

EU LIFE Roseate Tern Recovery Project



Photo by Brian Burke

Annual Site Breeding Report 2016

Compiled by Daniel Picc, RSPB Nature Recovery Unit

“Improving the conservation prospects of the priority species roseate tern throughout its range in the UK and Ireland”

LIFE14 NAT/UK/000394 ROSEATE TERN



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www.roseatetern.org

List of shortcuts

BWI – BirdWatch Ireland

HCC – Hampshire County Council

NPWS – National Parks and Wildlife Service

NWWT – North Wales Wildlife Trust

RSPB – Royal Society for the Protection of Birds

SNH – Scottish Natural Heritage

ROC – Rockabill

COQ – Coquet

LIL – Lady’s Island Lake

SPA – Special Protection Area – sites designated under the EU Birds Directive

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1 Tabularised summary of the 2016 breeding season

1.1 Breeding numbers of roseate terns in main colonies

<i>Site</i>	<i>Baseline mean breeding pairs (2011-2015)</i>	<i>2015 breeding pairs</i>	<i>2016 breeding pairs</i>	<i>% change between baseline and 2016</i>
<i>Rockabill</i>	1235	1388	1556	26%
<i>Lady's Island Lake</i>	164	215	209	27%
<i>Coquet Island</i>	86	111	104	21%
Total		1714	1869	

1.2 Productivity of roseate terns in main colonies

<i>Site</i>	<i>Baseline mean productivity (2011-2015)</i>	<i>2015 productivity</i>	<i>2016 productivity</i>	<i>% change between baseline and 2016</i>
<i>Rockabill</i>	1.08	1.12	0.66	-39%
<i>Lady's Island Lake</i>	1.13	1.15	1.08	-5%
<i>Coquet Island</i>	1.07	0.92	0.88	-18%

1.3 Breeding numbers and productivity of associated tern species in main roseate tern colonies

<i>Site</i>	<i>5-year mean (2011-2015)</i>	<i>2015</i>	<i>2016</i>	<i>% change between baseline and 2016</i>	<i>Productivity 2016</i>
<i>Common tern</i>					
<i>Rockabill</i>	2063	1945	2029	-1.6	0.26
<i>hghLady's Island</i>	903*	950	1012	12.1	2.35**
<i>Coquet</i>	1150	1160	1201	4.4	0.6
<i>Arctic tern</i>					
<i>Rockabill</i>	103	65	60	-41.7	0.01

<i>Lady's Island</i>	723*	849	844	16.7	1.79**
<i>Coquet</i>	1315	1471	1490	13.3	0.6
	<i>Sandwich tern</i>				
<i>Lady's Island</i>	1691*	1682	1799	7.0	1.36**
<i>Coquet</i>	1411	1624	1349	-16.9	1.51**

* Mean population size for 2012-2016

** Mean clutch size

1.4 Other roseate tern sightings in the 2016 breeding season

In 2016, there were 3 pairs of roseate tern breeding on the following sites:

- **The Skerries (Anglesey)** - 10 years since the last roseate tern pair bred at the site, one pair was discovered very late in the season, producing a single chick, found on 6th August.

Two roseate terns paired and bred with common terns in the same area of zone 1a as in previous years, nesting behind the garden wall to the West perimeter, and were believed to be the same returning individuals.

- **Larne Lough (Northern Ireland)** – The single pair bred successfully in a nest box on the north east corner of Blue Circle, raising one young (Wolsey 2016).
- **Dalkey Islands (Ireland)** – one pair laid egg, but was subsequently predated.

Furthermore, the following sightings during the breeding season were recorded, but not breeding confirmed.

- Long Craig Island (Forth Islands, Scotland) – one mixed pair of roseate with a common tern attempted to breed in 2016 as in 2015. The breeding success was unknown. In 2014, there was one bird present during the season.
- Another mixed pair of roseate and common bred in **Leith Docks (Forth Islands, Scotland)** in 2016 (Oksien 2016).
- **Solent and Southampton** – one bird was photographed on the trap camera located near the common tern nest on the 17th of July.
- There were three sightings of roseate tern on **Ynys Feurig** in 2016, on 24 June, 03 July and 06 July.

1.5 Breeding numbers of tern species at non-roseate tern project sites

	Common Tern	Arctic Tern	Sandwich Tern	Roseate Tern
Forth Islands SPA				
<i>Long Craig</i>	206	n/a	n/a	1 mixed pair
<i>Isle of May</i>	19	527	21	n/a
Ynys Feurig, Cemlyn Bay and the Skerries SPA				
<i>Ynys Feurig</i>	116-165	238-287	n/a	n/a
<i>The Skerries</i>	290	3816	n/a	1
<i>Cemlyn Bay</i>	60	60	2595	n/a
Solent and Southampton SAP	55	n/a	81	one sighting
Larne Lough SPA				
<i>Blue Circle Island</i>	145	n/a	1070	1
<i>Swan Island</i>	188	n/a	159	0
Dalkey Islands SPA (RoI)	8	97	n/a	1

2 Management recommendations

The recommendations listed below relate to regular management and monitoring (actions C.1, C.2 and D.1) and do not include special habitat creation/ restoration projects (action C.3).

2.1 Monitoring

1. Maintain close collaboration with the Scottish Wildlife Trust for providing numbers and productivity figures Isle of May, Forth Islands.
2. Obtain annual figures for common terns from Leith Docks SPA in Forth Islands.
3. Develop improved monitoring protocols for Long Craig (Forth Islands), Dalkey Islands, Larne Lough and Solent, mostly to improve the productivity assessment of target species and factors impacting the productivity.
4. Consider starting diet monitoring at Lady's Island Lake.
5. Consider chick growth or diet monitoring on Coquet to capture provide some measures of diet impact on productivity.
6. Consider more systematics predation and weather recording on all colonies.

2.2 Recording the impact of conservation interventions

1. Develop simple monitoring methods for interventions such as cheniers recharge, vegetation suppression methods and island restorations to the standard of Conservation Evidence publication.

2.3 Rockabill

1. Employ additional warden capacity early in the season before terns arrive to manage large gull species while conducting vegetation clearance.
2. Purchase Agri-laser and potentially new rifle to assist with gull management.
3. Erect a new hide, to increase recording effort for ring-reading and provisioning.

2.4 Coquet

1. Undertake trials for vegetation suppression methods within the garden area for Arctic terns.
2. Undertake trials for using artificial platforms for common terns.

2.5 Dalkey Islands

1. Carry out rat eradication in winter 2017.
2. Increase the frequency of monitoring visits.
3. Consider introducing colour ringing (of Common and Arctic Terns).
4. Consider starting monitoring of chick provisioning.
5. Erect a hide to facilitate additional monitoring effort.

2.6 Long Craig

1. Management of Long Craig colony should focus on maximising the productivity through increasing the space for nesting, as well as on minimising the impact of predation. The colony is probably heavily dependent on the immigration from Leith Docks population and the provision of space should accommodate more immigrants and decrease density dependent effects.
2. Consideration should be given to ring and flag common tern chicks to assess the survival rates and juvenile recruitment. Ideally similar study should be undertaken on Leith Docks, however there are issues with access.
3. The provision of at least 20 roseate tern nest boxes should be made, if the other threats are such as predation and nesting space are in control.
4. The monitoring should extend to include baiting stations for rats, determination of disturbance sources and possibly provisioning observations to assess the rates and fish quality. These activities should be carried out by dedicated warden and the use of trap cameras.
5. Depending on the results of disturbance and rat monitoring, provisions to minimise the risk of predations should be considered including fencing against foxes and poisoning of rats before the season.
6. Gulls should be discouraged from settling on the island before the tern breeding season, and then actively discouraged from using the island with electronic scarers and, if necessary, the use of Agri-lasers.

2.7 Ynys Feurig

1. Develop a formal plan of action with the RAF airbase to destroy any crow nests on their property before the breeding season and any subsequent re-nesting attempts made during the season.
2. Identify the owner and holder of shooting rights of the section of dunes between the RAF station and the islands, and gain permission to shoot crows as they fly between the two.
3. Conduct pre-season crow and fox control.
4. Consider use of laser hazing to deter other avian predators and discuss this with RAF.

2.8 The Skerries

1. Tackle oystercatcher predation early in the season.
2. Start vegetation suppression measures for stinging nettle and sea mayweed.

2.9 Cemlyn Bay

1. Further methods of deterring otters including sonic alarms and improved fencing around the islands.
2. Further nesting area to be created by work on the islands and rafts.
3. Improved monitoring via use of rings/tags or similar.
4. Wardening to start earlier.

2.10 Larne Lough

1. Start earlier than in 2016, i.e. April.
2. Re-deploy new roseate nest boxes.
3. Install a makeshift hide.
4. Keep a path clear for monitoring the interior of Swan Island.
5. Review 2016 habitat management and amend accordingly for 2017/2018.

2.11 Solent

1. Introduce fox control west of Limington Harbour.
2. Develop methods and monitor the whole SPA for terns.

3 Introduction

In October 2015, a partnership of the RSPB, BirdWatch Ireland and the North Wales Wildlife Trust received a 3.2 million Euro grant from the EU LIFE funding to improve the conservation prospect of roseate terns in the UK and Ireland.

The project builds on the successful long-term management of the colonies, which resulted in the steady increase of the population size in recent years. The increase of the UK and Irish populations can certainly be attributed to the increased productivity secured by the intensive management, including 24-hour wardening during the season, vegetation management, provision of nesting space and most importantly nest boxes. Managers of each of the colony discourage gulls from taking nesting space and control predation from gulls with ever more effective methods, including electronic scarers, Aerolaser guns, removal of eggs and elimination of rouge gulls.

Research conducted as part of this project revealed that while the growth of the Rockabill population relies mostly on productivity and survival of adults, the other two colonies, Lady's Island Lake and Coquet, are dependent on immigration from Rockabill. In recent years, however, Coquet has become less dependent on immigration (Seward *et al.* in prep.).

The mortality from trapping in the wintering grounds is thought to decrease since it became illegal and because of many years of education and economic growth in Ghana. This hypothesis is going to be tested as part of the project through the collaboration with the Centre for African Wetlands, who will conduct tern trapping survey over two winter seasons in 2016-2017.

The LIFE project's aim is to further support the three main roseate tern colonies (Rockabill, Lady's Island Lake and Coquet Island). Rockabill and Coquet are directly supported by the project while Lady's Island Lake is part of the data sharing and knowledge exchange network. The second aim of the project is to improve the site conditions at several roseate tern SPAs to encourage the re-colonisation and colony establishment within the former range (Solent and Southampton, Forth Islands, Ynys Feurig, Cemlyn Bay and the Skerries, Larne Lough, Dalkey Islands (Figure 1). This will be achieved by the improvement of the management through the increased wardening capacity, extension of breeding suitable nesting habitat, predation control, purchase of equipment, restoration of facilities and exchange of knowledge. There are a few research themes in the project i.e. demography study of all colonies, GPS and geolocator tagging, impact of gull predation and diet review. Important part of the project is to develop a long-term strategy for the Western European population, which includes a scoping exercise for places which might become important for the species in the future.



Figure 1 Location of the project sites

3.1 Objectives of the report

The report summarises the 2016 breeding season for all the project sites in the UK and Ireland in the context of the colony development over the last 10 years. Almost all project sites produce detailed season reports and they are the main source of information used for the compilation of this summary report. The reader should refer to these reports for more detailed analyses of the season, prepared first hand by the managers of the individual colonies.

The specific objectives of this report are as follows:

1. To summarise the numbers and productivity of roseate terns in the three colonies (Rockabill, Coquet and Lady's Island Lake) in 2016 in comparison with the 5-year mean.
2. To summarise the numbers of associated species on all project sites for 2016 in comparison with the 5-year mean.
3. Review of issues affecting productivity of all project sites.
4. Provide recommendations for site management.

Ultimately, the report attempts to assess the impact of the project on target species, however, it must be noted that this will be somewhat difficult in the first 2-3 years, as the first recruits from 2016 will breed for the first time in 2019. This means that a potential population growth resulting from the management during the project will be monitored only for the last two years of the project. However, the productivity can be measured throughout the project timeline and should give us a good indication of the expected population trend, if other demographic parameters like emigration/ immigration and survival will remain at the mean level.

4 Monitoring of the project sites

During the first Technical Group meeting it was decided that the monitoring methods for Rockabill, Lady's Island Lake, Coquet, the Skerries, Ynys Feurig and Cemlyn Bay were sufficient to satisfy the monitoring requirements set in the project proposal. These sites have been run for many years as nature reserves and the monitoring is part of the annual management. Altering these monitoring protocols would be detrimental to the long-term consistency of data.

In case of Dalkey Islands, Larne Lough, Solent and Southampton and Forth Islands, the monitoring has been less intensive or relied on input from third party observers and volunteers. With the additional resources from the project, we are able to intensify monitoring efforts in these areas.

As a minimum the project sites should monitor the following parameters:

1. Roseate tern numbers and productivity.
2. Numbers and productivity of associated species – notably common, Sandwich and Arctic terns.
3. Issues affecting tern productivity, such as the level and nature of predator activity and the incidence and nature of disturbance events.
4. Habitat extent and quality.
5. Impacts of specific management interventions such predator management activities, if occurred.
6. Refer to colony terms/count areas used in JNCC Seabird Colony Register

Close collaboration with the Scottish Wildlife Trust and National Trust for providing numbers and productivity figures for Long Craig and the Isle of May is required.

There are some improvements of the monitoring methods required for Dalkey, Larne Lough and Solent, mostly to improve the productivity assessment of common and Arctic terns and factors impacting the productivity. These will be addressed in 2017 season onwards.

4.1 Parameters monitored on roseate tern colonies

The roseate tern demographic and other monitoring parameters at each colony are presented in Table 1.

Due to the size of the Rockabill colony, most of the population parameters are measured in the study area. Lady's Island Lake and Coquet collect most parameters across the whole colony, apart from chick growth rate on Lady's Island Lake, which is measured within enclosures.

There are discrepancies in collecting provisioning data, with Rockabill conducting annual monitoring of roseate and common tern diet, while on Coquet the diet has been studied as part of numerous PhD studies. Diet data on Lady's Island Lake hasn't been collected regularly, although chick weight measurements provide some indication of the food supply at this site. There is a value in establishing the long-term monitoring on both sites, in the light of likely changes in food supply due to the climate change.

All sites carry out ringing and ring-reading, which is fundamental for establishing immigration/ emigration rates for each site and survival of birds in different age classes.

All sites also carry out annual censuses and productivity monitoring for associated tern species.

Table 1 Overview of monitoring parameters and methods used in roseate tern colonies (Rockabill, Lady's Island Lake and Coquet). Parameters marked with * representing minimum requirements in the project

Parameters	Rockabill	Lady's Island	Coquet
<i>Managing organisation</i>	BWI	NPWS	RSPB
<i>RT pairs*</i>	Nest count of all colony, incl. % of nest box uptake	Nest count of all colony, incl. % of nest box uptake	Nest count of all colony, incl. % of nest box uptake
<i>RT egg laying, incubation and hatching phenology</i>	Daily recording within the study area	Regular recording across the whole colony	Regular recording across the whole colony
<i>RT clutch size</i>	Daily recording within the study area	Regular recording across the whole colony	Regular recording across the whole colony
<i>RT hatching success</i>	Daily recording within the study area	Regular recording across the whole colony	Regular recording across the whole colony
<i>RT productivity*</i>	Daily recording within the study area	Regular recording across the whole colony	Regular recording across the whole colony
<i>RT chick growth rate</i>	Regular wing and weight measurements across the colony	Within 3 study enclosures	One off study – report in preparation
<i>RT provisioning</i>	Whole day observations in one area 3 days per season	Sporadic, not annually	Several PhD studies, but not annual monitoring
<i>RT predation & other limiting factors*</i>	Predation level from gulls, peregrine, kestrels and other species plus human disturbance recorded.	Predation level from gulls, peregrine, kestrels and other species plus human disturbance recorded	NE-licenced control of rogue gulls, nest removal and disturbance techniques, incl. Aero-laser and scarers. Night watches against egg collectors
<i>RT habitat management and species protection*</i>	Vegetation management, construction of terraces, deployment of nest	Deployment of nest boxes, chick shelters and fencing against land predators	Vegetation management, construction of terraces, deployment of

	boxes and chick shelters		nest boxes and chick shelters
<i>RT ringing and ring-reading*</i>	Ring-reading from 3 hides. 1 extra hide from 2016	Ringling and ring-reading from 1 hide	Ringling and ring-reading from mobile hides
<i>Associated tern species pairs*</i>	Two walk-through censuses	Two walk-through censuses	Single walk-through census
<i>Associated tern species productivity*</i>	Regular recording within the study area	Walk-through census	Regular recording within the study area
<i>Biosecurity</i>	Biosecurity plan in preparation	Annual rat poisoning taking place in Mar-Apr	Biosecurity plan in preparation

4.2 Monitoring baseline in the project

The 5-year mean for the roseate tern population size and productivity has been estimated for 2011-2015 to provide the baseline against the project success. This was introduced to accommodate natural fluctuations occurring in demographic parameters of all tern species, mostly associated with the survival, productivity and immigration/ emigration levels between sites. The above approach is preferable to a single year baseline proposed in the project proposal (73 pairs in 2013 for the UK and 1413 pairs in 2014 for the Republic of Ireland), as it eliminates the year bias.

The project success will be measured by the comparison of the 5-year mean population size and productivity for 2016-2020 against the 5-year mean for 2011-2015. Additionally, and due to the lagged breeding, the overall success of the project will be measured considering all the above listed monitoring parameters.

Generally, most conservation measures have not been implemented yet and therefore, it is difficult to link population trends with the project actions yet. This particularly applies to Larne Lough, Forth Islands, Solent and Southampton and Cemlyn Bay.

It needs to be noted that the population growth depends on many parameters such as productivity, immigration and survival of different age groups. Some factors influencing these demographic parameters are independent of the project, e.g. the weather, food availability and survival on wintering grounds. As a minimum, we can monitor these factors and try to judge if they contributed to the trends. However, if on average these factors don't change, the increased conservation effort with respect to nesting space and controlling predation should yield increases in population size and productivity.

5 Roseate tern population trends for the UK and Ireland

5.1 Population size and short-term trends

In 2016, there was a record number of roseate tern pairs breeding in all three colonies (1869), mostly due to the 12% increase on Rockabill and only slightly lower number of nests at Lady's Island Lake (-2.8%) and on Coquet (-6.3%), compared to 2015. The decrease in population on Coquet is most likely due to the high northerly winds and precipitation

throughout the spring and early summer (Davies and Morrison 2016). All colonies showed over 20% higher number of breeding pairs than the 5-year average for 2011-2015 (1235, 164 and 86 for Rockabill, Lady’s Island Lake and Coquet respectively) (Table 2).

In addition, three breeding pairs were recorded on the Skerries, Larne Lough and Dalkey Islands, bringing the UK/Ireland total to **1872** pairs. Two mixed pairs attempted to breed on the Skerries and one on Long Craig island in Forth Islands SPA (see Section 3.4 on page 31).

Table 2 Population size of roseate terns on three main colonies in 2015 and 2016 and % change between 2016 and the 5-year baseline

<i>Site</i>	<i>Baseline mean breeding pairs (2011-2015)</i>	<i>2015 breeding pairs</i>	<i>2016 breeding pairs</i>	<i>% change between baseline and 2016</i>
<i>Rockabill</i>	1235	1388	1556	26%
<i>Lady's Island Lake</i>	164	215	209	27%
<i>Coquet Island</i>	86	111	104	21%
<i>Total</i>		1714	1869	

The upward trend has been recorded for all the colonies in the last decade (Figure 2). In case of Rockabill, the increase in the population size has started in 1986 resulting in almost doubling the number of pairs within the last 10 years, from 820 in 2007 to 1556 in the last year (Figure 2).

Lady’s Island Lake and Coquet, both recorded the highest number of pairs in 2015 since the active management began (2015 and 111 pairs respectively), following the gentle upward trend that has started on both sites in the early 2000s, mostly due to the introduction of nest boxes and gull management on Coquet (Figure 2).

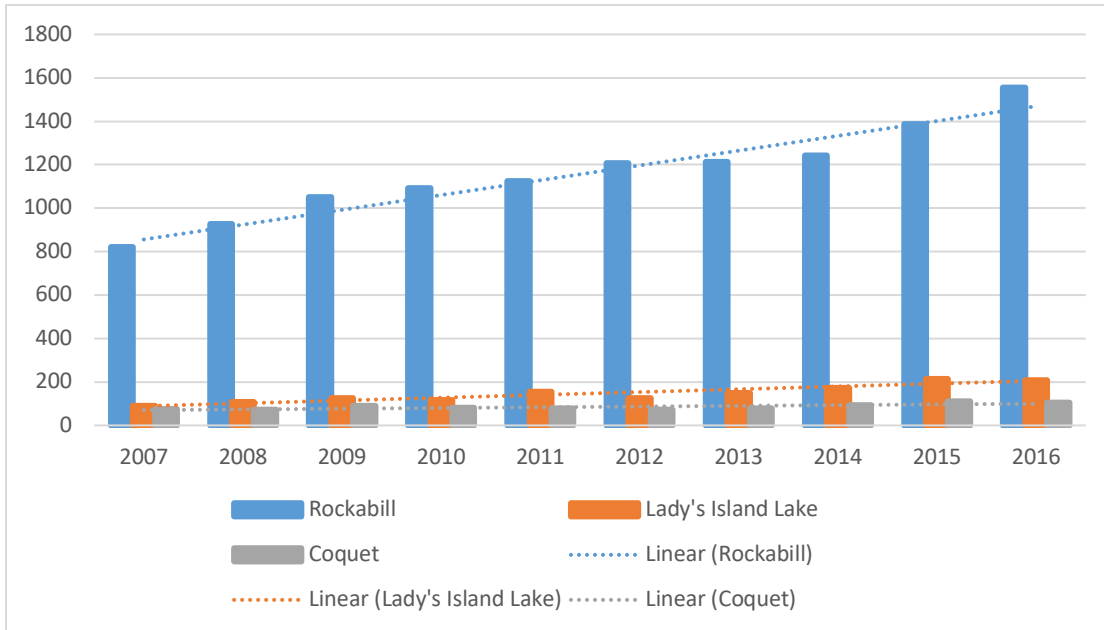


Figure 2 Population trends on Rockabill, Lady's Island Lake and Coquet between 2007 and 2016.

Lady's Island Lake population increased most sharply of all colonies, more than doubling its population in the last 10 years. The size of Rockabill population has grown 90% and Coquet 48% over the last 10 years (Figure 3).

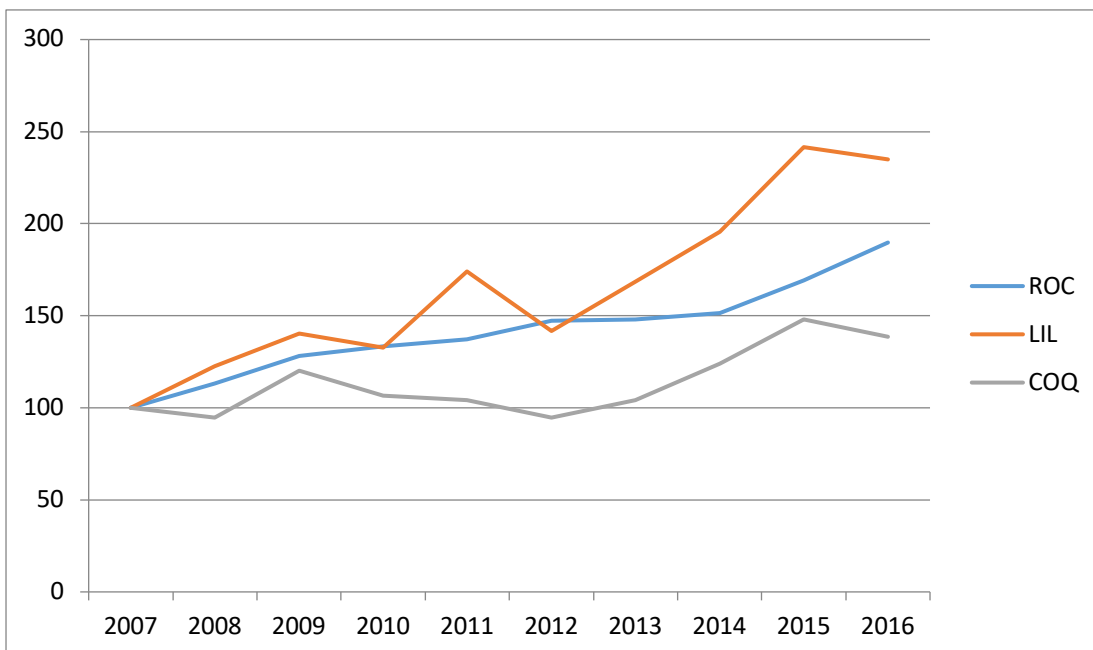


Figure 3 Relative population trend on Rockabill (ROC), Lady's Island Lake (LIL) and Coquet (COQ) between 2007 and 2016.

5.1.1 Population growth and demographic parameters

Apart from productivity (discussed below), the growth of the population is influenced by immigration/ emigration, juvenile recruitment and survival of different age groups. This can

be estimated from long series of ringing and ring-reading data as almost all chicks are ringed every year and intensive ring-reading is carried out each year on roseate tern colonies. This kind of study was undertaken as part of the project, considering population survey data, productivity and capture-mark-recapture data from Rockabill, Lady's Island Lake and Coquet for the period between 1992 and 2015 (Seward *et al.* in prep). Immigration rate was the most important contributor to population growth rate at LIL and COQ. At ROC, immigration was less important for population growth rate than productivity, juvenile recruitment and adult apparent survival. The population projection matrices suggested that the persistence of the populations at LIL and especially COQ are dependent on immigration; at zero immigration both populations are forecast to decline, at a range of productivity levels. However, Coquet has in recent years become slightly, less dependent on immigration (Figure 4). This shows that the Western-European meta-population of roseate terns require comprehensive international conservation strategies.

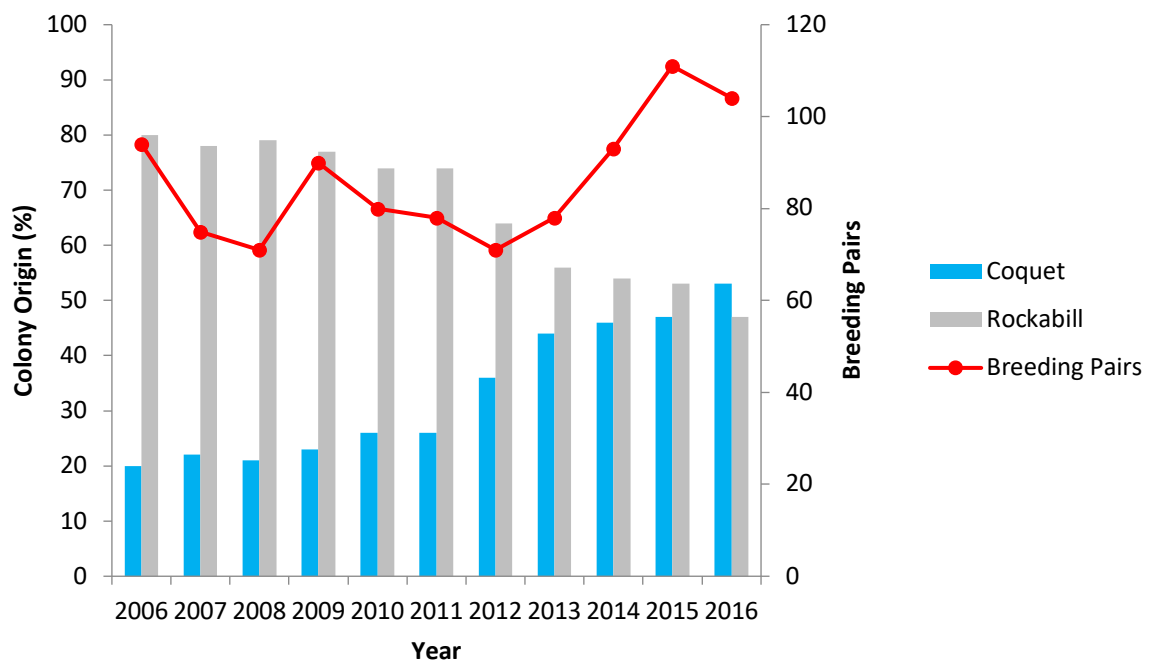


Figure 4 The colony origin of adult roseate terns on Coquet Island between 2006 and 2016 (Davies and Morrisson 2016)

5.2 Productivity

Productivity is measured as the number of chicks fledged per active nest.

Despite of the increasing number of breeding pairs in all colonies, in 2016 all sites recorded lower productivity than the 5-year baseline, with Rockabill falling to the lowest level on record (-39% compared to the 5-year baseline of 1.08) (Table 3).

Table 3 Productivity for Rockabill, LIL and Coquet in 2015 and 2016 and changes between 2016 and the 5-year base

Site	Baseline mean productivity (2011-2015)	2015 productivity	2016 productivity	% change between baseline and 2016
Rockabill	1.08	1.12	0.66	-39%
Lady's Island Lake	1.13	1.15	1.08	-5%
Coquet Island	1.07	0.92	0.88	-18%

This echoes the declining trend in productivity on all sites since 2010. In 2016, Coquet's productivity was 18% down (0.88) compared to the 5-year baseline of 1.07, following a declining trend since 2011. Lady's Island Lake trend was affected by 2012, when the productivity fell to 0.72 chicks per nest, but otherwise remains relatively high with the 5-year baseline of 1.13 (Figure 5).

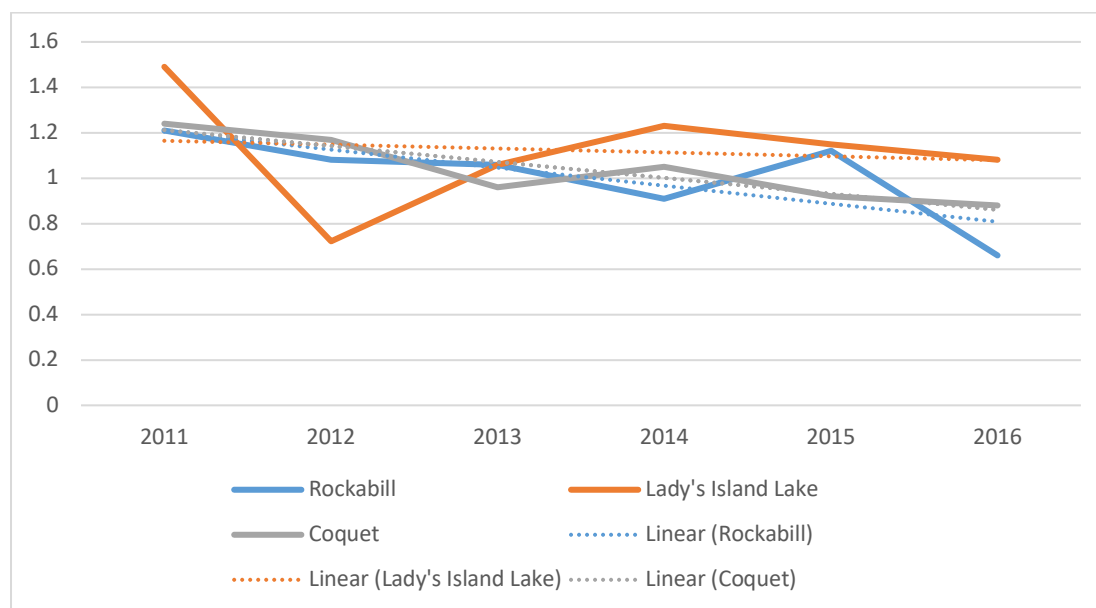


Figure 5 Productivity trend for Rockabill, Lady's Island Lake and Coquet between 2011 and 2016

To understand if the declining trend has only been a recent phenomenon or a long-term trend, it is necessary to look for the longer data series for productivity (Figure 6). It shows that the declines in the last 5 years are relatively steep for Rockabill and Lady's Island Lake, but only moderate for Coquet.

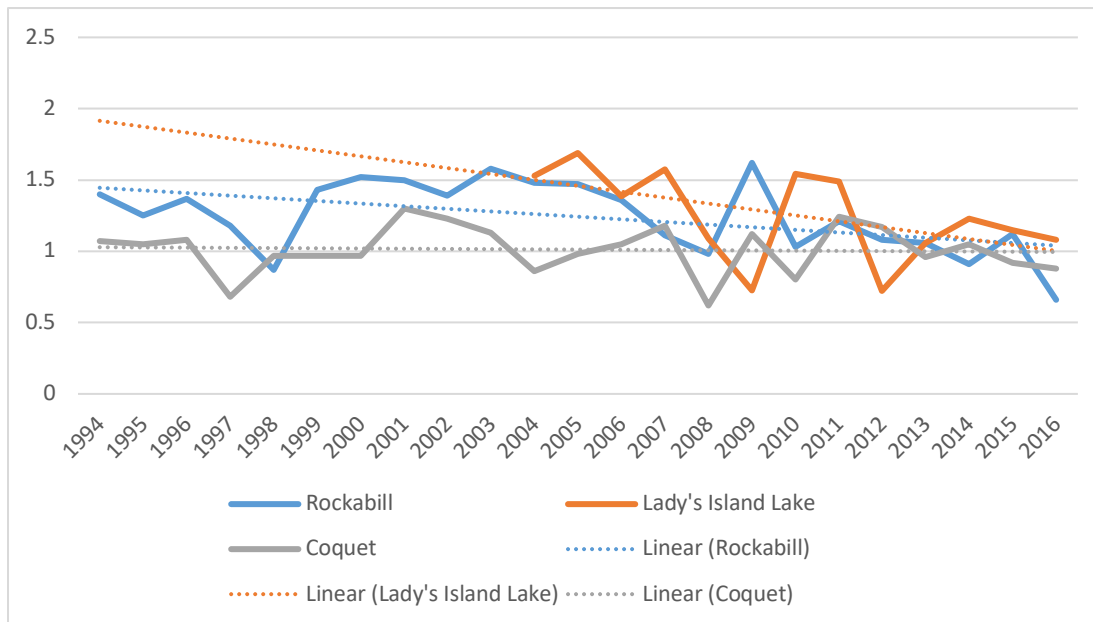


Figure 6 Long-term roseate tern productivity trend for Rockabill, Lady's Island Lake and Coquet

It is apparent that **Rockabill** decline has been most dramatic. After several very productive years between 1999 and 2006, in the last 10 years, there has been a steady decline, except for 2009. This might result in the halting of the population growth on this site in the future years.

The productivity on **Lady's Island Lake** were record high in several years, compared to the two other sites, however it is much more vulnerable to fluctuations in water levels on the lake and associated increase of predation as the island is accessible from mainland. This results in occasionally very low productivity, which drags the overall trend down, for example in 2009 and 2012.

The mean productivity on **Coquet** has been lower than Rockabill for most years between 1994 and 2016 (average of 1.01 and 1.24 respectively), however quite stable. Interestingly, the trends for both sites have followed similar patterns (most visible between 2008 and 2011). In the last 6 years, the productivity rates for both sites have been very similar due to the lowering rates at Rockabill (Figure 6). Weather is likely to be an important factor at this colony.

5.2.1 Density dependence for productivity on Rockabill

There are suggestions that the decline in productivity on Rockabill might be density dependent. As Ashmole's halo predicts (Birt *et al.* 1987), as the number of birds has increases they are competing with one another for resources, in particular food. This initially results in birds travelling further to find food, lowering provisioning rates which has consequences for productivity. But the capacity to increase foraging ranges is limited, especially in terns which tend to carry a single prey item back to the nest on each foraging trip. Therefore, competition means that the prey availability for each foraging bird is lower, provisioning is lower and productivity declines. The halo effect might not be detectable for smaller colonies (Gatson *et al.* 2007) and the results of diet monitoring (especially provisioning rates) might provide some answers as to whether the lack of food play some role in the productivity decline on Rockabill.

The implications of the halo effect might be to drive young adults which are being recruited into the breeding population to seek alternative breeding colonies, increasing the chances of new sites, or sites previously occupied, being colonised or recolonised respectively. This however, so far has not been recorded on Rockabill. The growth rate of the population does not show any signs of declining and emigration rates for all age group remain stable (Seward *et al.* in prep.).

5.2.2 Productivity levels required to sustain the population

Demography study (Seward *et al.* in prep.) identified the minimum level of productivity required for maintaining the growth of the population between 2016 and 2025, if all other demographic parameters (immigration, survival of juveniles, subadults and adults) remain at the mean level.

Assuming no change in the other demographic rates, a productivity of 1.0 or above will result in an increasing population at ROC. With a productivity of 0.5 or below, the ROC population will decrease. Between productivity levels of 0.6 and 0.9 it is not certain whether the ROC population will increase or decrease (population growth rate CIs overlap zero). Assuming no change in the other demographic parameters, any productivity between 0.5 and 1.5 will result in population increase at LIL. A productivity of 1.2 or above is required at COQ for population increase assuming no change in the other demographic parameters. Between productivity levels of 0.5 and 1.1, it is uncertain whether the COQ population will increase or decrease (CIs overlap zero) (Seward *et al.* in prep.).

5.3 Factors affecting roseate tern productivity

Apart from mortality from trapping on the wintering grounds, productivity is the only demographic parameter that we can, to some extent, control.

To understand factors affecting the productivity, we should consider the impact of factors listed in Table 4.

Table 4 Factors limiting roseate tern productivity and measures of their impact

Factor	Impact on population	Measure of impact
<i>Associated species</i>	Provide protection against predators. The productivity measure for associated species might be indicative of common issues food or weather in each season.	Population size and productivity
<i>Nesting competition with gulls</i>	Gulls nest earlier than terns and might take the space for nesting if not managed	Number of gulls breeding. Extend and methods of creating gull-free zones
<i>Nesting space and nest boxes</i>	There might be limited space for nesting especially on rocky islands. Terraces provide increased nesting space. Provision of nest boxes provide shelter for chicks	Area of terraces created and number and location of nest boxes

<i>Nest depredation</i>	A lot of the nest depredation is caused by gulls, but also by oystercatchers and turnstones. This lowers the hutching success.	Mean clutch size Hutching success
<i>Predation from gulls and other avian predators</i>	Gulls are responsible for the highest level of predation at all colonies. All colony managers manage the problem using different methods, but level of predation depends on the availability of alternative food source and changes throughout the season.	Number of predation attempts, species involved and outcomes
<i>Predation from non-avian predators</i>	Foxes, minks and rats have capacity to rapidly affect productivity or completely eradicate a colony if high level of predation persists over several years.	Number of predation attempts, species involved and outcomes
<i>Human disturbance</i>	Increased disturbance leave the chicks exposed to predators.	Number of disturbance occurrences
<i>Food availability and quality</i>	One of the most important factors, which is beyond managers influence however important to monitor.	Monitoring of prey species, size and provisioning rates
<i>Weather</i>	Adverse impact of the weather is especially dangerous during the hatching period when the chicks are vulnerable to low temperatures and wet conditions. Foraging capacities of adult birds can also be affected by the weather.	Record the weather throughout the season or obtain data from the nearest weather station

5.3.1 Associated species

The abundance of associated species, especially common and to a lesser extent Arctic tern is important for the ability of the colony to defend itself from the predators. Roseate tern being a less aggressive species, relies on the protection from more aggressive common and Arctic terns (Cabot & Nisbet 2013).

Productivity rates for associated species are indicative of the factors affecting all species, namely the weather, predation and food availability, although with respect of the latter, effective partitioning of food resources amongst sympatric tern species was observed, in terms of dietary segregation (different foraging methods) and foraging areas (Robertson *et al.* 2014).

Table 5 5-year mean and number of common, Arctic and Sandwich terns breeding on Rockabill, Lady's Island Lake and Coquet in 2015 and 2016

<i>Site</i>	<i>5-year mean (2011-2015)</i>	<i>2015</i>	<i>2016</i>	<i>% change between baseline and 2016</i>	<i>Productivity 2016</i>
<i>Common tern</i>					
<i>Rockabill</i>	2063	1945	2029	-1.6	0.26

<i>Lady's Island</i>	903*	950	1012	12.1	2.35**
<i>Coquet</i>	1150	1160	1201	4.4	0.6
	<i>Arctic tern</i>				
<i>Rockabill</i>	103	65	60	-41.7	0.01
<i>Lady's Island</i>	723*	849	844	16.7	1.79**
<i>Coquet</i>	1315	1471	1490	13.3	0.6
	<i>Sandwich tern</i>				
<i>Lady's Island</i>	1691*	1682	1799	7.0	1.36**
<i>Coquet</i>	1411	1624	1349	-16.9	1.51**

* Mean population size for 2012-2016

** Mean clutch size

On **Rockabill** common terns are most abundant with 2029 pairs breeding in 2016, a -1.6 decline from the 5-year mean. Unfortunately, like roseate terns, they had a record low productivity in 2016 – 0.26. The lack of food was identified as the main limitation based on the chick growth rates and possibly increased predation and tough weather (Burke, Kinchin-Smith and Newton 2016). The productivity of common terns has been lower than roseate terns for a few last years, which might explain the recent plateau in the growth of the population (Figure 7). Arctic terns are much less numerous on Rockabill with only 61 attempting to breed in 2016 and are therefore much more susceptible to predation, especially during the incubation period. Only 2-3 chicks hatched in total and one successfully fledged from the colony. Sandwich terns don't breed on Rockabill.

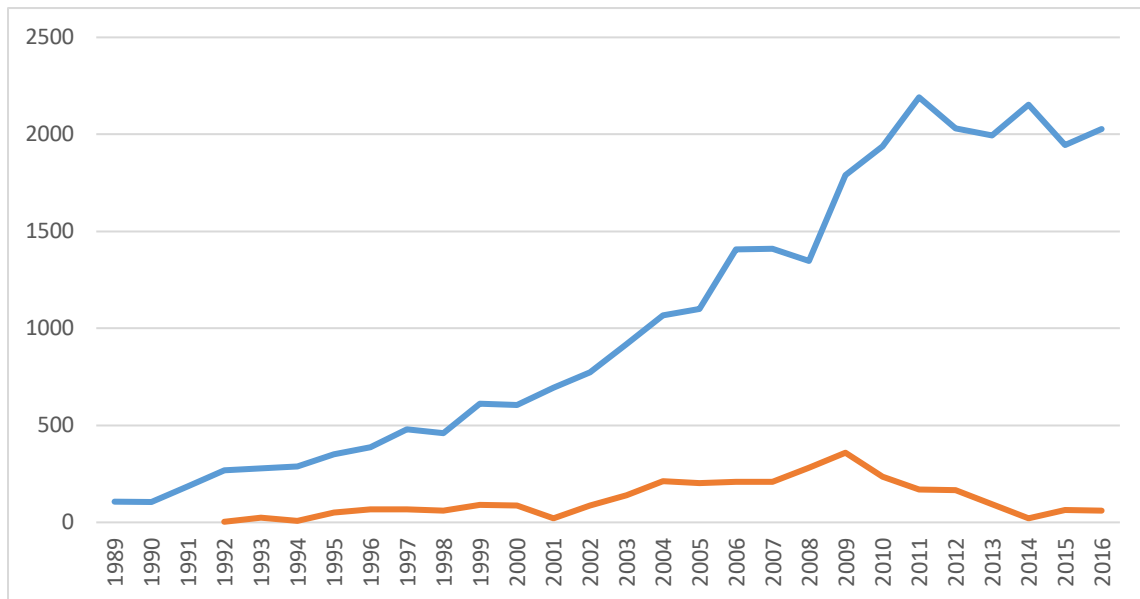


Figure 7 Population trend of common (blue) and Arctic terns (orange) on Rockabill between 1989 to 2016

Lady's Island Lake is also a stronghold for common terns with 1012 pairs breeding in 2016 (6.5% up compared to 2015). The site also supported 844 Arctic terns (0.6% decline compared to 2015) and 1799 Sandwich terns (7% increase compared to 2015). It was not possible to estimate Sandwich tern productivity in 2016, as it was noted that the ability of adult birds to feed chicks within the study enclosure was affected by the fence. After a few days of bad weather, the enclosure was removed. The productivity for common and Arctic terns are only expressed in clutch size at LIL (Daly, Murphy & Murray 2016), which provides an indication of pre-breeding conditions but not those during the breeding season.

Sandwich terns were numerous breeder at **Coquet** in 2016 with 1349 pairs (16.9 decline compared to 2015). Their productivity was measured in the clutch-size only in 2016 (1.51 eggs/ nest), as the ability to monitor productivity depends on the location of the colony. Arctic terns are more numerous than common tern with 1490 and 1201 pairs respectively. Both species increased slightly compared to 2015 following the steady increase on Coquet since mid-1990s, which was probably one of the factors behind the simultaneous increase in roseate tern population (Figure 8). Arctic terns tend to breed within the lighthouse gardens away from the roseate tern terraces, while common terns mainly nest around the outside of the walled gardens (Davies and Morrison 2016).

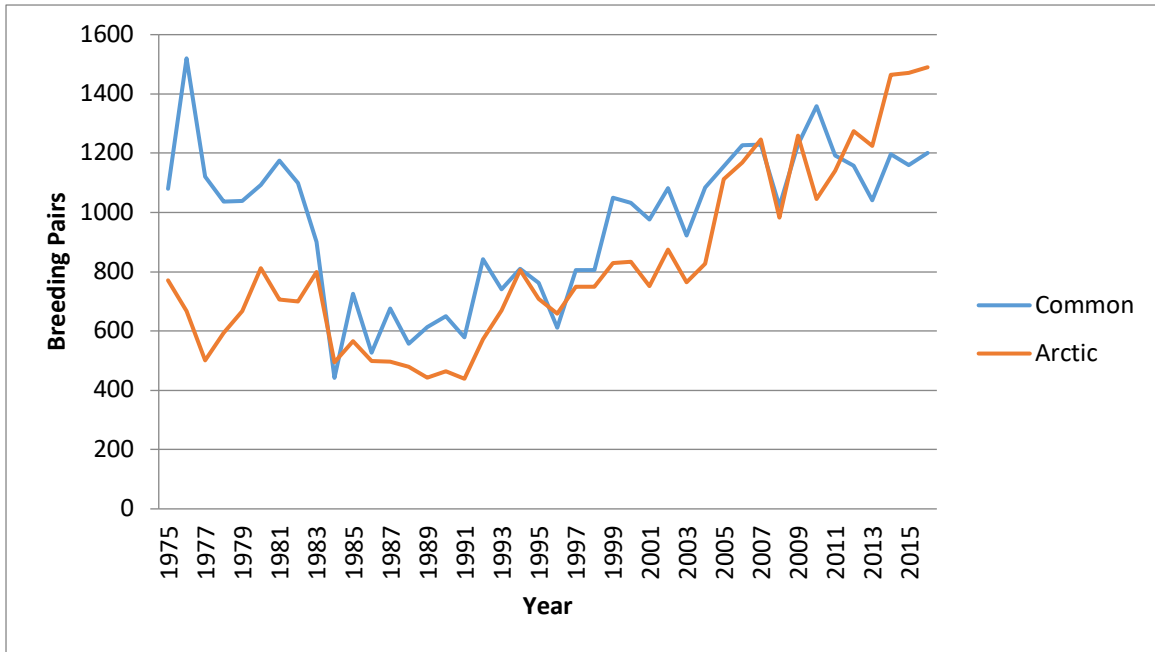


Figure 8 Number of common and Arctic terns on Coquet between 1975 and 2016

The mean productivity for common tern on Coquet between 1991 and 2016 was 1.16 and for Arctic tern 0.87 chicks per nesting pair (Figure 9). The productivity of both species varies greatly across years, but follows a similar pattern suggesting that it is effected by similar drivers acting on both species (Figure 9).

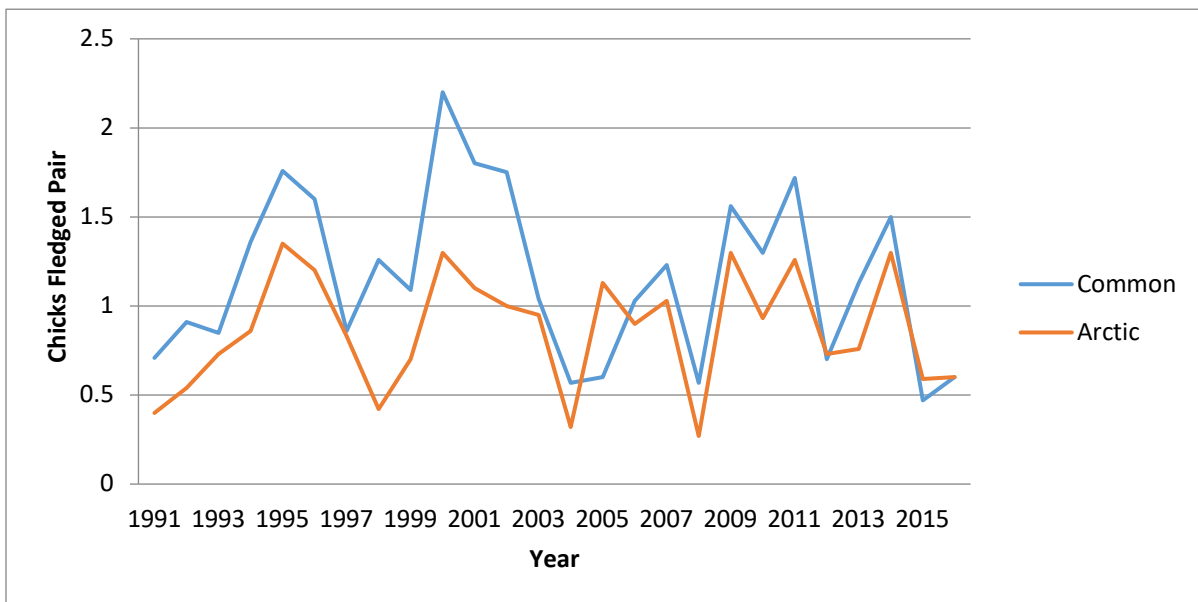


Figure 9 Productivity of common and Arctic tern on Coquet between 1991 and 2016

5.3.2 Disturbance from gulls and other avian predators

Herring and Great Black-back Gulls were responsible for a relatively high level of predation on **Rockabill** in 2016 resulting in lower productivity of all tern species terns. Gulls were also

responsible for the very low hatching success of Kittiwakes. The predation from other species, most importantly from peregrine falcon and kestrel were lower or similar level compared to other years.

Compared to previous years, predation from Black-headed Gulls caused concern at **Lady's Island Lake** and to some extent also on Coquet (Table 6). Peregrine Falcon and Kestrel were visiting the colony taking tern species on a few occasions.

There was a dedicated PhD student on **Coquet** this year studying the impact of large gull species on roseate tern colony. The study was part funded by Natural England to determine if the breeding Herring and Lesser Black-backed Gulls on the island are responsible for predation of roseate terns, which will inform improved gull control measures for the colony. The student undertook the whole day observations of the colony, recording all disturbance events. Some breeding Lesser Black-backed Gulls were GPS-tagged to monitor their movements. Pellets around the nests and stomach contents were also analysed. The predation wasn't noticeably more intensive than in previous years, after annual gull control measures were implemented. The report will be available in December 2016.

Table 6 Disturbance from gulls and other avian predators

	Rockabill <i>Burke, Kinchin-Smith and Newton 2016</i>	Lady's Island <i>Daly, Murphy & Murray 2016</i>	Coquet <i>Davies and Morrison 2016</i>
<i>Crow</i>	A pair attempted to nest on the island, but was removed by wardens.	A pair nested in the Monterey Tree on the northern end of Inish and another pair nested successfully on the main peninsula close to the castle.	N/a
<i>Peregrine</i>	Peregrine Falcons were only seen on six occasions and suspected on a further 3-5 days throughout the season (i.e. c10% of wardened days total), in contrast to previous years where they were much more regular visitors (e.g. suspected present 37 days/40% in 2015; Burke et al., 2015). Peregrines were seen or suspected to be responsible for disturbance on four dates in each of May and July, and twice in June. On average, disturbance attributed to Peregrines caused dreads of around 12 minutes (n=10) duration as well as unsettled behaviour for 10-20 minutes afterwards.	Two Peregrines made irregular visits to the islands up to mid-July and was noted taking tern species on most occasions. Two adult roseate terns were noted prey species on the 17/18th May.	A female peregrine visited the island approximately once every two days taking a low number of terns, and many pigeons and Black-headed Gulls fledglings
<i>Kestrel</i>	A juvenile Kestrel <i>Falco tinnunculus</i> came to the island on the morning of the 4th of August. It caused high levels of localised disturbance at various parts of the colony over the next two days as it hunted, caught and plucked 2-3 chicks in Garden 3 and likely elsewhere, and perched on the lighthouse, the houses, the stairs behind the house, the sheds in Garden 3 etc. As with Kestrels in previous years it tended to fly over to the Bill when mobbed, though did spend a lot of time on the metal structures on the east end of the Garden 3 shed also. Though the terns mobbed it, the	A pair bred nested in a ruin near the southeast end of the lake and were noted on several occasions flying over both Inish and Sgarbheen. One was observed taking an arctic tern chick on Sgarbheen on the 25th June.	Kestrels and sparrow-hawks were present as the terns numbers were low at the end of the season and concentrated their effort on other migratory species present.

	Kestrel usually stayed where the kill was made until disturbed by a warden.		
<i>Oystercatcher</i>	N/a	Two oystercatcher nests were situated within the roseate tern colony and their contents were removed (under licence) as adult oystercatchers are known to depredate tern eggs and chicks.	
<i>Black-headed Gull</i>	N/a	178 pairs of black-headed gulls nested in colony B and were noted taking tern chicks throughout the early part of the hatching when common/arctic chicks were small enough to be taken.	During periods of prolonged sea fret and poor fishing conditions the black-headed gulls attention turned to the tern colonies and predation by this species increased.
<i>Lesser Black-backed Gull</i>	See great black-backed gull	Two pairs of lesser black-backed gulls were noted in Colony 'A' close to the black-headed gull colony on Inish. One nest containing three eggs was located on the eastern shore and removed on the 18th May. No other nests were found.	21 nests were left out of 36 for the study. Responsible for the highest percentage of predation events of all gull species.
<i>Great black-backed gull</i>	The issue of gull predation was worse in 2016 than in any previous year of the project and was second only to significant food shortage as the main cause of the record low productivity seen for both Roseate and common terns, and almost-zero productivity for Arctic terns. In addition, egg depredation by great	Two great black-backed gulls were observed taking sandwich tern and black-headed gull chicks from late June to late July.	No breeding, but small percentage of all gull predation events recorded.

black-backed gulls (GB) was the sole reason for the record-low productivity of Kittiwakes this year.

Around 150-300 large gulls (great black-backed gulls *Larus marinus*; herring gull *Larus argentatus*) were present throughout the season, congregating on the Bill.

herring gull

See Great black-backed gull above

1 pair bred in 2016

5.3.3 Other factors limiting productivity

All nest boxes were used on Coquet

Table 7 Other factors limiting productivity

<i>Factor</i>	<i>Measure of impact</i>	<i>Rockabill</i>	<i>Lady's Island</i>	<i>Coquet</i>
<i>Nesting competition with gulls</i>	Number of gulls breeding. Extend and methods of creating gull-free zones	No gulls breeding	2 Lesser Black-backed Gulls. 1 nest removed.	1 herring gull 26 Lesser Black-backed Gulls Some gull nests were removed, breeding attempts are discouraged by a combination of methods
<i>Nesting space and nest boxes</i>	<i>Area of terraces created and number of nest boxes</i>	Vegetation clearance from nesting area and creation of flat surface (terraces) for the deployment of nest boxes and open nests.	No vegetation management required 330 nest boxes deployed. 91% of nest box uptake	Terraces covered with artificial material to prevent vegetation regrowth, but still strimming required. Areas

		759 nest boxes deployed, 68 more than in 2015. 100 boxes made as part of the project.		within the gardens are trimmed for Arctic terns. Also plots trimmed for Sandwich terns.
		91% nest box uptake, which is the highest recorded on ROC.		Boxes: 216
		Almost double productivity for pairs in nest boxes, compared to open nests.		99% nest box uptake
<i>Nest depredation</i>	<i>Mean clutch size</i>	Mean clutch size: 1.68	Mean clutch size: 1.43	Mean clutch size: 1.2
	<i>Hatching success</i>	Hatching success: 0.88	Hatching success: 0.85	Hatching success: 0.76
<i>Food availability and quality</i>	<i>Monitoring of prey species, size and provisioning rates</i>	Sandeels were the most common prey item (51.3%) presented to roseate tern chicks, followed by clupeids (47.4%) and gadoids (1.3%). Roseate tern chick provisioning rates peaked during the 17:00-20:00 period.	Not recorded	Not recorded
		Clupeids were also the most common prey item presented to Common Tern chicks (86.8%), followed by sandeels (11.9%) and Gadoids (1.3%).		
		Snake pipefish were seen at common tern nests in June and July, though not to the same extent as in 2015 or 2014. Prior to that they had not been recorded in any numbers on Rockabill since 2007.		

Weather

Record the weather throughout the season.

The weather was thought to contribute the lower productivity this year. A few days of strong winds and rain during the hatching period affected many chicks.

April. Temperatures were average, 7.3 degrees Celsius and a total rainfall of 79 mm.

May. Temperatures were below average, 11.4 degrees Celsius and a total rainfall of 70.3mm.

June. Temperatures were average 14.5 degrees Celsius and a total rainfall of 93.5mm.

July. Temperatures were average 15.3 degrees Celsius and a total rainfall of 40.9mm.

Precipitation was recorded at Lady's Island Lake on 32 days between 1st April and 31st July with heavy rain on the 19th June and the 9th July.

During the spring and beginning of summer the island was subject to strong northerly winds with prolonged rain and heavy sea frets. This weather was persistent throughout the laying, small chick and re-lay breeding stages and caused many nests to fail.

5.4 Other roseate tern breeding records in 2016

In 2016, there were 3 pairs of roseate tern breeding on the following sites:

- **The Skerries (Anglesey)** - 10 years since the last roseate tern pair bred at the site, one pair was discovered very late in the season, producing a single chick, found on 6th August. This juvenile was 15 days old on the day the wardens left, but two subsequent visits to the island indicate that it is almost certain to have been abandoned by the parents before fledging (Kelly and Smith 2016).

Two roseate terns paired and bred with common terns in the same area of zone 1a as in previous years, nesting behind the garden wall to the West perimeter, and were believed to be the same returning individuals.

- **Larne Lough (Northern Ireland)** – 1 pair of roseate tern was present throughout the season, first appearing on 13th May. On one occasion (9th of June) the presence of a third adult was suspected, but not confirmed. The single pair bred successfully in a nest box on the north east corner of Blue Circle, raising one young (Wolsey 2016). Roseate terns have been breeding on the island since 1993, although only 1 pair has bred since 2009 (Figure 10).

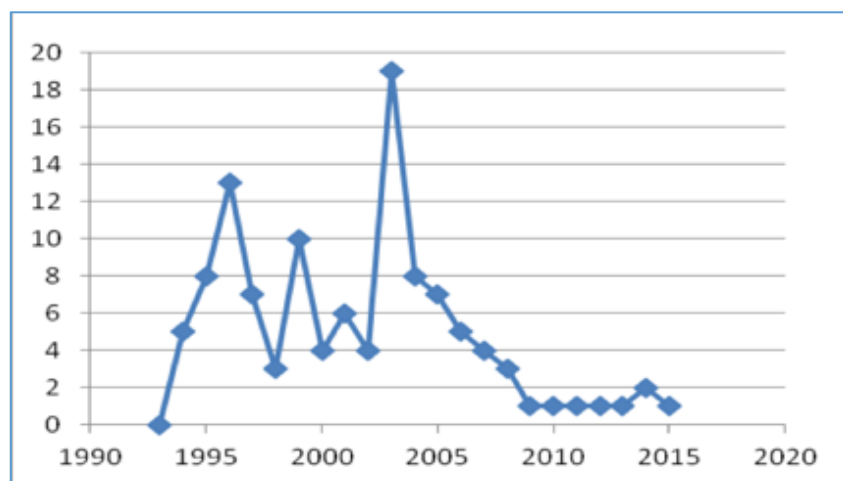


Figure 10 Number of roseate terns breeding on Blue Circle Island (Larne Lough) between 1993 and 2015.

- **Dalkey Islands (Ireland)** – one pair laid egg, but was subsequently predated.

Furthermore, the following sightings during the breeding season were recorded, but not breeding confirmed.

- **Long Craig Island (Forth Islands, Scotland)** – one mixed pair of roseate with a common tern attempted to breed in 2016 as in 2015. The breeding success was unknown. In 2014, there was one bird present during the season. The numbers of roseate terns on Long Craig between 1986 and 2014 is shown in Figure 11.



Figure 11 Number of roseate terns breeding on Long Craig island between 1986 and 2014 (Fife Bird Club data)

- Another mixed pair of roseate and common bred in **Leith Docks** in 2016 (Oksier 2016).
- **Solent and Southampton** – one bird was photographed on the trap camera located near the common tern nest on the 17th of July.

6 Other project sites without roseate tern colonies

Monitoring of non-roseate tern sites includes the numbers and productivity of associated tern species, of which common tern is most important for the potential recolonisation by the roseate tern. As mentioned above, roseate terns, as a less aggressive species, benefit from the protection of more aggressive common and Arctic terns. Conservation measures aiming at creating suitable conditions for the roseate tern should therefore focus on boosting the numbers of these species. Threats that can be managed should be minimised so that the site does not become an ecological trap for dispersing roseate terns.

6.1 Forth Island SPA

Forth Islands SPA consist of several islands (Figure 12) however, common terns breed only on Isle of May and Long-Craig island. Remaining islands within the SPA, where terns traditionally breed, have been taken over by large gull species. These were Inchmickery, Fidra and a number of other sites outside of the Forth SPA, namely Grangemouth, Rosyth Dockyard, Forth Rail Bridge, Granton Harbour, Aberlady Bay and St. Beldred's Boat (Jennings 2012).

More recently, outside of the Forth Island SPA, common terns have also bred on pontoons in Port Edgar Marina, 1.5 km south from Long-Craig, Carlingnose Pier and Leith Docks. The latter supported 818 pairs in 2010 and most likely comprises terns displaced from other sites within Firth of Forth area (Jennings 2012).



Figure 12 Forth Islands SPA (yellow) and Firth of Forth SPA (green)

6.1.1 Project activities in 2016

In 2016, the project team undertook a review of management options available for Forth Islands SPA. It has been concluded that the project will invest funding into improving the nesting conditions and limit predation impact on Long Craig. This population of common tern will additionally be supported by reinstalling pontoons in Port Edgar Marina.

The Isle of May is well managed by the SNH and, apart from exchange of knowledge and advisory, there is no need for direct intervention of the project on this site.

Consideration has been placed on creating nesting space for terns on Fidra, but considering the sheer number of breeding gulls and their declining conservation status, any lethal intervention would not be feasible. This, together with previous experience of controlling gulls on Inchmickery, did not allow for perusing this option.

However, from 2017 a tern warden will be employed to help with the habitat management, biosecurity and annual monitoring on Inchmickery and Fidra.

6.1.2 Monitoring of tern species in Forth Islands

In the light of the above, the monitoring report will focus on Long Craig and Port Edgar Marina, where direct conservation measures are planned. Additionally, Isle of May and Leith Dock numbers will be reported to gain the picture of the whole metapopulation.

The monitoring of terns on **Long Craig** is carried out by the Scottish Wildlife Trust, who manage and owns the site. Usually, four visits are made to the colony when all nest are counted and checked for hatching success and productivity. This is carried out on the whole colony, rather than in a study plot.

Number of breeding common terns in **Port Edgar Marina** has so far been carried out by the Forth Seabird Group. The tern warden will carry out the counts from 2017.

Isle of May is monitored by the SNH. Number of occupied nest is determined for the whole colony. In case of Arctic tern hatching success and productivity is measured within a study plot.

6.1.3 Numbers and productivity of tern species in 2016

168 pairs of common terns bred in 2016. Productivity and numbers of common terns for 2012-2016 is in Table 8. There was a low 0.26 productivity in 2016 (Oksien 2016). There has been a steady decline of common tern numbers over the years, which was probably the reason behind roseate tern decline (Figure 13).

Table 8 Numbers and productivity indices for common tern on Long Craig island between 2012 and 2016 (Oksien 2016)

Long Craig Island Common Tern Breeding					
	2012	2013	2014	2015	2016
Maximum adult count	5	109	312	200	266
Breeding pairs	0	73	131	132	168
Clutches	0	84	137	134	206

Eggs laid	0	151+	180+	169+	270+
Eggs Hatched	0	96	140+	161+	117+
Eggs Un-hatched	0	16	12	-	-
Eggs outcome unknown	0	39	10	-	-
Young Fledged	0	c90	130+	157	44+
Young Died	0	4	c10	4	20

The project will invest funds to increase the nesting area by heightening the island above tidal waters, together with improved fox and gull control before the 2017 season.

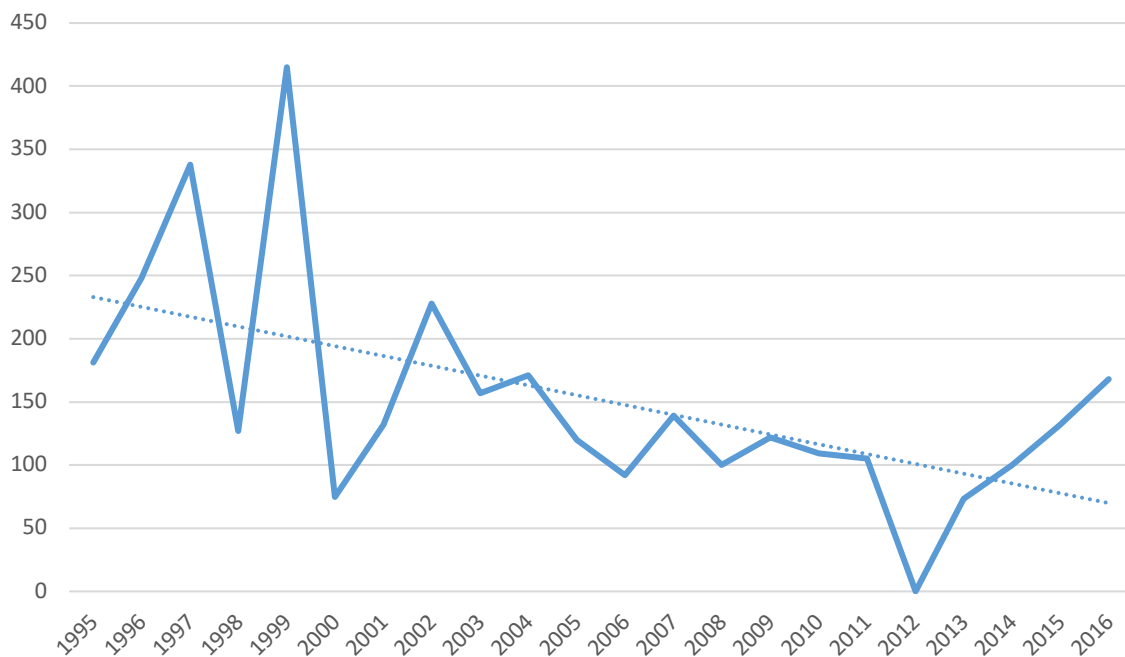


Figure 13 Number of breeding common terns on Long Craig between 1995 and 2016.

Port Edgar Marina did not support any terns in 2016 due to the deterioration of pontoons, which eventually sunk before the breeding season (Fraser per. comm. November 2016). The pontoons will be reinstalled by the project before the 2018 season. Previously, the site supported a small number of breeding common terns (3-45 pairs). Mean number of observed common terns from the BTO counts were much higher suggesting that the nesting space might have been an issue (Figure 14)

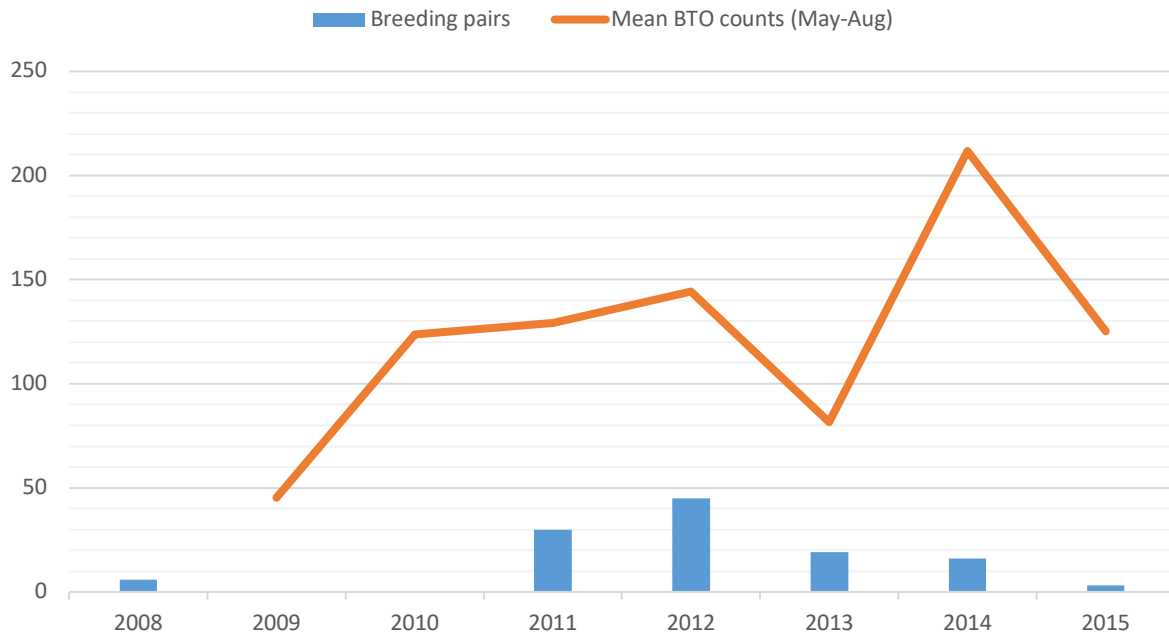


Figure 14 Breeding pairs and mean recorded number of common terns in Port Edgar between 2008 and 2015.

Isle of May is managed by the Scottish Natural Heritage (SNH), which remains in an advisory capacity to the project. In 2016, 19 pairs of common and 527 Arctic terns bred on the island. The managers created a terraced area (83 m²), which lured 21 pairs of Sandwich terns for the first time since 2008, when only 2 pairs bred. Productivity for Arctic tern was 0.65 and Sandwich tern 0.76. This autumn SNH plans to double the size of the terrace (David Steel, pers. comm., 14 Nov. 16).

6.1.4 Issues affecting tern productivity

Within the framework of the project, the productivity issues will be discussed only for the sites where direct conservation measures will be implemented, i.e. Long Craig and Port Edgar Marina.

Long Craig is a small island located very close to the mainland. The following issues have been identified for the site:

- The lack of nesting space – most of the island is vulnerable to flooding during high tides.
- Proximity to mainland with high risk of penetration by rats and land predators
- Depredation from large species of gulls
- Potential issues with food supply

The above pressures have not been sufficiently measured and therefore their impact is impossible to assess. This will change from 2017 when the dedicated warden will be able to take account of the scale of impacts.

Pontoons at **Port Edgar Marina** are vulnerable to damage and dislocation from tidal waters. However, this can be addressed through the design and appropriate fixing. The pontoons are located on the part of the marina that is not used by boat users. There is a minimal risk of rat and land predators, which can also be addressed through the design of vertical walls. Lastly,

there is a risk of pontoons being taken by gull species before the terns arrive, which require management.

6.2 Ynys Feurig, Cemlyn Bay and the Skerries SPA

The colonies of the four species of tern for which the SPA is classified are situated at three different sites: Ynys Feurig, Cemlyn Bay and The Skerries (Figure 15). Ynys Feurig is a series of small islets off the west coast of Anglesey which are joined to the Anglesey mainland at mid to low tide. Most tern species nesting at this part of the SPA are Arctic terns with a smaller breeding population of common terns. The Skerries is a group of sparsely vegetated rocky islets, approximately 17ha in extent lying 3 km off the north western coast of Anglesey. Most terns breeding on The Skerries are Arctic terns with a much smaller population of common terns. The other colony which makes up this SPA is at Cemlyn Bay on the north coast of Anglesey, which comprises a saline lagoon separated from the sea by a shingle ridge. At this site, the terns (mainly sandwich terns with much smaller numbers of common and Arctic terns) breed on two small islands within the lagoon (NRW 2015).

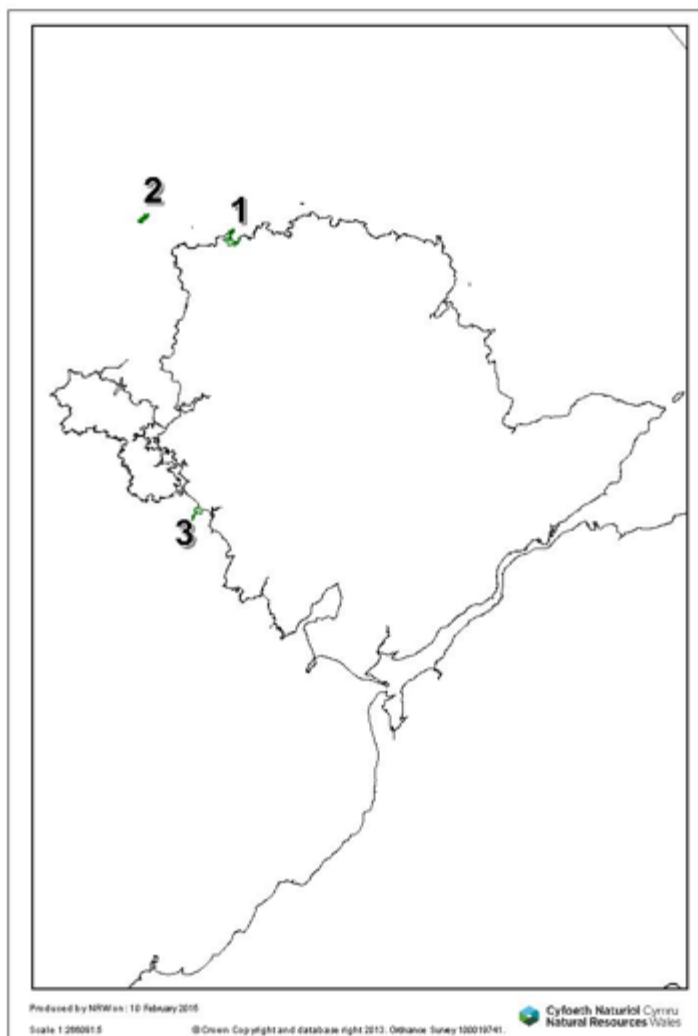


Figure 15 The location of Cemlyn Bay (1), the Skerries (2) and Ynys Feurig (3).

6.2.1 Project activities in 2016

The Skerries and Ynys Feurig are managed by the RSPB, while Cemlyn Bay by the North Wales Wildlife Trust. All colonies have been managed as nature reserves for many years.

Table 9 Management summary for Ynys Feurig, the Skerries and Cemlyn Bay

Ynys Feurig	The Skerries	Cemlyn Bay
<p>Biosecurity assessment was undertaken and the plan developed. Two wardens were employed throughout the season. 75 roseate tern nest boxes were deployed. The productivity of the colony was greatly affected by crow predation. Foxes were also recorded attempting to access the colony, but were successfully discouraged by wardens. One fox was eliminated early in the season by a contracted marksman. It was decided that a fox/crow contractor will be employed from January to minimise the number of predators before the breeding season. The cost will be covered from the vacant potable water system for the Skerries. The observation hide will be replaced in winter 2016-17. Thermo-vision equipment will be purchased before the end of the year to address the serious predation problem at this site.</p>	<p>6 small terraces were built by levelling ground by hand and surfacing with shingle or loose material (mainly rubble and clinker) and placed about 43 rosy boxes on them.</p> <p>7 roseate tern decoys were made by hand from clay, painted, and placed on one of the terraces.</p> <p>A roseate tape lure was borrowed from NRW and operated during the early part of the season; however it failed after a week or two and was never successfully repaired</p> <p>New nest boxes were built and deployed in an improved configuration, advised by the roseate tern colony managers from Rockabill and Coquet during a networking visit. The wardening season (2 full-time wardens) was extended two weeks to deal with the likely botulism occurrence in the colony, which killed 477 adults and 355 juveniles of Arctic tern. The case has been investigated by APHA (Animal and Plant Health Agency), but tests for any other disease were negative. It is likely that it will affect the number of birds next year.</p> <p>Biosecurity assessment was undertaken and the plan developed and now needs to be signed off.</p> <p>There was an increased pressure from large gulls and raven this year. Aerolaser was purchased to increase the effectiveness of gull management. It proved effective to discourage most gulls and ravens,</p>	<p>Two wardens were employed throughout the season. Upgrade to wardening facilities were not required in Year 1, as the National Trust (owner of the site) made some improvements in 2015. The accommodation needs will be reviewed and implemented before the 2017 season. There were no rough gulls in 2016 season, meaning that the marksmen contractor was not required. Purchase of anti-gull spikes, fencing and other equipment is planned for winter 2016-17.</p> <p>The repair to the shingle bar will be carried out by the National Trust, the site owner, as part of the property maintenance, and is not required anymore to be included in this project. NWWT will instead restore the tern island, which eroded and is consequently permanently flooded. Mudflats created by this process (up to 10% of the island) are not used for nesting by Sandwich terns, creating competition for space with common terns. Against this background,</p>

	<p>particularly in low light. As every year, gull nests within 150 meters from the colony were removed, under the licence.</p> <p>Vegetation growth at the site continues to increase at the site. This year at least 60 nests were completely inundated by vegetation and subsequently abandoned, leaving saturated dead chicks and eggs. In the next reporting season the project team will concentrate on developing an effective method to limit this growth and restrict the spread of both Stinging Nettle and Sea Mayweed. This will be conducted in collaboration with Coquet managers, who will be carrying out their own trial next season.</p>	<p>the following work is being planned:</p> <ul style="list-style-type: none"> • increase the availability of nesting habitat on the main island and smaller island • put in place rafts specifically designed to support nesting terns and prevent access by mammals • erect mammal proof fencing around at least part of the islands
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6.2.2 Numbers and productivity of tern species in 2016

Ynys Feurig

There were three sightings of roseate tern on **Ynys Feurig** in 2016, on 24 June, 03 July and 06 July. 75 nest boxes were placed on outer island in terraces with shingle/shells placed in front. This was an attempt to attract breeding Roseate Terns. This was unsuccessful (Hrastelj and Lane 2016).

There were 238-287 Arctic terns breeding in 2016 (427-456 in 2015), which was below the five-year mean 338-396 breeding pairs (Table 10).

Table 10 Estimates of Arctic tern pairs 2011-2016

Year	2016	2015	2014	2013	2012	2011
Pairs	238-287	427-456	335-389	158-220	533-630	520-554

The number of recorded breeding pairs of common terns on Ynys Feurig was lower than in 2015, with an upper estimate of 165 pairs (190 pairs in 2015) (Table 11).

Table 11 Estimates of common tern pairs 2011-2016

Year	2016	2015	2014	2013	2012	2011
Pairs	116-165	161-190	123-177	127-189	126-223	178-212

The overall trend of “commic” (Arctic and common terns) has recently been downwards most likely due to increased predation from foxes and crows (Figure 16).

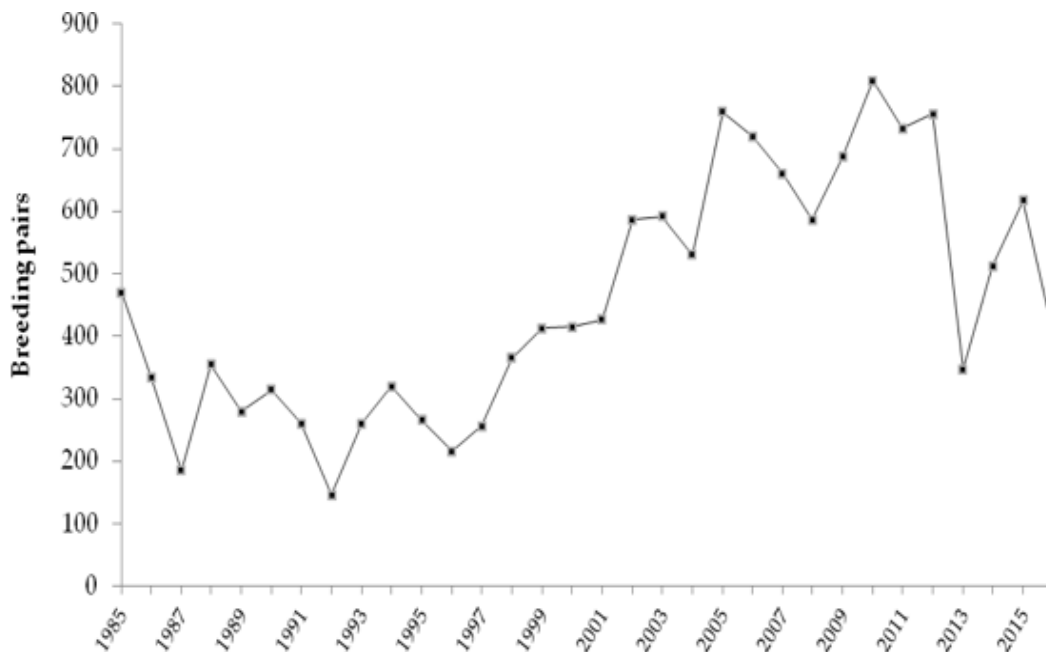


Figure 16 Number of "commic" terns breeding on Ynys Feurig between 1985 and 2016

The 2016 season was very poor when compared to the 2 previous years, with the number of 'Commic' breeding pairs totalling 403 (617 in 2015, 512 in 2014), this estimate is thought to be lower than the actual number of pairs attempting to breed. This was due to severe egg predation before the peak clutch count (21-25 days after first egg) could be carried out. Total mortality was again high in 2016 at 29.02% (30.84% in 2015). Chick mortality accounted for 11.96% of the total observed losses in 2016, which is considerably lower than the 69.79% in 2015. This chick mortality difference was concluded to be because of no fox intrusion in 2016. It must be stressed however, that egg predation by crows was a major factor in extremely low chick hatching, with egg predation accounting for 74.16% of the total observed losses. This is considerably higher than the 30.24% total egg losses in 2015. **Significant crow predation was observed throughout the egg stage, resulting in the total failure of middle island for the fourth season running** (Hrastelj and Lane 2016).

The Skerries

On the Skerries, one roseate tern pair produced a single chick late in the season. This is the first pair to have bred on The Skerries since 2006. Unfortunately, the chick was most likely predated (Kelly and Smith 2016).

3816 Arctic terns and 290 common terns bred on the Skerries in 2016. Colony size has expanded consistently since the start of the wardening program. Productivity was below target (target = 0.57 fledglings/pair) (Figure 17).

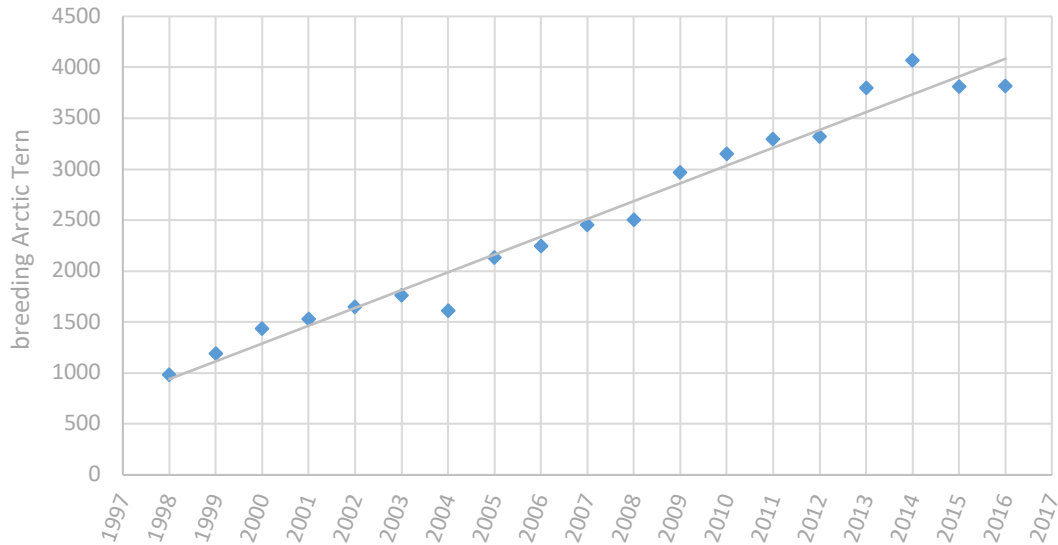


Figure 17 Breeding Arctic Terns on the Skerries from 1998 to 2016 (Kelly and Smith 2016)

Number of breeding common tern is much higher than target number. This season saw a continued increase in the number of common tern pairs, with the highest number of pairs ever recorded (290). Productivity was below target (target = 0.75 fledglings/pair) (Figure 18)

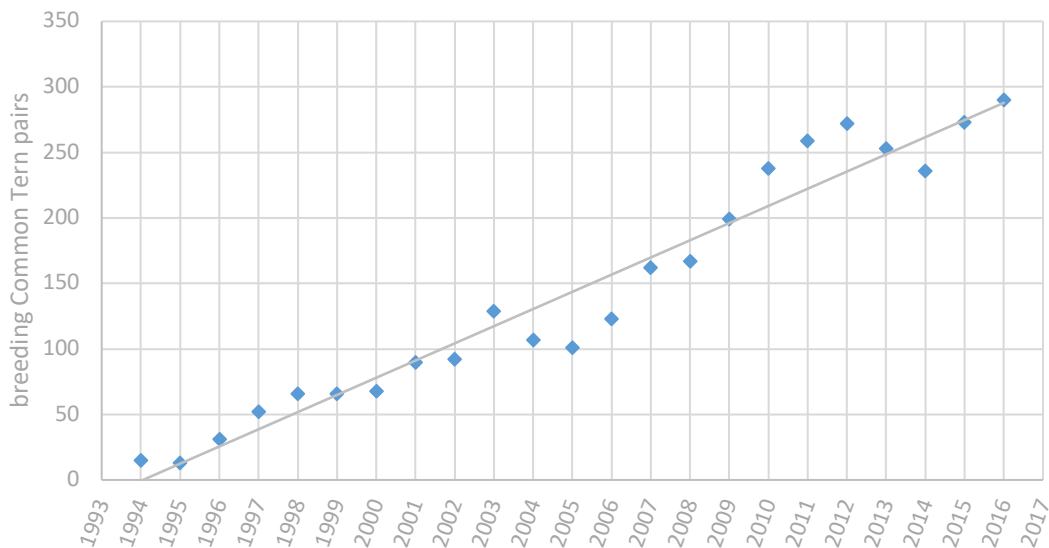


Figure 18 Breeding common terns on the Skerries from 1994 to 2016 (Kelly and Smith 2016)

This season suffered the highest predation ever recorded at the site. Great black-backed gull, herring gull and Raven all took large numbers from the colony. While less than five herring gulls are prolific predators, no positive identification of individuals was made. By the end of the season many, if not all, Great black-backed gull nest sites were littered with tern fledgling remains and caution must be taken to avoid singling-out or overstating the predation levels of those gulls most visible from usual vantage points (Figure 19)

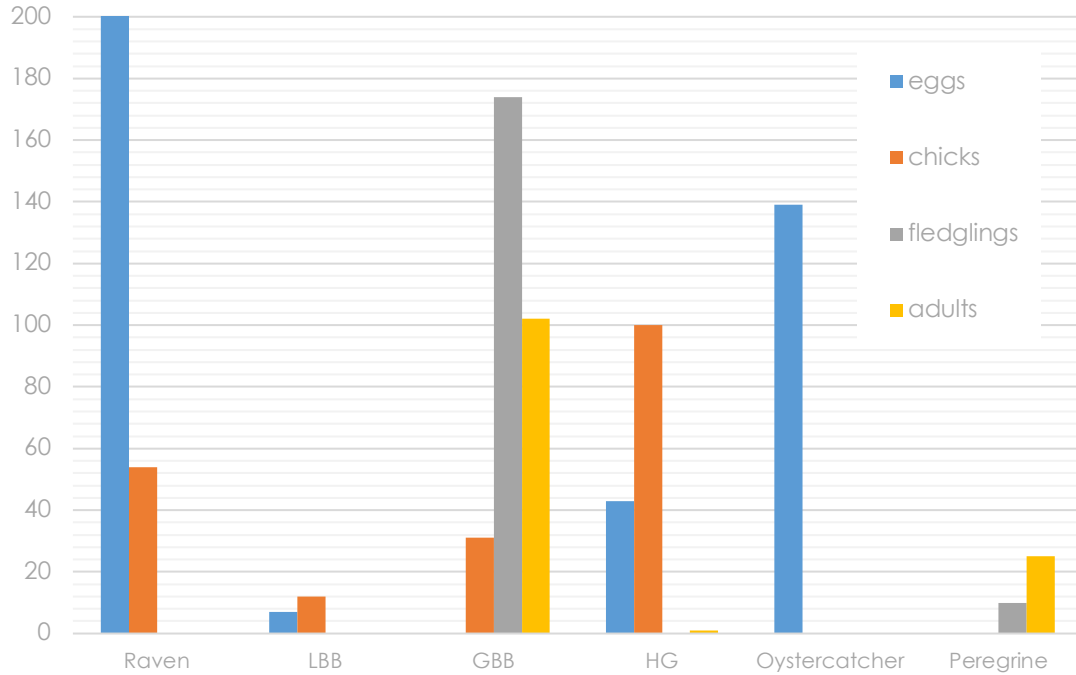


Figure 19 Minimum confirmed predation of tern eggs, chicks, fledglings and adults by predator species on the Skerries in 2016 (Kelly and Smith 2016).

This season saw the mortality of 471 adult Arctic Terns most likely from botulism, which need to be finally ascertained. At least 355 juveniles (3 weeks old and above) were also found dead in similar circumstances to the adults.

Cemlyn Bay

1. Monitoring methods and the effort.

Tern and gull numbers within the colony are counted daily throughout the season. These counts are conducted from the shingle ridge overlooking the colony (30-50 m distance). In addition, one direct colony count was carried out; poor weather prevented secondary counts (Wynne 2016).

2. Roseate tern numbers and productivity

As in previous years, there were regular records of single birds throughout the season. The first was recorded on the 14th May and there were another three records during May. There were five records in June. There were records on five days in July. The last record was on the 28th July, the individual had silver rings on both legs. No display, copulation and ‘scraping’ behaviours were seen.

3. Numbers and productivity of associated species – notably common, Sandwich and arctic terns

Table 12 Results of Colony Count on 27th May 2015 (Wynne 2016)

	Sandwich Terns	Common Terns	Arctic Terns	Black-headed Gull
No. Pairs (Estimate)	2295	17	31	353
No. Eggs	3178	19	47	878
Mean Clutch Size	1.38	1.12	1.52	2.49

Table 13 Summary of colony activity for 2016 (Wynne 2016)

	Sandwich Terns	Commic²	Common Terns	Arctic Terns	Black-headed Gull
No. Pairs (Estimate)	2595	120	60	60	374
No. Eggs	3680*	113*	63*	53*	893*
Mean Clutch Size	1.42	0.94	1.4	1.84	2.39
Max Observed Fledglings	1650	2	2	0	300
Estimated Fledglings	1900	2	2	0	400
Productivity	0.73	0.02	0.03	0	1.07
Survival Rate	0.52	0.02	0.03	0	0.44

* Estimated total number based on true average from nest count.

While predation levels were, relatively speaking, low (total observed/recorded predation of breeding adult Sandwich terns is estimated at less than 1% and fledgling Sandwich at 6%), there were significant levels of disturbance particularly affecting the common/Arctic terns - this is thought to be down to the otter presence compounded by goose family/group (a wire strand around the island collapsed under the weight of seaweed).

Human disturbance was minimal although there is an increasing use of Cemlyn Bay for recreational activities which may have a detrimental effect on the feeding of the terns. We hope to address this.

6.3 Larne Lough SPA

6.3.1 Project activities in 2016

Biosecurity assessment was completed and implemented. An external contractor was employed throughout the season. The warden monitored bird numbers on Blue Circle and Swan islands and deployed and checked wax chewing stations for rat monitoring and mink traps. Numerous corpses carrying signs of mammal predation were found, most likely caused by otter or mink. Vegetation management was carried out towards the end of the season to create open space for common terns. 18 new nest boxes were deployed. More details are in (Table 14).

Table 14 Details of management activities on Blue Circle and Swan islands in 2016 (Wolsey 2016)

New roseate nest boxes	Eighteen new roseate nest boxes were deployed on 10 th May (see image 2 in appendix 1). The one nesting pair of roseates did not use these boxes (they used an old concrete box). These new boxes were retrieved for the winter during the October habitat management visit.
Deployment of rat chews	As detailed earlier in this report, on 9 th June approximately 20 rat chews were deployed on Blue Circle and 8 deployed on Swan Island. These were then inspected on each subsequent visit for signs of having been eaten. None showed signs of being eaten by rats.
Mink rafts	Two mink rafts were deployed on Blue Circle and one on Swan Island on 12 th July. One of these on Blue Circle and the one on Swan had to be deployed in terrestrial locations and so had to have the ‘well’ for holding the clay tracking compound modified with a water-holding membrane. They were all inspected during the subsequent two visits, but none showed any signs of mink or any other tracks.
Trail camera	A trail camera was deployed on Blue Circle, on 12 th July, overlooking the lowest access point where the outer wall is breached and the tide flows in and out of the inner island. This was considered the most likely entry/exit point for otter or mink (though they could access the island at any point around the edge). During the first week of deployment 182 video recordings were made, and then 110 recordings in the second week. None recorded any mammalian activity.
Habitat management (October)	Three areas on Blue Circle Island – roughly equating to the common tern and Sandwich tern nesting areas shown on Map 1 above – were sprayed with herbicide to kill the multi-year growth of couch grass. The aim of this is to leave better breeding habitat for common and Sandwich terns, in particular the common terns.

6.3.2 Numbers and productivity of tern species in 2016

Roseate tern. Only 1 pair of roseate tern was present throughout the season, first appearing on 13th May. On one occasion (9th June) the presence of a third adult was suspected, but not confirmed. The single pair bred successfully in a nest box on the north-east corner of Blue Circle, raising one young.

Sandwich tern. A count of nests on 23rd May resulted in a count of 1,070 on Blue Circle and 129 on Swan Island. Subsequent additional nesting on Swan Island increased the number there to 159, giving a total of 1,229 for the two islands. Breeding on Blue Circle seemed to be synchronous, but on Swan Island it was spread over the whole season with eggs still hatching at the time of the last (during the season) visit on 26th July. This spread on Swan made it particularly difficult to assess exactly how many pairs bred, but the figure of 1,229 is thought to be a minimum.

Common tern. A total of 333 pairs of common terns are thought to have attempted to breed on the two islands (145 on Blue Circle, and 188 on Swan). On both islands the season for this species was protracted, with fresh breeding attempts being made into July. As described and discussed in the productivity section below, the breeding outcomes from each of the

islands was very different, with some reasonable success on Swan, but very poor productivity on Blue Circle.

Table 15 Productivity estimate for terns on Blue Circle and Swan islands in 2016 (Wolsey 2016)

Species	Productivity assessment	Productivity
Sandwich tern	As with black-headed gulls the high numbers of sandwich tern, their density, the mobility of their chicks and the dense vegetation made estimation of productivity extremely difficult. However, the large number of fledged young present from mid-June (165 on 25 th June, 330 on 6 th July) indicated that this species had a very successful year. This probably still the case even taking account of some losses to (otter?) predation and food shortage late in the season.	good
common tern	The productivity of common terns was quite different on Blue Circle and Swan Island. On Swan Island an extended breeding season meant that small numbers of fledged and near fledged common terns were seen from the end of June. The dense vegetation on Swan meant that finding young was difficult. Nevertheless, productivity is thought to have been fair on Swan. In contrast, on Blue Circle, although the occasional very young chick was found from mid-June, none were seen to have survived to even near fledging, despite repeated and detailed searching. Only at the very end of the season, mid-July, did there begin to be more young (though still very young) common terns on Blue Circle, and none are known to have fledged.	fair (Swan) poor (Blue Circle)
roseate tern	The single pair of roseate terns on Blue Circle managed to fledge a single chick. This bird was on Swan Island a few days later, and has possibly been re-sighted in Wexford in early August 2016 (to be confirmed).	1.0 good

6.3.3 Issues affecting productivity

Predators have been an issue on both Blue Circle and Swan Islands throughout the season. Mammalian and avian predators have been involved (Wolsey 2016).

Avian predator species appear to be limited in number. Through the season there have been a very small number of Herring, Lesser Black-backed and Great black-backed gulls present either at Blue Circle or Swan Island. However, in most cases numbers have been limited to 1, 2 or 3 birds and while it must be assumed that they have been undertaking some predation, they were not seen to be particularly active and their impact is thought to be relatively minor.

Hooded crows were not present for most of the season but they did begin to make an appearance near the end of the season – first seen on 6th July with 2 birds present, and then 1 bird on 12th July. They were not seen to be particularly active and their impact is thought to be relatively minor.

A Black-headed gull was seen to take a small Sandwich tern chick on Swan Island. It must be assumed that this was not an isolated incident, and therefore, given the number of black-headed gulls on both islands, they may have had a significant impact on other species. It could be that the very poor productivity of common terns on Blue Circle has been caused by black-headed gulls. The productivity of common terns only appeared to improve at the very end of the season when most of the black-headed gulls had left (though the same could be said about Mediterranean gulls).

Mediterranean gulls are also likely to have been significant predators, though this is only assumed from their reputation rather than from observation on Blue Circle or Swan. With up to 12 adult Mediterranean gulls present these birds could have had a real impact on other species. Mediterranean gull nesting sites were all close to the Sandwich tern colony (though of course nowhere on the island is far away) though it is not known if this is significant. Mediterranean gulls may also be responsible for the poor common tern productivity.

Without the ability to sit and observe undisturbed avian activity on Blue Circle it is hard to know which species is doing what. Thus the recommendation for a small observation hide.

Mammalian predation was evident throughout the season, particularly on Swan Island. On the first of the season's visits, on 10th May, a decapitated black-headed gull on Swan Island was a sign of things to come. During most visits to Swan there were a small number of remains of both chicks and adults that appeared to have been killed by a mammalian predator. It seems likely that the productivity of common tern, black-headed gull, Sandwich tern and red-breasted merganser were all affected to some degree by mammalian predation.

On Blue Circle Island predation by a mammal was not evident until 3rd June when 5 young black-headed gulls were found dead and largely eaten. Predation on Blue Circle slowly increased after this to a peak on 6th July when there were a large number of freshly dead birds – mostly young Sandwich terns. The nature of the carcasses – where many were turned inside out – indicated that the most likely predator was an otter. This peak in predation coincided with the presence of a considerable number of weak young Sandwich terns and black-headed gulls – it is thought due to a shortage of food – and thus the predation may not have made much of a difference to productivity levels as the young birds killed may not have survived anyway.

There was no evidence of rats or mink on either island, despite deploying rat chews (on 9th June) and 3 mink rafts (on 12th July).

6.4 Dalkey Islands SPA

6.4.1 Project activities in 2016

Biosecurity assessment was completed in June 2016.

Warden was employed and attended the site twice a week to mark nests, assess clutch size, hatching success and productivity. This year our focus was increasing the frequency of basic monitoring visits and running public events.

6.4.2 Numbers and productivity of tern species in 2016

Methods are evolving as we have just resumed more regular wardening of the site – aimed to make 1-2 visits a week to both nesting islands to mark nests, assess clutch sizes, hatching success, ring chicks etc. (Newton, *pers. comm.* Nov 2016).

Only one pair of roseate tern bred on Maiden Rock after a few years of absence. However, return of a pair is good news since no nesting attempts in 2015.

Common Tern - 8 pairs

Arctic Tern - 97 pairs

Overall mean clutch 1.98, productivity about 0.19

6.4.3 Issues affecting productivity

Nesting space and nest boxes were deployed both on Maiden Rock and Lamb and a healthy colony of over 100 terns were breeding (97 and 8 pairs for Arctic and common tern respectively). Unfortunately, almost all chicks were suddenly predated between warden visits. It is likely that this predation was caused by American mink. Deployment of a new batch of Roseate Tern nest boxes on Lamb Island did not draw in Roseate Terns and the only pair to nest used the ‘traditional’ cluster of boxes on Maiden Rock. However, on Lamb, the Arctic Terns appeared to ‘choose’ to nest near the new box terraces and many chicks sheltered in them. The attempts to shift the colony from Maiden Rock to Lamb will continue in coming years.

6.5 Solent and Southampton SPA

Solent & Southampton Water SPA is situated on the central southern coast of mainland UK and North of the Isle of Wight. Along the south coast of Hampshire, the SPA area extends from Hurst Spit to Hill Head. The area covered on the north coast of the Isle of Wight stretches from Yarmouth to Whitecliff Bay (Figure 20). The total area of the SPA is 5505.86 ha. Historical records for roseate tern suggest that one or two pairs nested most years between 1967 and 1978. An average of two pairs nested between 1993 and 1997 (Natura 2000 data form for SPA) and two pairs nested each year between 2002 and 2006. More recently, one or two roseate terns have been observed amongst common tern colonies but no nesting attempts were recorded.

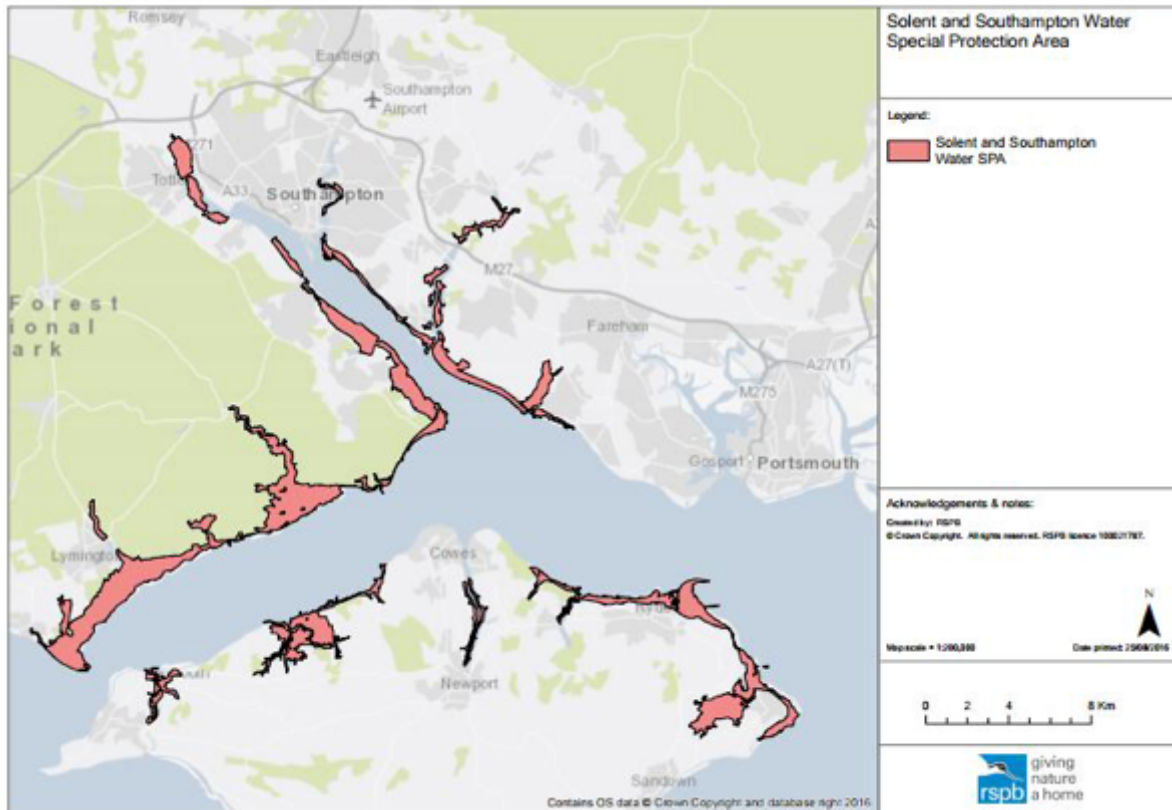


Figure 20 Solent and Southampton Water SPA

6.5.1 Project activities in 2016

Project Officer was employed to prepare the plans for the Lymington cheniers recharge and breakwater works. Several meetings with Natural England, Lymington Harbour Commissioner and contractors were arranged to present the plans, address concerns and develop detailed technical and financial plans. The plans will be submitted to NE for obtaining the licence.

Additionally to the proposed recharge of cheniers, we are proposing to further support common terns with the trial of three artificial platforms, placed on lower laying cheniers. These will be temporal structure deployed only during the season. This will not impact the overall budget for the habitat work as the cost for breakwater work will be lower than anticipated.

The work is due to take place in early spring 2017, according the foreseen timescale.

In April, we employed the Tern Warden. The warden focused mostly on monitoring of terns and the community engagement. The site enjoys regular visitors to Hurst Spit and Key Haven – Lymington Reserve. The monitoring was carried out in collaboration with the Hampshire County Council (HCC) who has been managing and monitored the saltmarsh colonies for several years on behalf of the Hampshire and Isle of Wight Wildlife Trust (HIOWT). We hired the boat from HCC to carry out the monitoring and site visits. The RSPB has never been active in this area and the first season was used by the project staff to familiarise themselves with the colonies and developed a better working relationship with key stakeholders. Trap cameras were deployed at common tern nest to investigate potential predation issues, however no predation event was recorded. Contract has been drawn with the

HIOWT for the fox control in Western part of the SPA (Key Haven – Lymington reserve) and it will commence from January 2017. The colonies in Eastern part of the site are free of foxes due to intensive control being undertaken on private land.

6.5.2 Numbers and productivity of tern species in 2016

The current records and observations of common, Sandwich and little terns are confined to a relatively small area of the Solent and Southampton Water SPA, stretching 9 km and covering an area of 1109.93 hectares between Hurst Spit and Boldre Foreshore (Figure 21). For the purposes of the report, this area will be referred to as the north-west Solent and is made up of a wide range of coastal habitats which are of biological and geomorphological importance. The north-west Solent has a total of nine designations, including SSSI status.

Lymington-Keyhaven Nature Reserve makes up a large part of the north-west Solent area, east of Lymington River. The reserve is owned and managed by Hampshire County Council and the adjacent saltmarshes and mudflats outside the seawall are leased by Hampshire and Isle of Wight Wildlife Trust (HIWWT). On the western side of Lymington River the salt marshes are owned by the New Forest District Council (NFDC) and are leased to HIWWT.

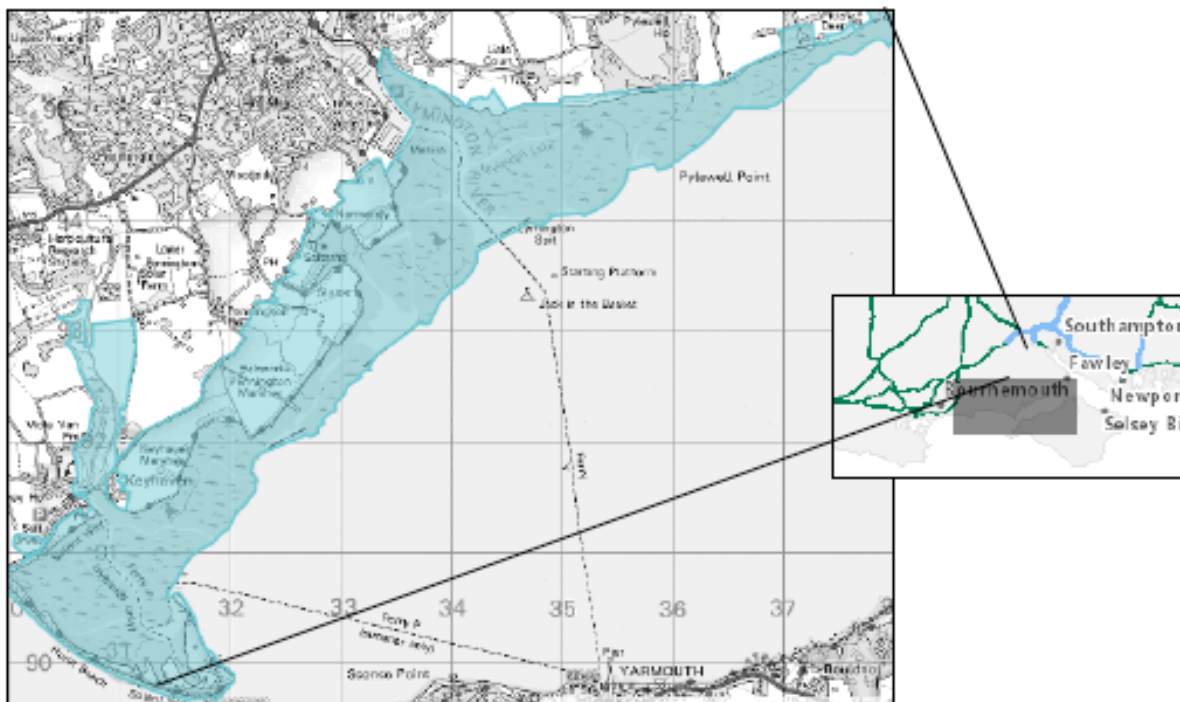


Figure 21 Map showing the north-west Solent. Survey and monitoring of tern populations was undertaken in this area of the Solent and Southampton Water SPA

The saltmarshes and mudflats either side of Lymington River are of international importance and support large numbers of breeding, feeding and roosting birds. The most notable of these species are the common, little and sandwich tern, all of which use the shingle banks on the seaward side of the saltmarshes as nesting areas. These shingle banks, more commonly referred to as cheniers, form as the result of wave action throwing shell deposits and fine shingle onto the surface of the saltmarsh; the substrate created is ideal nesting habitat for terns. Roseate terns have been observed nesting on several chenier locations in the north-west Solent, amongst common tern colonies. One of the other main nesting locations for common

and little terns is Normandy Lagoon, which is situated on the eastern side of Lymington-Keyhaven Nature Reserve.

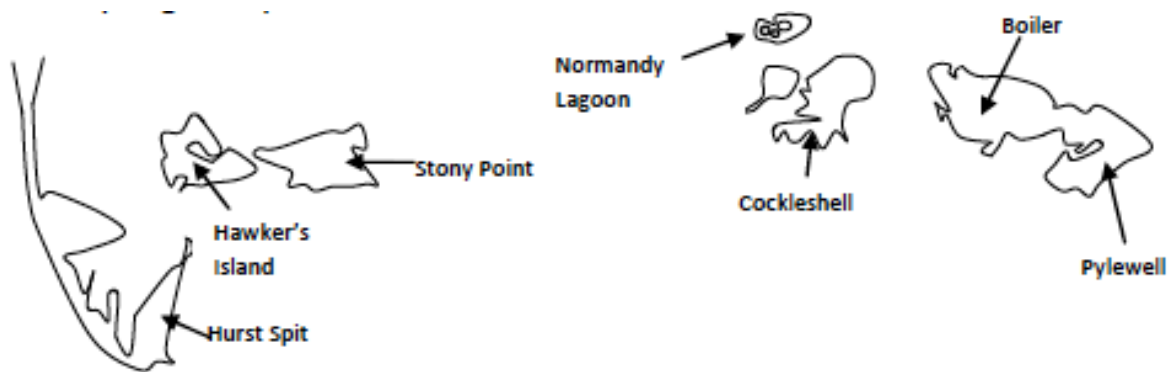


Figure 22 Names of specific islands within North-West Solent

Roseate tern

One bird was photographed on the trap camera located near the common tern nest on the 17th of July.

Sandwich tern

A grand total of 81 sandwich tern pairs nested on Boiler and Cockleshell (Belcher and Brown 2016). This was a decrease of six pairs compared with 2015, when 87 pairs were recorded. The largest colony was located on Cockleshell, with birds choosing to nest on the ridge of the shingle chenier, amongst dense vegetation. Conversely, in 2015 the largest colony of sandwich terns was located on Pylewell. Adults were observed roosting on Pylewell later in the 2016 season but no nests were recorded.

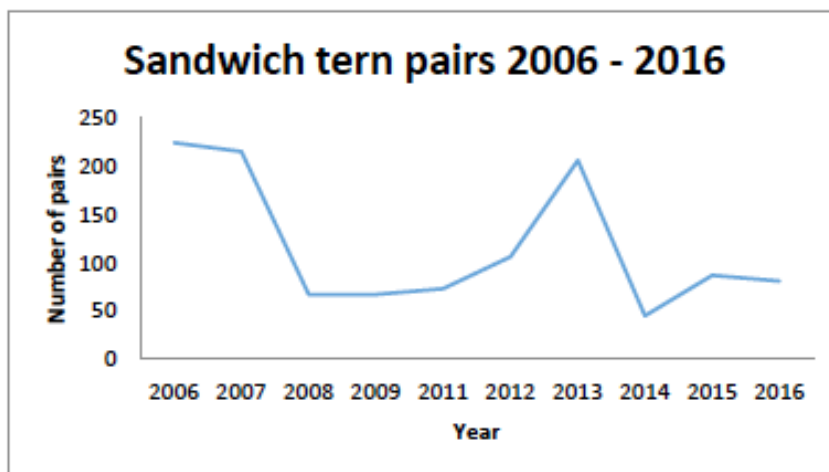


Figure 23 Sandwich tern pair on North-West Solent between 2006 and 2016

Common tern

A total of 55 nests were recorded across the sites. The lack of coordinated nest count this year significantly reduced the amount of breeding information for common terns, which made it difficult to draw conclusions / accurately identify trends though comparison with other years.

We were unable to access the nesting grounds during incubation periods and therefore do not have nest counts or monitoring data for this time. The only nests recorded were found on 6th or 7th June during the black-headed gull nest count or during visits to deploy trail cameras. It is not possible to use 55 as an accurate representation of the nesting attempts this season but is our only figure in the absence of a coordinated nest count. Observations in the north-west Solent areas suggest a relatively low number of common terns in comparison with previous years. The largest number of nests recorded was on Boiler, with birds observed nesting on the shingle cheniers but also in densely vegetated areas which were very low-lying and close to the strand line.

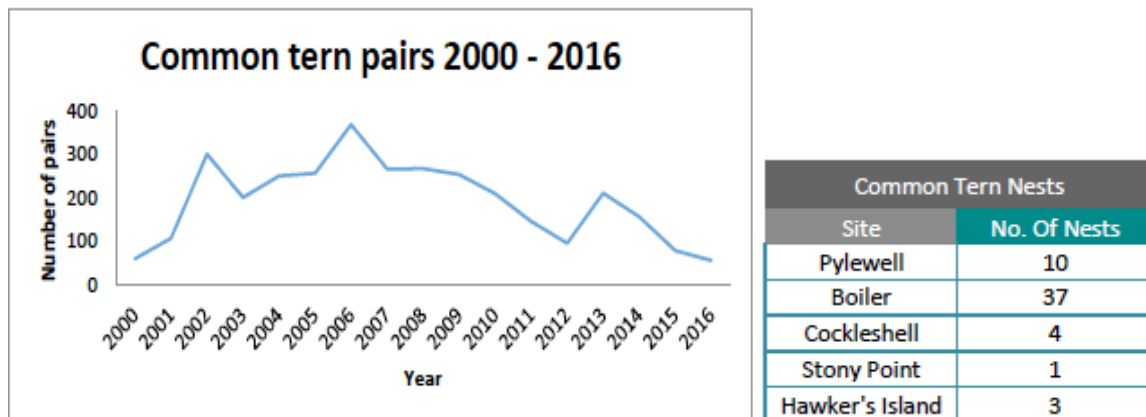


Figure 24 Common terns breeding in North-West Solent between 2000 and 2016 and the breakdown of numbers per colony

6.5.3 Issues affecting productivity

Limited nesting space above the high spring tide is the biggest issues for this site and it will be address through the LIFE project.

Further assessment of the large gull predation needs to be addressed next season.

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