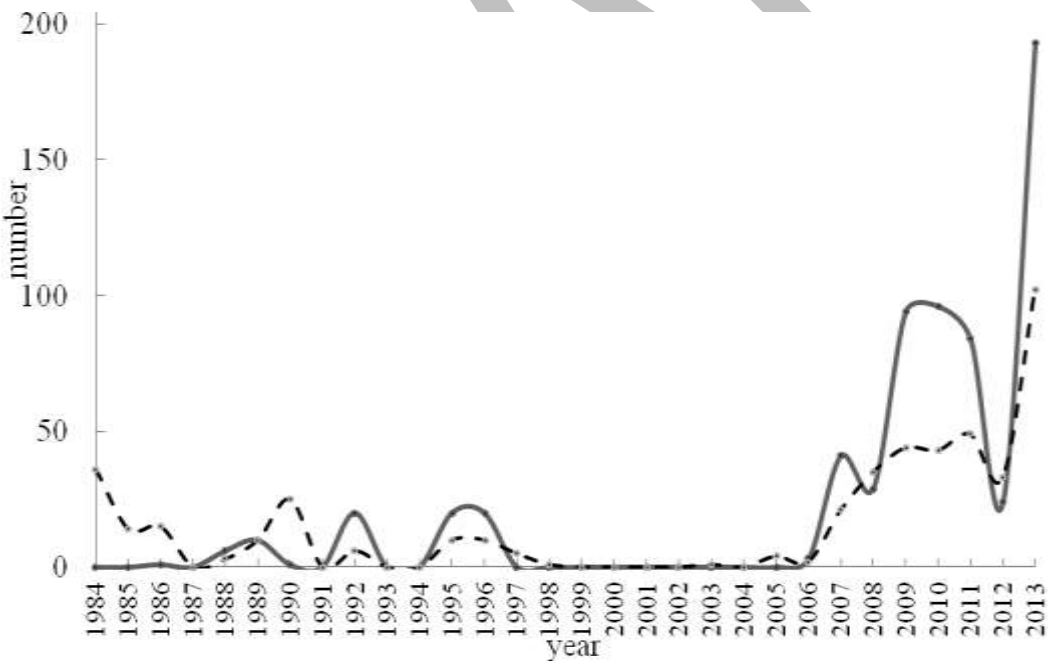


Figure 5: the number of breeding pairs of Little Terns (– – –) and the number of Little Tern chicks presumed to have fledged (——) recorded at the Haven, Baltray from 1984 to present. The figures from 1984-2006 were provided by Larry Lenehan (unpublished data). The figures from 2007-2012 were taken from McKeever and Reilly (2007) and Reilly (2008; 2009; 2010; 2011 and 2012)

3.4 Ringing and morphometric measurements

3.4.1 Ringing

Ringing commenced on June 25th, three days after the first chick hatched and the last Little Tern ringed was on July 28th (Appendix 2: Table 7). In total 169 chicks were ringed, out of which 166 chicks of known age were ringed, 100 on the day they hatched (Day 0), 37 on Day 1, 14 on Day 2, 10 on Day 3, 3 on Day 4, 1 on Day 5 and 1 on Day 6. Chicks ringed between Day 0 and 4 were ringed at or near the scrape and so could be aged and attributed to a nest. The chicks ringed on Day 5 and 6 were trapped with siblings who had been ringed at the scrape, and so they could be aged and attributed to a nest. Also, 3 chicks were ringed at a later age and the nest they came from was not known. In addition 19 Ringed Plovers from 8 broods were ringed. Ringed Plover ringing was curtailed to save rings during the middle of the breeding season.

A number of chicks were not ringed as, due to the large number of chicks which hatched at the same time, there were two occasions when the wardens ran out of rings. Also on several occasions when the decision was made not to ring a chick whose tarsus was considered too small to take a ring when initially trapped, the chick subsequently moved away from the nest before it could be re-trapped. Despite this 83.25% of chicks were successfully ringed in 2013.

3.4.2 Ring Recoveries

A number of ringed birds were breeding at Baltray this year. As no ringing had been carried out at Baltray up until this year it is thought that these were birds ringed at Kilcoole as chicks. The presence of birds ringed in Kilcoole was confirmed when a dead adult was found in the colony with a ring numbered NW38131. It had been ringed on July 5th 2010 in Kilcoole and was thus 3 years old (Keogh *et al*., 2010). In addition, the ring (NW38576) was recovered from an 18 day old chick ringed at Baltray in 2013 at nest B65. It appeared to have died of natural causes.

3.4.3 Chick Biometrics

A total of 96 (53.8%) of the 169 ringed chicks were re-trapped at least once. Three chicks were re-trapped five times, (NW38580 - B97, NW38611 – B4 and NW38618 – B16), which was the highest number of re-traps for an individual chick (Appendix 2: Table 7). At 3-4 days old chicks become increasingly mobile and so the number of re-traps of older chicks is small, however it still gives an indication of chick growth (Table 3 and Figures 6-8). A total of 309 measurements were taken of chick biometrics.

3.4.4 Summary Statistics

The numbers of Little Terns caught in their first few days is very high, though the sample size drops quickly after day 0-1 (Table 3). Though there is some variation around the means, the measurements were quite consistent for each age group, though this is difficult to tell in older chicks due to the small sample size.

Table 3: minimum, maximum and mean (a) wing length and (b) weight values for Little Tern chicks age Day 0 to Day 16. n = 306

	wing length (mm)			weight (g)		
age (days)	**Min.**	**-Mean-**	**Max.**	**Min.**	**-Mean-**	**Max.**
0 n = 103	9	-12.5-	15	5.4	-7.5-	10.3
1 n = 86	10	-13.7-	16.5	6.5	-9.4-	13.5
2 n = 38	12.5	-15.4-	18.5	7.5	-11-	13.5
3 n = 22	15	-18.9-	24	12.5	-15.3-	19.8
4 n = 19	20	-24.9-	33.5	15.3	-18.9-	22.4
5 n = 11	21.5	-28.6-	35	16.5	-21.4-	26.4
6 n = 9	30	-39-	47	23.3	-27.6-	32.1
7 n = 6	33	-40.3-	53	24.5	-28.7-	32.9
8 n = 4	45	-51.1-	63.5	31.6	-35.6-	42.5
9 n = 2	60	-60-	60	38.9	-38.95-	39
10 n = 1		-55-			-37-	
11 n = 1		-70.5-			-41.6-	
13 n = 2	87.5	-88.8-	90	43.8	-45.6-	47.4
14 n = 1		-94-			-49.2-	
16 n = 1		-106-			-50.8-	

3.4.5 Chick Wing Length

Wing length increases slowly during the first few days. After day four, the rate of wing growth increased as the chicks' pins started to come through (Figure 6). Chicks began to show true flight feathers from day 13. The rate of wing length increase did not appear to be slowing in the older chicks though the small sample size of older chicks makes this hard to judge. The average wing

length for adult Little Terns is 176-187mm for males and 167-180mm for females (Baker, 1993), so the wing length of the chicks would be expected to continue increasing until it reaches adult size. Wing length is strongly positively correlated with age showing that any change in age is tightly linked to a change in wing length (Correlation coefficient, n = 306, r = 0.94).

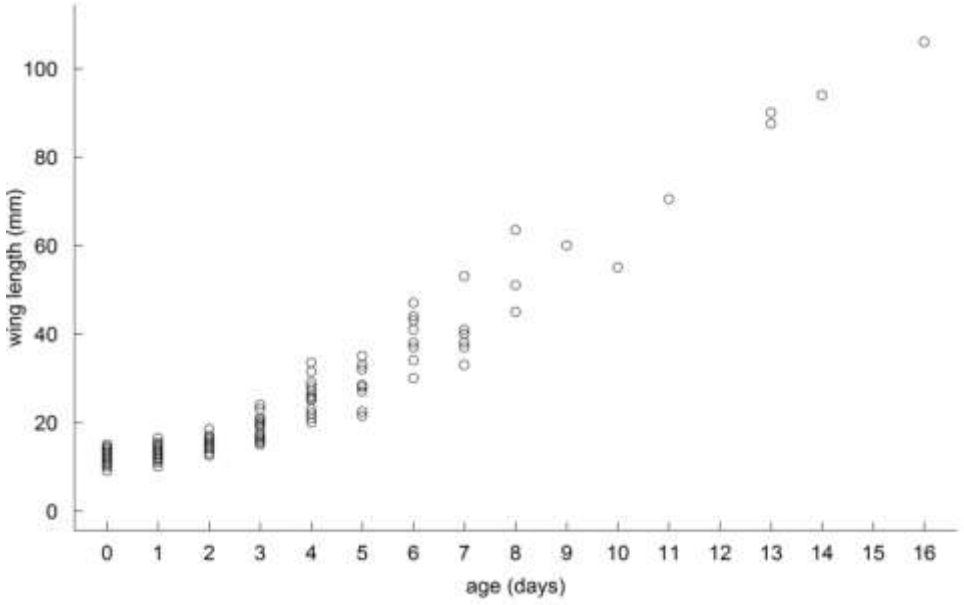


Figure 6: the rate of wing growth as Little Tern chick's age increases. n = 306

3.4.6 Chick Weight

Chicks rapidly increase in weight during their first days (Figure 7). They will easily double their weight or more in the first five days. At approximately day nine, the growth rate asymptotes and begins to slow as the chick approaches its adult weight. The average weight for an adult Little Tern is 50g (Gochfeld and Burger, 1996), and this was reached by chicks older than two weeks (Table 3). Weight is strongly positively correlated with age, showing that any change in age is tightly linked to a change in weight (Correlation coefficient, n = 306, r = 0.97). Therefore the asymptote in the relationship after day 9 does has little affect the strength of the linear relationship, though possibly due to a lack of data points for chicks older than day 9.

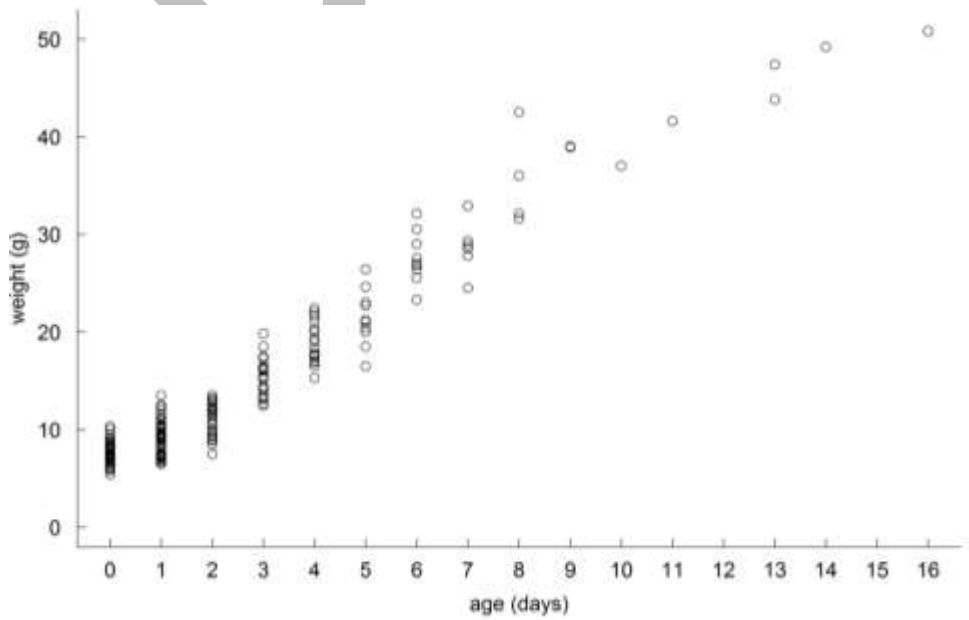


Figure 7: rate of increase in Little Tern chick weight as age increases. n = 306

3.4.7 Chick Wing Length vs. Weight

Wing length and body weight are closely linked measures of gross morphology, taken together they give a picture of the size of a bird. The wing length and weight of growing Little Tern chicks were positively correlated (Correlation coefficient, n = 308, r = 0.96). This shows that a change in one is closely linked to a change in the other (Figure 8). The tail of the graph begins to describe an upwards curve as older chicks (13-16 days old) begin to reach their adult weight, but continue to increase in wing length as they have not yet reached adult wing length.

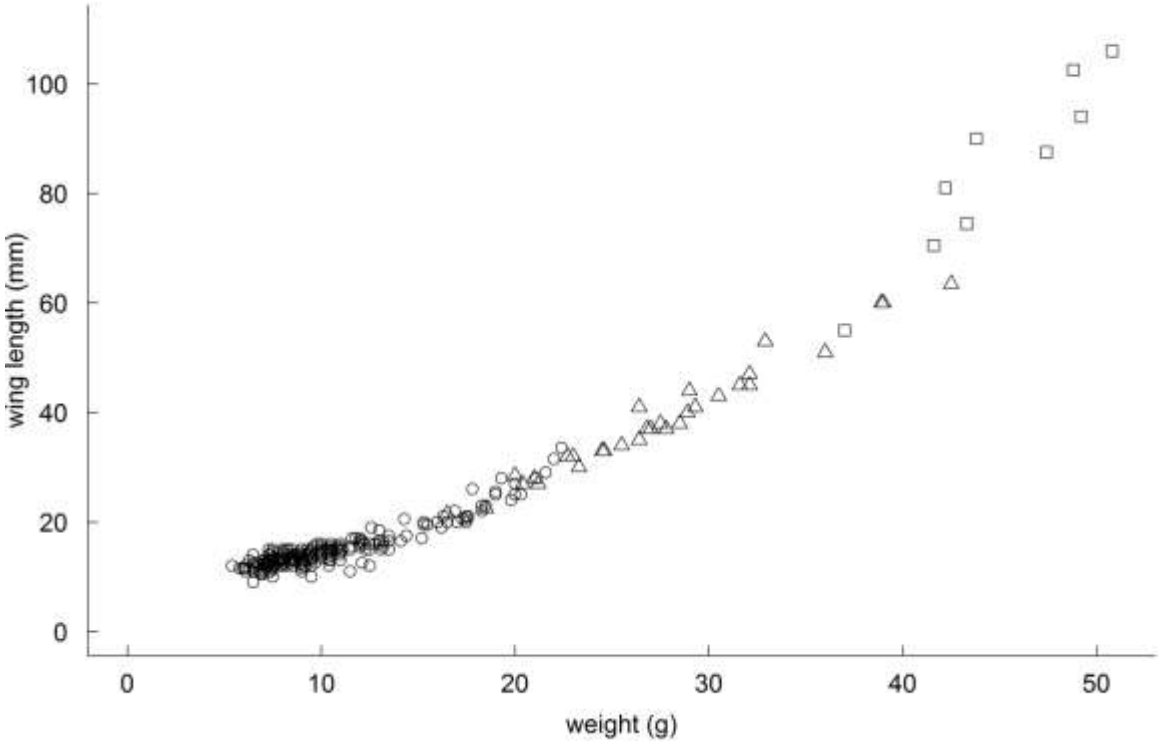


Figure 8: the correlation between Little Tern wing length (in millimetres) and body weight (in grams). Age group is indicated: ○ age 0 to 4 days; △ age 5 to 9 days and; □ age ≥10 days. n = 308

3.5 Dietary observations

81 parent-feeding-chick events were observed throughout the study. Details on chick age, fish type and length were recorded at each event using a telescope to observe a nest or chicks. Chicks were observed aged Day 0, Day 1, Day 2, Day 3, Day 5, Day 6, Day 7, Day 10, Day 11, Day 12, Day 15, Day ~15 to 20, Day ~20 to 28 and Day 28+. Food size was measured in "bill-lengths": one unit (BLS) is approximately the length of a full grown adult Little Tern's bill.

Feeding of Day 0 chicks was not observed: out of seven observations of a chick this age, food was only offered twice and, on both occasions, the food was not eaten. Day 1 - 3 chicks consumed sandeel, various fish fry species and European Sprat (*Sprattus sprattus*), which were an average of 1.2 BLS. Day 5 - 15 chicks consumed a similar diet, but the average size of the food offered increased to 1.4BLS. Chicks from Day 15 on incorporated more variety into the diet by also consuming shrimp.

The average size of food for these chicks was: 1.2BLS for Day 15 – 20 chicks; 1.6BLS for Day 20 – 28 chicks; and 1.5BLS for fully fledged chicks of Day 28+ (Table 4). Statistical analysis of food length indicated that there was no significant difference in the size of food pieces offered to chicks of different ages (general linear model, n = 81, p = 0.5)

Table 4: food substrate type and size offered to chicks of different ages (note that although the food was offered, it was not always consumed by the chick). Chick age is measured in days. Food size is measured in "bill-lengths" –one unit is the length of an adult Little Tern bill. n = 81

age of chick (days)	proportion of food substrates offered to chick by parent bird	minimum, maximum and average length of substrate offered to chicks of this age (bill lengths)
0 n = 7	no feeding during observation - (71%) fish spp. - (14%) Sprat - (14%)	0.8 (min) - 1 (max) average: 0.9
1 n = 9	sandeel - (11%) fish fry spp. - (44%) Sprat - (44%)	0.8 (min) - 2 (max) average: 1.2
2 n = 18	sandeel - (5%) fish fry ssp. - (33%) Sprat - (55%) Eel – (5%)*	1 (min) - 2 (max) average: 1.2 * eel 3 bill lengths removed
3 n = 7	sandeel - (28%) fish fry spp. - (71%)	1 (min) - 1.4 (max) average: 1.2
5 n = 5	sandeel - (20%) Sprat - (60%) Eel - (20%)	1 (min) - 1.9 (max) average: 1.3
6 to 7 n = 5	sandeel - (60%) Sprat - (40%)	1 (min) - 2 (max) average: 1.4
10 to 15 n = 8	sandeel - (50%) Sprat - (37%) Eel - (12%)	1 (min) - 1.5 (max) average: 1.3
15-20 n = 8	sandeel - (50%) Sprat - (37%) shrimp - (12%)	1 (min) - 1.8 (max) average: 1.2
20-28 n = 7	sandeel - (85%) Sprat - (12%)	0.9 (min) - 2.5 (max) average: 1.6
28+ (fledged) n = 12	sandeel - (16%) Sprat - (66%) fish fry spp. - (8%) shrimp - (8%)	1 (min) - 2.5 (max) average: 1.5

In the case of the nine feeding events observed for Day 1 chicks, the food was not accepted by the chick three times. At most, chicks of this age were fed four times per hour. In Day 2 chicks, five out of seventeen feeding events also resulted in the chick refusing the food. Occasionally, the parent bird consumed the food if the chick refused it. On one instance, a 3BLS European Eel (*Anguilla anguilla*) was offered to Day 2 chicks. None of the chicks were able to swallow it and the parent bird abandoned it near the nest. At most, Day 2 chicks were fed 8 times per hour. Over half of the food offered to Day 3 chicks was also refused, perhaps because some of these chicks were being fed very

regularly (up to 10 times per hour). Similarly, Day 5 – 15 chicks refused food three times out of eighteen feeding events and one case, the parent consumed the food. Chicks of this age were fed an average of four times per hour and were often brought food simultaneously by both parents. Only one case did a chick over the age of Day 15 refuse food. Begging for food continued in fully fledged chicks. Small scuffles over food broke out between fledglings of Day 28 on and parent birds carrying food were often chased by several fledges.

Small sample sizes make it difficult to draw any firm conclusions from the feeding observations; however some general trends are apparent, though with some inconsistencies. Differences can be seen in the proportion of a chick's diet made up by different fish and crustacean species as the chick ages (fig.9). While fish fry spp. are an important part of the diet of chicks between Days 1 and 3 they are rarely eaten by chicks any older than Day 3. The proportion of sand eels consumed generally increases as the chick ages. Sprat is generally important at all ages. Shrimp only feature for older chicks though are rarely eaten, as are Eels.

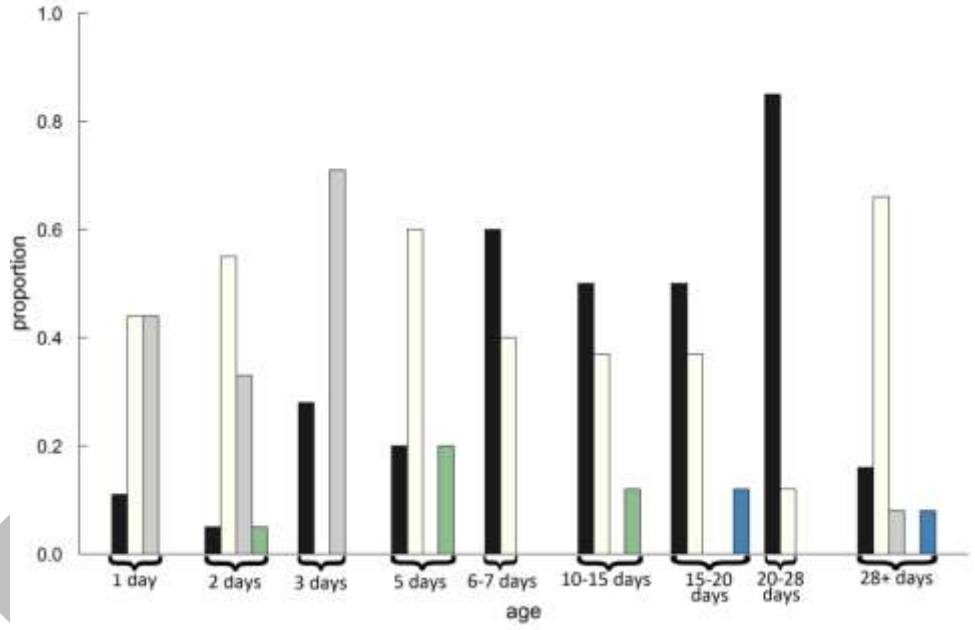


Figure 9: the proportion of: sandeel ; Sprat; fish fry spp.; Eel and; shrimp offered by parent Little Terns to chicks of varying age groups during the 2013 breeding season in Baltray.

3.6 Nest moves

A total of 29 nest moves were carried out on 20 nests as detailed below.

June Spring Tide [24th to 28th]

21/6/13 -B85, B90, B64, RP17

22/6/13 -B85, B64

24/6/13 -B85, B64, B66, B41, B87, B38, B86, B30, B47, B55, B81, B79, B63, B60, B57, B95

July Spring Tide [24th to 26th]

18/7/13 -B102

19/7/13 -B102, B106

20/7/13 -B102, B106

21/7/13 -B106

22/7/13 -B106

Of the 29 nest moves attempted 27 were successful with the parent returning to incubate in the newly positioned nest. Out of the 20 nests moved 15 hatched successfully, 3 were washed out subsequently, one was abandoned and one proved to be infertile.

RP17 (the only Ringed Plover nest moved) could not subsequently relocate its newly positioned nest. The nest was moved back to its original position and the parent bird located its eggs within 40 minutes of the move being made. It was located very far down the beach and was washed out later that night. B90 was outside the electric fencing and when its nest was moved it could not find the new location. It is extremely difficult to move a tern nest which is outside a fenced area to the inside as the fence is the main marker by which the parents orientate themselves. Nest B90 was moved back to its original position and the parents returned to the nest within 30 minutes of the mover being made. This nest was washed over (indicated by the tide line) yet miraculously B90 hatched two chicks. The nest must have been submerged for a short enough time that the parents were able to keep the eggs warm.

Nests B102 and B106 were washed out despite being repeatedly moved. They were the lowest two nests on the beach in the 2013 breeding season. Nest B86 returned to incubate after its nest was moved but subsequently abandoned its nest 3-5 days after the move. It is possible that the disturbance from the mover could have been a factor in it abandoning its nest. The eggs of nest B79 proved to be infertile, even though the parents continued to incubate until August. It is not thought that the move contributed to this as these eggs were malformed, oddly coloured and noticeably light in weight, as if they were largely empty.

3.7 Predators and disturbance

Terrestrial: No depredation from terrestrial predators was observed this season. This is likely to be due to the presence of night wardens. A Red Fox was present in the surrounding area and was seen in the vicinity of the colony on multiple occasions in May and June, so the decision was made to remove the animal. It was removed on June 23rd. However, within four days another fox was sighted. The speed at which another fox appeared suggested that this may have been the mate of the fox that had been removed. However the second fox was only seen once and did not endanger the colony. An Otter (*Lutra lutra)* was present throughout the season, but it was seen only in the river. A Stoat (*Mustela erminea hibernica*) was also sighted on one occasion, chasing an Irish Mountain Hare (*Lepus timidus hibernicus*) through the dunes on June 22nd.

Avian: Several potential avian predators posing a danger to fledged Little Terns and adults were observed in the area. A pair of Kestrels believed to be raising a brood regularly hunted within the colony between July 15th and 28th. Eight Little Tern chicks were depredated by Kestrel in that time. In an attempt to deter the Kestrels wardens would shout, bang metal objects together and use a siren on a megaphone provided by Louth Nature Trust. However the Kestrels soon grew accustomed to this noise deterrence and these attempts only met with limited success. Walking out underneath where they hunted seemed to perturb them but they would usually just fly to the opposite end of the colony to the warden and resume hunting. Also the Kestrels would often fly in very low, thus avoiding detection until the terns were disturbed. However the intensity of the attacks lessened from July 23rd and the Kestrels were not seen after July 28th.

Several other birds of prey were observed hunting Little Terns. A Merlin (*Falco columbarius*) was recorded hunting in colony on May 16th, a Sparrowhawk (*Accipiter nisus*) was observed hunting in colony on June 23rd and a Peregrine Falcon (*Falco peregrinus*) was recorded hunting in colony on May 22nd and 26th. There is no evidence of depredation by these three species. A Short-eared Owl (*Asio flammeus*) was sighted on the night of the July 20th but it did not take any interest in the Little Tern colony.

Hooded Crows were present in large numbers early in the season, with 68 seen on June 3rd, and often landed on the beachfront or close to the colony. Therefore the decision was taken to remove some of the local population and 14 Hooded Crows were removed in May and early June. This also seemed to deter most other crows from settling in the colony area and their numbers were low (<10) from mid-June onwards. One breeding pair remained throughout the season. They were exceptionally wary of humans and hid amongst the rocks by the sea wall. They were known to land on the foreshore and then walk up the beach into the colony. It is thought they were responsible for depredating four eggs from two nests (B20 and B53). They were not observed depredating the nests but the depredation matched that of corvid behaviour, as the whole eggs were carried away leaving no fragments, and the nests were in the vicinity of the sea wall were the crows were often seen.

Rooks (*Corvus frugilegus*) were present throughout and on several occasions groups of up to seven flew into the North enclosure and were mobbed out by Little Terns. However they did not succeed in depredating any nests. A Magpie (*Pica pica*) pair was seen on June 10th and 19th and July 14th; a Raven (*Corvus corax*) was occasionally observed throughout the season and three Jackdaws (*Corvus monedula*) were present on May 24th and 25th, however none of these corvid species caused any problems.

Several seabirds which presented potential threats to Little Tern chicks and eggs were present throughout the season; the Lesser Black-backed Gull (*Larus fuscus*), Great Black-backed Gull (*Larus marinus*), Herring Gull (*Larus argentatus*), Black-headed Gull (*Chroicocephalus ridibundus*), and Grey Heron (*Ardea cinerea*). A Great Skua (*Stercorarius skua*) was seen on July 19th, when it aggressively flew at a roost of Little Terns, causing 100+ Little Terns to take flight, but continued on out to sea. Gulls were thought to have been responsible for heavy predation of Little Tern eggs in 2008 (Reilly, 2008) and any gull species flying over the colony was relentlessly mobbed by the Little Terns. However no predation by any seabirds was observed.

Flocks of up to 100 Starlings (*Sturnus vulgaris*) 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.

Human The particularly good weather this summer is likely to have caused a greater number of visitors to the beach than in previous years. These visitors also stayed for longer and engaged in more activities. Because the beachfront of the Haven is very exposed during low tide, there was a daily presence of people in the vicinity of the Terns. Many recreational walkers had to be guided away from the colony by the wardens, most of whom had missed the information signs about the project and were unaware of the situation. Many dogs were also let off the lead on the beachfront by their owners, despite the signs. Dogs frequently chased the birds, including the Little Terns and the wardens regularly had to request they be put back on the lead. However, it appears that none of these activities led to the damage of Little Tern eggs or chicks due to quick reactions by the wardens.

On June 20th a large dog managed to jump into the colony and then became trapped as it was shocked by the electric fence each time it attempted to leave. It was eventually chased out of the colony by the wardens and no nests were damaged. Its owner was apologetic when approached and put the dog on its lead. On July 27th, a child climbed through the fence and into the colony but was quickly guided back out by the warden and caused no damage. Two riders on horseback attempted to ride down the beachfront, but turned back after one of the horses was spooked by mobbing birds. They were subsequently informed about the project and did not ride near the protected area again. Two children on quad bikes also attempted to drive down the beachfront on July 14th but were prevented from doing so by the warden.

Jet skis regularly went through the river and estuary. These may cause disturbance to Little Terns feeding. Although the NPWS informed the Drogheda Port Company of this problem, they were reluctant to engage with the problem and the jet skis continued their activity. The Coastguard helicopter flew over on July 2nd and 7th. Although the brooding Little Terns did rise off their nests in alarm, the presence of the helicopter was so brief that disturbance was minimal.

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. 102 breeding pairs produced 193 chicks which are presumed to have fledged in the 2013 breeding season at Baltray. This is more than double the number of breeding pairs and chicks presumed to have fledged during the projects previous best year, 2010, when 43 pairs fledged 96 chicks (Reilly, 2010). Productivity this year was high at 1.89 fledglings per pair (upper estimate, see results). This was not as high as in 2010 (2.23 fledglings per pair), 2009 (2.18) and 2007 (1.95), but it was significantly higher than 2012 (0.73), 2011(1.73) and 2008 (0.82) (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.

This year the first Little Tern eggs were found on 30th May, a week later than the average for previous years, May 24th (McKeever and Reilly 2007; Reilly, 2008; 2009; 2010; 2011; 2012). The last nest, which was believed to be one of four re-lays of early failed nests, was found on July 18th. It was subsequently washed out. Hatching began on the 22nd of June and continued until July 28th. The commencement of hatching was eight days later than the average of previous years, June 14th. The late start to nesting and hatching reflected the effect of the prolonged cold wet and windy conditions particularly in early May. However, the exceptionally hot July made up for this late start. The modal incubation length was 20.96 days, well within the 18-22 day range cited by Cramp (1985), indicating favourable conditions.

The largest loss of eggs in 2013 related 9 eggs from 7 nests where the egg was infertile or the chick did not survive to hatching. A percentage of eggs will always be infertile and this is quite a small number considering the large number of eggs laid this season, with only 4% of eggs laid proving to be infertile. This number could also reflect that there may be a large number of birds from the highly productive 2009 and 2010 seasons breeding for the first time. Inexperienced breeders often fail to hatch all of their eggs (Keogh *et al*. 2010). Another egg was found randomly laid on the beach and was never incubated. This 'egg dump' may have been laid by an inexperienced female which had not yet chosen a suitable scrape.

Four eggs in 3 nests were abandoned. Nest B89 (1 egg) was abandoned for an unknown reason. The remaining egg in nest B53 was abandoned after one egg was depredated from the nest (presumably by a corvid). It is regularly reported elsewhere that pairs abandon a partially depredated nest. B86 was abandoned with 2 eggs. This may be because this nest was moved to safeguard it from the reach of the June spring high tides. This disturbance may have caused it to abandon the nest. However, it is also possible that it may be because B86 was laid outside the electric fence in the buffer zone between the electric fence and the string fence (see colony map). It was the nest laid furthest north in this buffer zone and so would have been most exposed to disturbance from people, as any walkers along the string fence would scare the incubating bird off this nest before wardens could reach them. Also a fox was seen in the buffer zone area on June 20th. It failed to locate any nests before being scared away but this disturbance may have caused the pair to abandon the nest.

A further 8 eggs were lost to spring tides, 4 from 2 nests in June and the same in July. This was a very low number of eggs lost to tides in comparison to previous years, and is second only to 2010 when no eggs were lost to spring tides (McKeever and Reilly 2007; Reilly, 2008; 2009; 2010; 2011; 2012). This success is due to two factors, favourable tides and multiple successful nest moves. The tides this year were extremely favourable. During the June spring tides a combination of high

pressure and a westerly wind prevented the tide flooding all but two nests. While the July spring tide was much higher than the previous month's, a large proportion of the nests had already hatched by this point. Overall the nest moves were extremely successful as 14 nests which would have otherwise been washed out successfully hatched. The only nests to be washed out this season were those on the foreshore side of the electric fence. Attempts were made to move B102 and B106 but they were washed anyway. B92 and B93 were considered to be in such a poor position that no attempt was made to move them.

The strong action of the spring tides on June 24th to 28th and July 23th to 27th made dramatic changes to the beach during the season. The existing sandbar to the north of the colony was strengthened with further deposits of sand and shingle. This was an important roosting spot for waders but suffered from high disturbance due to being north of the fenced area. A new sandbar was created in front of the southern enclosure by the first spring tide. This provided protection from later tides as well as being an important high tide roost for Little Terns, and later in the season for loafing flocks of the other four species of tern that breed in Ireland, the Common Tern (*Sterna hirundo*), Roseate Tern (*Sterna dougallii*), Arctic Tern (*Sterna paradisaea*) and Sandwich Tern (*Thalasseus sandvichenis*).

Egg depredation this year was very low. A combination of the protective electric fence and 24 hour wardening meant that there were no known losses of Little Tern eggs to mammalian predators. Four Little Tern eggs from two nests were taken by a corvid, presumably the Hooded Crow pair which were active in the same area. Current management practices should keep this from becoming a major problem. The largest source of loss this season was by a pair of Kestrels which took 8 fledged chicks between July 15th and 28th. This is the first time a Kestrel has been recorded taking Little Terns at Baltray. The wardens employed noise deterrence to deter the Kestrels, but this only had a short term effect. Supplementary feeding was considered but when it was attempted at Great Yarmouth in Britain supplementary feeding of Kestrels had no demonstrable effect on predation levels, and may have even artificially inflated the local population (Smart and Ratcliffe, 2000). However the problem seemed to resolve itself as the Little Terns quickly adopted a much more aggressive response towards the Kestrels. Also, as July progressed the number of Common Terns loafing with the Little Terns increased significantly and these larger birds seemed to be an effective deterrence to the Kestrels, mobbing them aggressively when they approached the tern flock. Therefore, we simply recommend the continued use of noise deterrence to counter Kestrel depredation in future. Only two Little Tern chicks were found dead from natural causes and this reflects the generally good weather this season.

A total of 169 (83.25%) Little Tern chicks were ringed this year, the majority in or close to the nest scrape within 3 days of hatching. These were the first chicks to ever be ringed at Baltray and were ringed on the left leg to distinguish them from those ringed at Kilcoole which were ringed on the right leg. Re-trapping was carried out as often as possible in order to collect data on growth rates. 96 chicks (56.8%) were re-trapped at least once. This data was used to construct growth curves. Across years, these could be used as an indicator of feeding rates, and hence the availability of prey to Little Terns at Baltray. As the data set grows in future years, it will also permit a greater insight into the growth of older chicks near fledging. As chicks become highly mobile after Day 3 very few older chicks were caught this year, which only allowed a snapshot of this age group. It appears that Little Tern chicks are approaching their final adult weight at about 2 weeks of age, but their wing length continues to increase, though further data will be needed to get a clearer picture of this.

The feeding ecology of the Little Tern chicks at Baltray was also studied for the first time. This gave an insight into the diet of the chicks and how it changes, with a general switch from fish fry to sandeel after about Day 3. It also showed the importance of Sprat throughout the early life of the chicks. However, further data collection will have to be carried out in future years before any more firm conclusions can be drawn. It does show however that a variety of fish species are important in the feeding ecology of Little Terns.

The initiation of the Little Tern protection scheme at Baltray has seen a dramatic regeneration of the colony at Baltray. 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 (Larry Lenehan, unpublished data). In the seven breeding seasons since this project began 562 chicks are presumed to have fledged (McKeever and Reilly 2007; Reilly, 2008; 2009; 2010; 2011; 2012). There has been an increase in breeding pairs of Little Terns every year since the project was initiated (Figure 5). The only exception to this was the 2012 season when 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 exceptionally 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. There also has been a general increase in number of fledged young produced per year, though this has been more variable, reflecting the vulnerability of this species to being washed out by tides (2012) and heavy predation by corvids (2007), gulls (2008) and foxes (2011 and 2012) (McKeever and Reilly 2007; Reilly, 2008; 2011; 2012). Foxes are a particularly serious risk as they can wipe out an entire colony in one night, emphasising 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 (Appendix 2: Table 6). No Little Tern or Ringed Plover eggs were lost to mammalian depredation after the fence was completed and 24 hour wardening initiated.

The growth in the number of breeding pairs of Little Terns at Baltray in 2013 was astounding, more than doubling the previous high of 49 in 2011 (Reilly, 2011). A large factor in this may be the highly successful breeding seasons in 2009 and 2010. The average age of first breeding for a Little Tern is 3 years, though occasionally they breed at 2 years (Gochfeld and Burger, 1996). Therefore many of the chicks from 2009 and 2010 were likely to commence breeding in 2013, which may explain the huge increase in breeding pairs in 2013. Another factor may be movement of birds from Kilcoole to Baltray. Since the Baltray protection scheme began in 2007 the average number of breeding pairs has dropped at Kilcoole from the numbers present between 2003 and 2006 (Maljkovíc *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). Though this may just be a natural fluctuation it seems probable that some of the birds hatched in Kilcoole are recruiting to Baltray to breed. The discovery this year at Baltray of a dead adult Little Tern ringed at Kilcoole in 2010 proves that this movement is occurring. The shingle area at Baltray is much larger and could be expected to attract more birds in the future if Kilcoole is at its carrying capacity. This may have been the case this year as, while the nesting area at Kilcoole was still in poor condition due severe erosion caused by storms in 2012 (Keogh, 2012), the suitable nesting at Baltray was the largest it has been since the project was initiated (McKeever and Reilly 2007; Reilly, 2008; 2009; 2010; 2011; 2012). This may have attracted further Kilcoole birds to Baltray

(evidenced by the multiple sightings of ringed birds), and partially explain the surge in number of breeding pairs at Baltray. It is likely that the east coast population of Little Terns acts as a single metapopulation, 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), indicating that dispersal may extend even further afield. A colour ringing scheme at Irish breeding colonies would be extremely useful as it would allow these movements to be monitored in the coming years.

Overall, 2013 was a very good year for all breeding colonies of Little Terns along the east coast of Ireland. Confirmed breeding took place at four sites; Baltray (102 pairs), Portrane/Rogerstown (1-3 pairs), Kilcoole/Newcastle (45 pairs) and Wexford Harbour (120+ pairs). Therefore, approximately 270 pairs of Little Terns bred on the Irish east coast in 2012. This compares favourably to 2012 when 244-245 pairs were believed to have attempted breeding at a total of four sites along the east coast. In comparison, surveys conducted in previous years estimated the national population of Little Terns as a whole to be 257 pairs 1984 and 174 pairs in 1995 (Whilde, 1993; corrected in Hannon *et al.*, 1997). The number of breeding pairs of Little Terns on the west coast in 2013 is unknown, but it's thought that there may have been 150 in 2012 (Keogh *et al*., 2012; Suddaby, 2012). However, it would seem that the national population is, at least for the time being, on the increase overall with an estimated 270 pairs on the east coast and maybe 150 pairs on the west coast. On the east coast at least, this is largely down to increased effectiveness of the wardening schemes at Baltray and Kilcoole/Newcastle as well as the relocation of the Wexford Harbour colony to a less accessible breeding location.

5. Recommendations

5.1 Colour Ringing

The initiation of a colour ringing scheme at Baltray and Kilcoole would be of great benefit, aiding our understanding of the movements of breeding Little Terns between these two colonies and elsewhere.

5.2 Trapping Adults

The colony at Baltray is now large and stable enough 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.

5.3 Observation Platform

Much of the nesting area this year was not visible from the inland side of the protective fence. This made watching for new nests and carrying out incubation checks more difficult. Often nests in non-visible areas could only be found by entering the colony and searching for nests, which was not ideal. Also it was usually not possible to ascertain the exact date any nest found this way was laid if it was found with more than one egg, which meant that these nests had to be visited much more regularly to check for evidence of hatching. The provision of a number of high chairs or raised observation hides would be of great benefit as this would reduce the number of visits made to the colony and cut down on disturbance. To cover all non-visible areas 3-4 such observation platforms would be necessary.

5.4 Fencing

The Little Terns were found to use the whole of the suitable nesting area this season, including some areas outside the electric fence, so efforts should be made to fence as much of the suitable nesting area as possible in future years.

5.5 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 string fence, endangering chicks.

5.6 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.little ternconservation.blogsot.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 (http://www.louthnaturetrust.org/littleterns_2013). 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.

5.7 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.

5.8 Blackboard

A blackboard or whiteboard could be placed in the site portacabin during the project and used to give up to date figures for numbers of nests and chicks, and inform people of the other species which can be seen at the site.

5.9 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.

5.10 Emergency Phone Numbers

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

5.11 First Aid Kit and Fire Extinguisher

A first aid kit is needed for the project in case of emergencies. A fire extinguisher is needed for the project caravan.

5.12 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.

5.13 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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Appendices

Appendix 1: Site Biodiversity

Species observed at the Baltray site from May 13th to August 9th 2013. Species were recorded from the within and the immediate area of beach around the colony (BCH), offshore (OFF), on the river (RIV), in the adjacent sand dunes (DUN) and on the track (TRK) leading to the site.

AVES (125 species)

CHARADRIIFORMES: SHOREBIRDS AND RELATIVES

Little Tern (*Sternula albifrons*) – present throughout and breeding, BCH
Common Tern (*Sterna hirundo*) – ~30 present throughout, 200+ present June to August in loafing flocks with juveniles, BCH
Roseate Tern (*Sterna dougallii*) – 1-2 seen occasionally throughout, 10+ present late-June to August, present with juveniles in loafing flocks in late July and August BCH
Sandwich Tern (*Thalass sandvichenis*) – 40+ present June to August in loafing flocks with juveniles, BCH
Arctic Tern (*Sterna paradisaea*) – 20+ present June-August in loafing flocks with juveniles, BCH
Black Tern (*Chlidonias niger*) – 1 seen flying over colony on 20th July
Ringed Plover (*Charadrius hiaticula*) – breeding throughout, 700+ migrants in late July, BCH
Oystercatcher (*Haematopus ostralegus*) – present throughout, 300+ in late July and August, BCH, RIV
Black-tailed Godwit (*Limosa limosa*) – 2 to 3 present June to August. 32 seen on July 5th BCH
Bar-tailed Godwit (*Limosa lapponica*) – 2 to 3 present June to August, BCH
Turnstone (*Arenaria interpres*) – 7-30 present June to August, BCH, RIV
Sanderling (*Calidris alba*) – present throughout, 700+ migrants in late July and August, BCH
Dunlin (*Calidris alpina*) – present throughout, 3000+ migrants in late July and August, BCH
Redshank (*Tringa totanus*) - 2 present through August, BCH
Knot (*Calidris canutus*) – 41 present 13th May, 1 present 7th June, BCH
Curlew (*Numenius arquata*) – 1 to 3 present throughout, BCH
Whimbrel (*Numenius phaeopus*) – 1 occasionally present throughout, 7 seen on July 4th, BCH
Ruff (*Philomachus pugnax*) – 8 present on 8th July, BCH
Lesser Black-backed Gull (*Larus fuscus*) – up to 20 regularly present throughout, BCH
Great Black-backed Gull (*Larus marinus*) –20- 50 present throughout, BCH
Herring Gull (*Larus argentatus*) – 100-300 present throughout with juveniles, BCH
Black-headed Gull (*Chroicocephalus ridibundus*) – up to10 present throughout, BCH
Common Gull – (*Larus canus*) – seen on 7th and 8th August, RIV
Guillemot (*Uria aalge*) – 2 present on 5th August, BCH
Kittiwake (*Rissa tridactyla*) – seen 14th July, OFF
Great Skua (*Stercorarius skua*) – 1 flew over colony 19th July

PELECANIFORMES: CORMORANTS AND RELATIVES

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

ANSERIFORMES: WATERFOWL

Mute Swan (*Cygnus olor*) – 2 fly over colony on 28th June
Brent Goose (*Branta bernicla*) – 34 present from 13th to 21st May
Shelduck (*Tadorna tadorna*) – 6 present on 21st May, 2 present on 5th June
Mallard (*Anas platyrhynchos*) – 2 present 20th May

CICONIIFORMES: HERONS AND RELATIVES

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

PASSERIFORMES: PERCHING BIRDS

European Starling (*Sturnus vulgaris*) – juvenile flocks of 20 to 100 present throughout, DUN, BCH
Meadow Pipit (*Anthus pratensis*) – present throughout, DUN, BCH
Skylark (*Alauda arvensis*) – present throughout and breeding DUN, BCH
Blackbird (*Turdus merula*) – seen 11th June, 10th July, TRK
Song Thrush (*Turdus philomelos*) – present in June, DUN
Yellowhammer (*Emberiza citrinella*) – 1 seen 15th June, DUN
Reed Bunting (*Emberiza schoeniclus*) – occasionally seen throughout, TRK
Grasshopper Warbler (*Locustella naevia*) – 1 seen on 14th May, DUN
Garden Warbler (*Sylvia borin*) – 1 seen 14th May, DUN
Sedge Warbler (*Acrocephalus schoenobaenus*) - present in June, DUN, BCH
Willow Warbler (*Phylloscopus trochilus*) – 1 seen 8th August, TRK
Stonechat (*Saxicola torquata*) – occasionally seen May to July, BCH, DUN
Pied Wagtail (*Motacilla alba yarrellii*) – present throughout, BCH
Linnet (*Carduelis cannabina*) – present throughout, juvenilles in flocks of up to 15 in August, DUN
Wheatear (*Oenanthe oenanthe*) – occasionally seen in May, late-July and August, TRK
Barn Swallow (*Hirundo rustica*) – 1-6 present throughout, DUN
Sand Martin (*Riparia riparia*) – occasionally seen throughout, DUN
House Martin (*Delichon urbicum*) – 1 seen on 31st May, DUN
Magpie (*Pica pica*) – pair seen 10th and 19th June and 14th July, DUN
Hooded Crow (*Corvus cornix*) –present throughout. Up to 20 present early in the season, though numbers declined due to predator control. Only a single resident pair from mid-June onwards, with occasionally up to 10 individuals present. 68 seen on June 3rd, BCH, RIV
Rook (*Corvus frugilegus*) –1-10 seen daily, occasionally up to 20 seen. 40+ seen on May 28th, RIV, DUN
Raven (*Corvus corax*) – 1 seen on June 17th, July 16th and August 4th and 7th, DUN, TRK
Jackdaw (*Corvus monedula*) – 3 present 24th and 25th May, DUN

APODIFORMES: SWIFTS AND RELATIVES

Swift (*Apus apus*) – 2 present on 14th May

COLUMBIFROMES: DOVES AND PIGEONS

Woodpigeon (*Columba palumbus*) – occasionally seen throughout, DUN, TRK
Collared Dove (*Streptopelia decaocto*) – seen on 26th July, TRK

CUCULIFORMES: CUCKOOS AND RELATIVES

Cuckoo (*Cuculus canorus*) – audible 26th June, 14th and 15th July

STRIGIFORMES: OWLS

Short-eared Owl (*Asio flammeus*) – 1 seen on top of lockbox on 20th July, DUN

FALCONIFORMES: BIRDS OF PREY

Sparrowhawk (*Accipiter nisus*) – 1 hunting in colony 23rd June, BCH, DUN
Kestrel (*Falco tinnunculus*) – pair occasionally hunting throughout, BCH, DUN
Merlin (*Falco columbarius*) – 1 hunting in colony 16th May and 15th June, BCH, DUN
Peregrine Falcon (*Falco peregrinus*) – hunting in colony 22nd and 26th May, BCH, DUN

ACTINOPTERYGII (5 species)

Sprat (*Sprattus sprattus*)
European Eel (*Anguilla anguilla*)
Sea Bass (*Dicentrarchus labrax*)
Sea Trout (*Salmo trutta*)

REPTILIA (1 species)

Viviparous Lizard (*Lacerta vivipara*) – seen in Marram Grass on 19th June

MAMMALIA (6 species)

Irish Mountain Hare (*Lepus timidus hibernicus*) – present throughout, BCH, DUN
Otter (*Lutra lutra*) – observed on river from 7th to 11th of June and on 6th August
Red Fox (*Vulpes vulpes*) – observed on beach May 26th and 31st; June 14, 20, 22, 23 and 27th
Stoat (*Mustela erminea hibernica*) – observed in sand dunes on 22nd June
Rabbit (*Oryctolagus cuniculus*) – observed on beach on June 9th, 25th and 26th
Grey Seal (*Halichoerus grypus*) – observed in river on 13th June

INSECTA (21 species)

LEPIDOPTERA: BUTTERFLIES AND MOTHS

Common Blue (*Polyommatus icarus*) – observed 5th June to 8th August
Orange-tip (*Anthocharis cardamines*) – observed 19th June to 21st June
Small White (*Pieris rapae*) – observed 19th June to 21st June
Large White (*Pieris brassicae*) – observed 3rd June to 9th August
Green-veined White (*Pieris napi*) – observed 7th June to 9th June
Ringlet (*Aphantopus hyperantus*) – observed 6th July to 8th July
Meadow Brown (*Maniola jurtina*) – observed 8th July to 30th July
Small Tortoiseshell (*Nymphalis urticae*) – seen on 13th July
Small heath (*Coenonympha pamphilus*) – seen on 7th June
Five-spot Burnet (*Zygaena trifolii*) – observed 5th June to 9th August
The Cinnebar (*Tyria jacobaeae*) – observed 20th June to 9th August
Common Footman (*Eilema lurideola*) – seen on 13th July

ODONATA: DRAGONFLIES AND DAMSELFLIES

Large Red Damselfly (*Pyrrhosoma nymphula*)

HYMENOPTERA: BEES, ANTS AND WASPS all Hymenoptera specieswere seen throughout July and August

Red-tailed Bumble Bee (*Bombus lapidarius*)
Buff-tailed Bumble Bee (*Bombus terrestris*)
White-tailed Bumble Bee (*Bombus leucorum*)
Common Carder Bee (*Bombus pascuorum*)
Black Garden Ant (*Lasius niger*)
Red Ant (*Myrmica rubra*)
-

DERMAPTERA: EARWIGS

Common Earwig (*Forficula auricularia*)-present throughout, most common in July and August

COLEOPTERA: BEETLES

7-spot Ladybird (*Coccinella 7-punctata*)
14-spot Ladybird (*Propylea 14-punctata*)
Ground Beetle (*Pterostichus madidus*)

OTHER INVERTEBRATA (14 species)

Edible Crab (*Cancer pagurus*)
Shore Crab (*Carcinus maenas*)
Broad-clawed Porcelain Crab (*Porcellana platycheles*)
Chrysaora isosceles
Common Jellyfish (*Aurelia aurita*)
Common Brittle-star (*Ophiothrix fragilis*)
Common Starfish (*Asterias rubens*)
Sea Potato (*Echinocardium cordatum*)
Common Mussel (*Mytilus edulis*)
Common Oyster (*Ostrea edulis*)
Pod Razorshell (*Ensis siliqua*)
Common Cockle (*Cardium edule*)
Common Whelk (*Buccinium undatum*)
White Garden Snail (*Theba pisana*)

PLANTAE (21 species)

Sea-holly (*Eryngium maritimum*) – found on beach and dunes, flowered in July
Rosebay Willowherb (*Epilobium angustifolium*)–found in dunes, flowered July, August
Sea Sandwort (*Honkenya peploides*) – found on beach, flowered throughout
Pyrimidal Orchid (*Anacamptis pyramidalis*) – found in dunes, flowered June, July
Biting Stonecrop (*Sedum acre*) – found in dunes
Wild Radish (*Raphanus raphanistrum maritimus*) – found in dunes
Ox-eye Daisy (*Leucanthemum vulgare*) – found on beach, flowered in August
Viper's-bugloss (*Echium vulgare*) – found in dunes, flowered in July
Sea Campion (*Silene maritime*) – found on beach
Birdsfoot Treefoil (*Lotus corniculatus*) – found in dunes, flowered throughout
Hare's-foot Clover (*Trifolium arvense*) – found on track, flowered June to August
Sea Rocket (*Cakile maritima*) - found on beach
Sea Spurge (*Euphorbia paralias*) – found in dunes
Ragwort (*Senecio jacobaea*) – found in dunes, flowered throughout
Marram Grass (*Ammophila arenaria*)
Sand Cat's-tail (*Phleum arenarium*)
Sea Lyme Grass (*Elymus arenarius)*
Couch (*Elytrigia repens*)
Thongweed (*Himanthalia elongata*)
Eelgrass (*Zostera marina*)
Serrated Wrack (*Fucus serratus*)

FUNGI (1 species)

Field Mushroom (*Agaricus campestris*)

Appendix 2: data collection

Notes for Table 5

107 egg lays are listed with a B*n* designation. However B98 was considered to be an egg dump rather than a true nest as it had no scrape and was never incubated. Therefore there were 106 active nests this season.

The total number of chicks presumed fledged in the column "Presumed Fledged" is 201. This is because it was not possible to tell which nests the fledged chicks depredated by Kestrel belonged to. Factoring in these eight fledged chicks taken by the Kestrel gives the true number of chicks presumed fledged: 193.

The total number of chicks ringed specified in the column "Ringed" is 166 chicks. However, this does not take into account the three chicks ringed which could not be attributed to any nest (NW38718, NW38724, and NW3873). Factoring in these three chicks gives the true number of chicks ringed: 169.

Notes for Table 6:

A total of 76 Ringed Plover chicks hatched from 95 eggs in 24 nests. The first three nests containing 12 eggs are suspected to have been depredated by a fox early in the season before the fence was put in place. One nest containing three eggs was washed by the June spring tide. An additional three eggs failed to hatch, two due to infertility and one in which the chick began to hatch but died before it fully cracked open the egg. In addition to the two Ringed Plover chicks listed as found dead in Table 6, an additional five Ringed Plover chicks were found dead throughout the season whose nest was not known. Of the seven Ringed Plover chicks found dead, six were less than two days old and one was fully fledged. In total five Ringed Plover chicks died from natural causes, one was found trapped in the green mesh fence and one was found apparently trampled two days after the fencing was removed and wardening ceased on August 11th.

Therefore 69 Ringed Plover chicks are assumed to have fledged this season. Ringed Plovers have greatly benefited from the reduction in disturbance and predator control carried out as part of this project.

Notes for Table 7

Although ring numbers are listed in numerical order, this is not the sequential order in which they were used as indicated by the associated dates. Ring numbers NW38601-NW38700 were used first, followed by NW38551-NW38600 and then NW38701-NW38738. Any other dates which appear out of sequence are because the chick was not ringed on the day it was first processed, as its tarsus was considered too small to take a ring, and was then subsequently ringed at a later date when re-trapped on the nest.

There was a duplicate of the ring number NW38635. As these rings were not applied at the same time, this was only noticed after the second NW38635 was applied. As the duplicates were on different species, one Little Tern and one Ringed Plover, it was decided that both rings be left in place. Ring number NW38708 was lost.

A total of 309 measurements of chick biometrics were made, of which 298 measurements were taken of chicks of known age during ringing and the re-trapping of ringed chicks. Also, eight measurements were taken of chicks which were measured on day 0 or 1, but not ringed as their tarsus was considered too small to take a ring, and subsequently moved away from the scrape before they could be ringed. In addition three chicks of unknown age were measured and ringed.

Table 5: Information on Baltray Little Tern nesting outcomes 2013

nest ID	eggs laid	eggs lost	hatch date(s)	hatched	ringed	chicks lost	presumed fledged
B1	2	-	22/06/13	2	1	1 (natural causes)	1
B2	2	-	24/06/13, 25/06/13	2	2	-	2
B3	2	-	23/06/13	2	2	-	2
B4	2	-	24/06/13	2	2	-	2
B5	2	-	24/06/13	2	1	-	2
B6	2	1 (infertile)	24/06/13	1	1	-	1
B7	2	-	25/06/13	2	0	-	2
B8	2	-	25/06/13	2	0	-	2
B9	2	-	23/06/13	2	2	-	2
B10	2	-	28/06/13, 29/06/13	2	2	-	2
B11	2	-	23/06/13, 24/06/13	2	0	-	2
B12	2	-	24/06/13	2	0	-	2
B13	2	-	27/06/13	2	2	-	2
B14	2	-	25/06/13	2	2	-	2
B15	2	-	24/06/13	2	1	-	2
B16	2	-	24/06/13, 25/06/13	2	2	-	2
B17	2	-	27/06/13	2	2	-	2
B18	2	-	28/06/13	2	2	-	2
B19	2	-	26/06/13, 27/06/13	2	2	-	2
B20	3	3 (corvid predation)	-	0	-	-	0
B21	2	1 (infertile)	28/06/13	1	1	-	1
B22	2	-	27/06/13, 28/06/13	2	2	-	2
B23	2	-	26/06/13	2	2	-	2
B24	2	-	26/06/13, 27/06/13	2	1	-	2
B25	3	-	29/06/13 (2chick), 30/06/13	3	1	-	3
B26	2	-	28/06/13, 29/06/13	2	2	-	2
B27	3	2 (infertile)	28/06/13	1	1	-	1
B28	3	-	30/06/13, 01/07/13	3	1	-	3
B29	3	-	30/06/13 (2chick), 01/07/13	3	3	-	3
B30	3	-	30/06/13 (2chick), 01/07/13	3	2	-	3
B31	2	-	24/06/13	2	1	-	2
B32	2	-	27/06/13	2	2	-	2
B33	2	-	26/06/13	2	0	-	2
B34	2	1(infertile)	28/06/13	1	1	-	1
B35	2	-	28/06/13, 30/06/13	2	2	-	2
B36	2	-	27/06/13	2	2	-	2
B37	2	-	27/06/13	2	2	-	2
nest ID	**eggs laid**	**eggs lost**	**hatch date(s)**	**hatched**	**ringed**	**chicks lost**	**presumed fledged**

nest ID	eggs laid	eggs lost	hatch date(s)	hatched	ringed	chicks lost	presumed fledged
B38	2	-	28/06/13	2	2	-	2
B39	2	-	24/06/13	2	2	-	2
B40	2	1 (infertile)	24/06/13	1	1	-	1
B41	2	-	29/06/13, 30/06/13	2	1	-	2
B42	2	-	24/06/13	2	2	-	2
B43	2	-	25/06/13	2	2	-	2
B44	2	-	30/06/13	2	2	-	2
B45	2	-	28/06/13	2	2	-	2
B46	2	-	26/06/13	2	0	-	2
B47	3		30/06/13 (2chick), 01/07/13	3	2	-	3
B48	2	-	28/06/13	2	2	-	2
B49	2	-	30/06/13, 02/07/13	2	2	-	2
B50	3	-	30/06/13	3	3	-	3
B51	3	-	03/07/13	3	2	-	3
B52	2	-	30/06/13, 01/07/13	2	0	-	2
B53	2	1 (corvid predation) + 1 (abandoned)	-	0	-	-	0
B54	2	-	26/06/13	2	2	-	2
B55	2	-	01/07/13	2	0	-	2
B56	2	-	01/07/13	2	2	-	2
B57	3	-	02/07/13 (2chick), 03/07/13	3	2	-	3
B58	3	-	04/07/13	3	3	-	3
B59	2	-	04/07/13	2	2	-	2
B60	2	-	01/07/13	2	2	-	2
B61	3	-	03/07/13, 04/07/13, 05/07/13	3	3	-	3
B62	2	-	02/07/13, 03/07/13	2	2	-	2
B63	2	-	27/06/13	2	2	-	2
B64	2	1 (infertile)	01/07/13	1	1	-	1
B65	3	-	29/06/13, 30/06/13 (2chick)	3	3	1 (natural causes)	2
B66	2	-	27/06/13, 28/06/13	2	2	-	2
B67	3	-	03/07/13	3	3	-	3
B68	2	-	02/07/13	2	2	-	2
B69	1	-	04/07/13	1	1	-	1
B70	2	-	01/07/13	2	2	-	2
B71	2	-	25/06/13	2	2	-	2
B72	2	-	02/07/13, 03/07/13	2	2	-	2
B73	2	-	27/06/13	2	0	-	2
B74	2	-	03/07/13	2	2	-	2
B75	3	-	03/07/13	3	2	-	3
B76	2	-	05/07/13	2	2	-	2
B77	3	-	26/06/13	3	0	-	3
B78	2	-	26/06/13, 27/06/13	2	2	-	2

B79	2	2 (infertile)	-	0	-	-	0
B80	2	-	30/06/13	2	2	-	2
B81	3	-	30/06/13, 01/07/13 (2chick)	3	3	-	3
B82	3	-	07/07/13	3	3	-	3
B83	2	-	11/07/13	2	2	-	2
B84	2	-	02/07/13, 03/07/13	2	2	-	2
B85	2	-	10/07/13, 11/07/13	2	2	-	2
B86	2	2 (abandoned)	-	0	-	-	0
B87	2	-	01/07/13	2	2	-	2
B88	2	-	06/07/13, 07/07/13	2	2	-	2
B89	1	1 (abandoned)	-	0	-	-	0
B90	2	-	10/07/13, 11/07/13	2	2	-	2
B91	2	-	28/06/13	2	2	-	2
B92	2	2 (June spring tide)	-	0	-	-	0
B93	2	2 (June spring tide)	-	0	-	-	0
B94	2	-	06/07/13	2	2	-	2
B95	2	-	14/07/13	2	2	-	2
B96	3	-	10/07/13, 11/07/13 (2chick)	3	3	-	3
B97	3	-	04/07/13, 05/07/13 (2chick)	3	3	-	3
B98	1	Egg dump	-	-	-	-	-
B99	2	-	02/07/13	2	2	-	2
B100	1	-	08/07/13	1	1	-	1
B101	2	-	07/07/13	2	2	-	2
B102	2	2 (July spring tide)	-	0	-	-	0
B103	1	-	28/07/13	1	1	-	1
B104	2	-	28/07/13	2	2	-	2
B105	2	-	12/07/13, 13/07/13	2	2	-	2
B106	2	2 (July spring tide)	-	0	-	-	0
B107	2	-	21/07/13	2	1	-	2

Table 6: Information on Ringed Plover nesting outcomes in the Baltray Little Tern Colony 2013

nest ID	eggs laid	eggs lost	hatch date(s)	hatched	ringed	chicks lost	presumed fledged
RP1	4	4 (fox depredation)	-	-	-	-	-

RP2	4	4 (fox depredation)	-	-	-	-	-
RP3	4	4 (fox depredation)	-	-	-	-	-
RP4	4	-	26/06/13	4	0	-	4
RP5	4	-	26/06/13, 27/06/13	4	4	-	4
RP6	4	-	04/07/13	4	0	-	4
RP7	4	-	27/06/13, 28/06/13	4	3	-	4
RP8	4	-	03/07/13	4	2	1(natural causes)	3
RP9	4	-	04/07/13	4	3	-	4
RP10	4	-	10/06/13	4	0	-	4
RP11	4	-	27/06/13	4	0	-	4
RP12	4	-	29/06/13	4	0	-	4
RP13	4	-	26/06/13	4	0	-	4
RP14	4	-	27/06/13	4	0	-	4
RP15	4	1 (infertile)	05/07/13, 06/07/13	3	2	-	3
RP16	4	-	28/06/13, 29/06/13	4	0	-	4
RP17	3	3 (washed by tide)	-	-	-	-	-
RP18	4	-	05/07/13, 06/07/13, 07/07/13	4	2	-	4
RP19	4	-	03/07/13	4	0	-	4
RP20	4	-	02/07/13, 03/07/14	4	0	-	4
RP21	4	1 (infertile)	27/06/13	3	0	-	3
RP22	4	-	03/07/13	4	0	-	4
RP23	4	1 (did not hatch)	28/07/13	3	2	-	3
RP24	3	-	11/08/13, 12/08/13	3	1	1(trampled)	2

Table 7: Baltray Little Tern Chick ringing and morphometric data 2013

ring ID	nest ID	species	Date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)
NW38551	**B30**	LITTE	03/07/13	3	17.3	20.5																
NW38552	**B30**	LITTE	03/07/13	3	14.1	16.5	05/07/13	5	21.0	28.0												
NW38553	**B99**	LITTE	03/07/13	1	10.8	15.5																
NW38554	**B99**	LITTE	03/07/13	1	7.3	15.0																
NW38555	**B84**	LITTE	03/07/13	1	8.2	15.0																
NW38556	**B84**	LITTE	03/07/13	0	7.5	14.5	09/07/13	6	26.4	41.0												
NW38557	**B72**	LITTE	03/07/13	0	7.2	12.0																
NW38558	**B72**	LITTE	03/07/13	1	8.0	14.5																
NW38559	**B74**	LITTE	03/07/13	0	7.9	12.0	04/07/13	1	10.0	14.0	05/07/13	2	12.5	15.0								
NW38560	**B74**	LITTE	03/07/13	0	8.3	14.0	05/07/13	2	13.2	16.5												
NW38561	**B57**	LITTE	03/07/13	1	8.2	12.0	04/07/13	2	8.9	14.5												
NW38562	**B57**	LITTE	03/07/13	1	8.6	14.0	04/07/13	2	10.6	15.0												
NW38563	**B68**	LITTE	03/07/13	1	10.3	14.5																
NW38564	**B68**	LITTE	03/07/13	1	10.2	15.0																
NW38565	**B62**	LITTE	03/07/13	0	8.4	13.0																
NW38566	**B62**	LITTE	03/07/13	1	9.3	14.0	05/07/13	3	15.3	19.5												
NW38567	**B67**	LITTE	03/07/13	0	7.2	12.0	05/07/13	2	11.0	15.0												
NW38568	**B67**	LITTE	03/07/13	0	6.8	11.0																
NW38569	**B44**	LITTE	03/07/13	3	16.2	19.0																
NW38570	**B51**	LITTE	03/07/13	0	7.8	13.0																
NW38571	**B51**	LITTE	03/07/13	0	7.9	13.0																
NW38572	**B64**	LITTE	03/07/13	2	11.5	15.0	04/07/13	3	14.4	17.5												
NW38573	**B61**	LITTE	03/07/13	0	6.5	11.0	04/07/13	1	7.3	12.5												
NW38574	**B70**	LITTE	03/07/13	2	12.8	16.0	06/07/13	5	26.4	35.0												
NW38575	**B65**	LITTE	03/07/13	3	13.1	15.0																
NW38576	**B65**	LITTE	03/07/13	3	13.5	17.5																

ring ID	nest ID	species	Date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)
NW38577	**B69**	LITTE	04/07/13	0	7.1	12.5	15/07/13	11	41.6	70.5												
NW38578	**B87**	LITTE	04/07/13	3	14.3	20.5																
NW38579	**B87**	LITTE	04/07/13	3	15.3	19.5																

ring ID	nest ID	species	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)
NW38697	**B29**	LITTE	01/07/13	1	9.0	11.0	04/07/13	4	17.6	21.0												
NW38698	**B29**	LITTE	01/07/13	0	6.5	9.0	02/07/13	1	7.4	14.0												
NW38699	**B29**	LITTE	01/07/13	1	9.0	11.5																
NW38700	**B49**	LITTE	01/07/13	1	9.5	10.0	02/07/13	2	12.1	12.5	03/07/13	3	15.5	19.5	05/07/13	5	21.2	27.0				
NW38701	**B67**	LITTE	05/07/13	2	9.0	14.0	08/07/13	5	16.5	21.5												
NW38702	**B76**	LITTE	05/07/13	0	6.6	11.0																
NW38703	**B76**	LITTE	05/07/13	0	6.8	11.0																
NW38704	**B94**	LITTE	06/07/13	0	7.6	12.0																
NW38705	**B94**	LITTE	06/07/13	0	7.3	12.0																
NW38706	**B88**	LITTE	06/07/13	0	7.3	12.0	07/07/13	1	9.6	15.5												
NW38707	**B88**	LITTE	07/07/13	0	7.2	12.5																
NW38709	**B82**	LITTE	07/07/13	0	6.9	10.5	08/07/13	1	7.1	13.0												
NW38710	**B82**	LITTE	07/07/13	0	7.4	11.0	08/07/13	1	7.6	13.0												
NW38711	**B82**	LITTE	07/07/13	0	8.1	13.0																
NW38712 (right leg)	**B70**	LITTE	07/07/13	6	32.1	47.0																
NW38713	**B101**	LITTE	07/07/13	0	8.5	13.0	08/07/13	1	8.5	13.0												
NW38714	**B101**	LITTE	07/07/13	0	8.7	14.0	08/07/13	1	9.4	14.0	13/07/13	6	29.0	44.0								
NW38715	**B100**	LITTE	08/07/13	0	8.0	12.0	15/07/13	7	32.9	53.0												
NW38716	**B90**	LITTE	10/07/13	0	7.6	12.0	11/07/13	1	8.6	13.0												
NW38717	**B96**	LITTE	10/07/13	0	9.1	13.0	11/07/13	1	10.4	13.0												
NW38718	**-**	LITTE	10/07/13	-	48.8	102.5																
NW38719	**B85**	LITTE	10/07/13	0	5.8	11.5	11/07/13	1	7.2	12.0	13/07/13	3	12.6	19.0								
NW38720	**B90**	LITTE	11/07/13	0	7.2	12.0																
NW38721	**B85**	LITTE	11/07/13	0	6.6	11.0	13/07/13	2	11.6	17.0												
NW38722	**B96**	LITTE	11/07/13	0	8.7	13.0	15/07/13	4	22.4	33.5												
NW38723	**B96**	LITTE	11/07/13	0	7.2	11.5																

ring ID	nest ID	species	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)	date	age (days)	weight (g)	wing length (mm)
NW38724	**-**	LITTE	11/07/13	-	42.2	81.0																
NW38725	**B83**	LITTE	11/07/13	0	8.1	13.0	15/07/13	4	22.0	31.5												
NW38726	**B83**	LITTE	11/07/13	0	7.8	12.5	15/07/13	4	21.6	29.0												
NW38727	**B105**	LITTE	14/07/13	2	11.8	17.0																
NW38728	**B95**	LITTE	14/07/13	0	7.5	10.0	15/07/13	1	9.2	12.0												
NW38729	**B105**	LITTE	14/07/13	1	8.6	14.0																
NW38730	**B95**	LITTE	14/07/13	0	8.2	12.0	15/07/13	1	10.0	13.5												
NW38731	**-**	LITTE	15/07/13	-	43.3	74.5																
NW38732	**B107**	LITTE	25/07/13	4	16.9	22.0																
NW38733	**B104**	LITTE	28/07/13	0	9.1	12.0	29/07/13	1	11.1	15.0												
NW38734	**B104**	LITTE	28/07/13	0	7.5	12.0	29/07/13	1	9.7	12.5												
NW38735	**RP23**	RINPL	28/07/13	0	8.7	10.5																
NW38736	**RP23**	RINPL	28/07/13	0	8.6	11.0																
NW38737	**B103**	LITTE	28/07/13	0	7.3	13.0	29/07/13	1	9.4	14.5	30/07/13	2	9.8	16.0	31/07/13	3	12.5	16.0				
NW38738	**RP24**	RINPL	11/08/13	0	8.3	11.0																

Appendix 3: Project publicity

Wings magazine, Autumn 2013 issue

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

Údaráis Áitiúla Lú
Louth Local Authorities

Louth Heritage Forum
Fóram Oidhreachta Lú

Louth Nature Trust

An Chomhairle Oidhreachta
The Heritage Council

Haven on Earth

Susan Doyle and Darren O'Connell reflect on their season wardening the tern colony at Baltray, Co Louth

A stroll amongst the dunes of the Haven, in Baltray, Co Louth, reveals an unheralded wildlife refuge hidden at the end of a narrow spit on the Boyne estuary. The Haven is home to one of the last remaining Little Tern colonies in Ireland which, thanks to a Louth Nature Trust initiative and strong local support, has gone from zero breeding success six years ago to a record-breaking 197 chicks in 2013.

We joined the Baltray project as fieldworkers with BirdWatch Ireland this summer. Living on-site through sunshine and thunderstorms, we witnessed the spectacle of Little Tern chicks hatching, growing up and fledging.

Baltray supports a whole host of other visitors, both avian and mammalian. Ireland's four other breeding tern species – Common, Arctic, Roseate and Sandwich Terns – regularly use the area to feed and roost in, gathering in loafing flocks along the sandbars.

The area is also a haven for waders, both resident and migratory – Ringed Plovers, Oystercatchers, Curlews, Sanderlings, Dunlins and Black-tailed and Bar-tailed Godwits congregate in huge flocks during the winter. The occasional Little Egret or Grey Heron drops in to join the Cormorants 'hanging themselves out to dry' along the shoreline.

The dunes support a bountiful flora and fauna. Meadow Pipits, Starlings, Stonechats, Linnets and incredibly tame Skylarks flit amongst the grasses; bumblebees bustle between patches of colourful wild flowers; Kestrels hover expectantly over the grass and Short-eared Owls make ghostly visits.

BRIEFNI MARTIN

The Little Tern colony site at Baltray, Co Louth, protected by fencing.

An Irish Mountain Hare spent some days inside the colony fence until finally chewing its way through the mesh to a life free from bombardment by terns! Early morning visitors may also be lucky enough to catch our local otter returning to his holt or a stoat returning from its night's hunting.

Amongst the wild creatures here you can spot two Little Tern wardens – that's us! – cut off from civilisation, starved of electricity, battling a severe earwig infestation of the fridge and wholly unaware of who won at Wimbledon! We live a life of sea salt and sand in a tin box (known to some as a "caravan"), boiled in the sunny afternoons and frozen at night. The plumbing is a sophisticated rota of five-gallon drums filled by hosepipe in a local farmyard, and the shower is the bottom half of a Ballygowan bottle nailed to a post. However, this is a small price to pay to experience the incredible wildlife on offer at this hidden gem, and in September we will tell everyone that this summer, the best since 1976, was the summer we spent living on the beach. – ***Susan Doyle & Darren O'Connell (Little Tern Wardens, Baltray)***

Drogheda Leader, published on July 3rd.

DROGHEDA LEADER

A record 'Ternout'

Record amount of chicks expected at Little Terns site at Baltray

By Ian Watters

THERE are record numbers of chicks expected to hatch at the Little Terns nesting site in Baltray, with the best nesting figures ever achieved taking place this year, and a call has gone out for volunteers to help protect the nesting site.

Last year the Little Terns Project in Baltray had one of their worst years on record, with tides and predators depleting the numbers of Little Tern chicks who survived to only 24. There were also fears expressed that due to a lack of funding and manpower that the project would not continue. Thankfully however the Louth Nature Trust, in collaboration with BirdWatch Ireland, is ensuring the project continues.

"This year we are experiencing the best nesting figures ever achieved and we need help in the protection of this beautiful bird from predator and human alike. The section of beach they occupy is closed to the public during the season and we thank all those who have avoided walking in the area. This voluntary conservation effort started seven years ago. It has grown from 20 chicks in year one to this year's 90 plus nests with 190 plus eggs," it was explained by Dominic Hartigan of the Louth Nature Trust. Ornithogists Susan Doyle and Darren O'Connell are on site this year to offer advice and help to any volunteers. There is a constant watch kept to project the bird from predators.

Ornithologists Susan Doyle and Darren O'Connell of Birdwatch Ireland at the nesting site in Baltray. Photo: Eric O'Neill.

The *Drogheda Leader* spoke to Susan Doyle (24) who has just finished her degree in Zoology in Trinity College. She is originally from Dublin, but is staying in the Baltray area until the nesting season is over in August.

> "This year we are experiencing the best nesting figures ever achieved"

"We can't leave the site unattended and we have night wardens also who are on from 10pm until 6am. We are looking for people to help out in the day between 6am and 10pm and would love to hear from them. They can do anything from an hour up, and it would be a great help."

"It is such a large space we are covering. I am with BirdWatch Ireland and such a site as this is important to preserve. The season has been going very well so far and we are expecting to have about 200 chicks, which would be a record number. The season started a bit later this year but we are expecting the birds to leave for Africa in August. Any help we can get would be appreciated," she said.

People who would like to volunteer and help can contact 086-2434874 or go to www.louthnaturetrust.ie .