

Annual Roseate Tern Newsletter 2017



Roseate tern adult at Rockabill © Brian Burke

Compiled by Chantal Macleod-Nolan
RSPB, Nature Recovery Unit
No. 11 (April 2018)



Supported the LIFE funding as part of the project “Improving the conservation prospects of the priority species roseate tern throughout its range in the UK and Ireland”

Table of Contents

Introduction	3
Roseate Tern LIFE Recovery Project	4
Habitat Creation in Western Solent	4
Restoring tern habitat at Cemlyn	6
Tern Diet	9
Aerolaser Trial	11
Building First Ever Roseate Tern Terraces in France.....	11
Ghana.....	14
2017 Roseate Tern Breeding Figures	16
Europe	16
Rockabill (Republic of Ireland)	16
Lady’s Island Lake (Republic of Ireland).....	19
Dalkey Island (Republic of Ireland).....	21
Larne Lough (Northern Ireland)	24
Coquet Island (England)	25
Brittany and Normandy (France).....	28
Azores (Portugal).....	31
North East America	35
Maine Coast Islands (Maine)	35
<i>Diet Study Analysis</i>	38
<i>Stable Isotopic analysis of seabird eggshells</i>	41
Buzzards Bay (Massachusetts).....	43
Falkner Island (Connecticut).....	47
Great Gull Island (New York)	49
Caribbean Roseate Tern Population	52
Florida (U.S.)	52
The Virgin Islands (British and United States).....	54
Roseate Tern Use of Staging Sites in the North-eastern United States	59
History of the U.S. Geological Survey’s CRTMP Roseate Tern Staging Site Studies.....	59
Staging site research done prior to 2011	60
Research since the use of 3-character plastic field-readable colorbands began in 2011.....	62

Introduction

Welcome to the 11th edition of the Annual Roseate Tern Newsletter, which covers the 2017 breeding season.

I would just like to say thank you to everyone who has contributed to this year's edition; the wealth of knowledge gathered here is fantastic. Receiving articles from not only site managers about their colonies and the techniques they are trialling, but also researchers whose investigations further our understanding on the tern's lifecycle is incredibly valuable. Their results will direct our future management practices. Ideally it is our hope that this cross-Atlantic collaborative newsletter will continue to bridge gaps across roseate tern colonies.

In 2017, the roseate tern populations across both North America and Europe continued to increase with a key number of colonies having a record breaking year. Great Gull Island continued to expand with the highest nest count since 1988 as did the tern populations at Buzzards Bay. Rockabill and Lady's Island Lake also had the highest record of breeding pairs since monitoring began in earnest, while Coquet had their best productivity count.

On a more sombre note, the roseate tern colonies in Florida are continuing to decline rapidly with habitat loss, predation and hurricanes attributed as the main cause. Wardens are working hard to counter this through creating artificial platforms and trialling lures. Initial surveys between 2016 and 2017 show a 33% decline for the Virgin Island's populations, however as this population fluctuates annually, more surveys years are needed to accurately assess it. In Northern Ireland, the remaining roseate tern pair were unsuccessful in fledgling any chicks due to high levels of predation.

Meanwhile, other colonies are continuing to recover such as Maine (USA), with wardens working on tackling predators and invasive vegetation. The roseate terns in the Azores also fared better with the population growing by 35% since 2016. Ile aux Moutons (France) and Falkner Island (USA) are continuing to slowly increase and the latter site trialled a common tern exclusion zone which yielded some good results. As a result of the international networking visits between the Roseate Tern LIFE Project and Bretagne Vivante in 2017, site managers recently created tern terraces on Ile aux Moutons in hopes the roseate terns will respond favourably in 2018.

With each colony facing a multitude of threats and pressures including climate change; it is great hear about the scale of habitat restoration work, vegetation, and predation control being undertaken that has yielded positive results.

Good luck with the 2018 season!

Kind Regards,

Chantal Macleod-Nolan, Roseate Tern LIFE Project Assistant

Chantal.Macleod-Nolan@rspb.org.uk

Roseate Tern LIFE Recovery Project

In 2017, the Roseate Tern LIFE Recovery Project was in its second year of implementation and you can read about the highlights below. In 2018, we anticipate the following developments:

- First batch of 20 roseate terns with geolocators will hopefully come back from Africa to Rockabill. Further 10 GLS tags are planned to be deployed on Rockabill and 10 on Coquet later this year.
- Boat tracking research will be carried out on Rockabill. After the GPS tagging trials on Arctic terns (paper later this year), we have concluded that using GPS tags might be too risky for roseate tern welfare.
- Demography paper will be published (the second version of the manuscript is with the journal).
- Report on tern trapping in Ghana will be published within a couple of months.
- Major restoration of Blue Circle Island on Larne Lough (Northern Ireland) will be carried out in the autumn.

Plenty to look forward to in the next edition of the newsletter.

Habitat Creation in Western Solent

The Solent is one of the LIFE project's sites, which historically had roseate terns breeding. Currently, with the loss in available nesting space, the remaining tern species: common, little and Sandwich, have been in decline. To increase a prospect of roseate tern return, the focus was on boosting common tern colonies. To this end, several habitat creation/restoration projects were completed in March 2017.

The first project involved the construction of three nesting bunds on the eastern breakwater in Lymington River. These structures, which protect Lymington harbour from erosion, were identified as being suitable for nesting terns; providing an area free from mammalian predators and/or human disturbance. It took four days to construct the bunds, which were fabricated using hessian sandbags filled with concrete. Gaps between the rock revetments were filled in with sandbags to form a level nesting area which was reinforced with stainless steel pins. The hessian will wear away with time, leaving behind a solid concrete structure.



Figure 1: Breakwater bunds ©Daniel Piec

In the north-west Solent, the principal nesting habitat for terns is shell ridges, called ‘cheniers’, which line the leading edges of Lymington saltmarshes. Erosion of the saltmarshes has led to a reduction in the profile and height of cheniers, and sea-level rise causes frequent nest flooding during high tides.

A known common tern nesting area towards the mouth of Lymington river was recharged with 88 tonnes of marine-dredged shingle. The recharge has increased the height of the existing chenier by approximately 0.5m and will hopefully increase the area of available nesting space for common terns.



Figure 2: Chenier after the shingle recharge © Matt Brown

Tern rafts are a widely used technique for providing island habitat in areas of deep or fluctuating water levels. Their purpose is to improve tern breeding success by providing areas safe from flooding, disturbance or predation. Ten partially fabricated tern rafts were purchased and deployed on saline lagoons, six at Lymington-Keyhaven nature reserve and four at North Solent NNR.



Figure 3: Deploying the new tern rafts © Matt Brown

Unfortunately, in 2017 there was no recorded nesting attempt at any of the newly-created habitats. The failure of the breakwater to yield any tern nests can potentially be attributed to deterrents in the form of a nesting greater black-backed gull and territorial oystercatcher. Similarly, the peregrine falcons, which nested near the shingle recharge and used the markers surrounding the recharge as perches, likely explains the absence of any tern nests on the chenier.

Throughout the season, three drone flights were undertaken by an operator from the University of Southampton in order to capture aerial images of the shingle recharged area and movement over time. Fig. 1 shows the seaward edge of the recharge material has retreated by around 1m in some places however the difference between the second and third flights reveals reprofiling in the northern area of the grid has resulted in some seaward movement of material also.

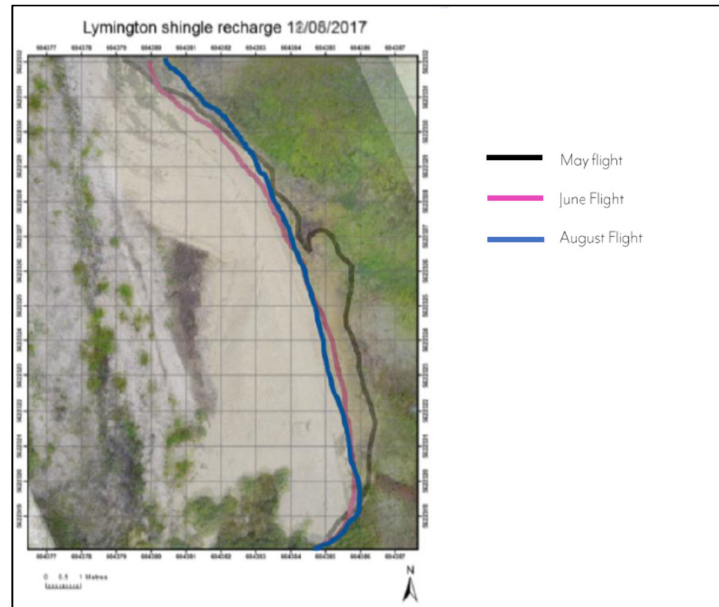


Figure 4: Overlaid drone images from three flights over the recharge area (Belcher and Brown, 2017)

There is also the factor of transition time; despite these habitats not being used in the first season of implementation, they may become of increasing importance as the saltmarsh islands continue to erode and favoured habitat disappears.

Bibliography

Belcher, C. and Brown, M. 2017. North-West Solent Breeding Tern Report. RSPB Internal Document

Restoring tern habitat at Cemlyn

Situated on a series of small islands in the lagoon, over the last decade Cemlyn's tern colony, and in particular the Sandwich terns, have fared remarkably well. The five year (2012-2016) average breeding population for Sandwich terns is 2400 pairs with an increasing trend. There is an average Mean Clutch Size of 1.42 and productivity estimated at 0.73 over the same period. The success of the Sandwich tern colony is remarkable – it current stands at about 20% of the UK population and 3% of the world population. This achievement has resulted in competition for space with other tern species and also disturbance of later nesting species, especially by near fledged chicks.



Figure 1: These small islands in Cemlyn lagoon supports the sole Welsh colony of Sandwich terns - all 2400 pairs of them! ©Google Maps

However, 2017 produced a dramatic and catastrophic break in this run when the colony was devastated by a small family of otters. We are currently preparing work to help us prevent a repeat of this in 2018.

The picture for common and Arctic terns is less rosy; there is a small colony of both, usually in the region of 30-60 birds and with a low productivity (0.02 or thereabouts). There remains the notable absence of roseate terns breeding at Cemlyn, although in 2015 a pair may have “possibly” bred – based on observations of behaviour etc. but no confirmed nest was found. The importance of a viable common tern colony for roseate terns to breed is well established.

The colony as a whole also faces many threats; in the short-term predation, especially by large gulls and mammals; in the longer-term climate change may also have consequences for the availability of secure breeding habitat. The predicted increase in frequency and strength of winter storms could result in a breach to the shingle ridge at Cemlyn and a consequent increased risk of the colony flooding. The additional threat posed by the new nuclear power station at Wylfa, the main site for which is approximately a km away, is also substantial. Of particular relevance is the proposed breakwater at Porth y Pistyll which could lead to changes in coastal geomorphological process in Cemlyn, including accelerating and/or altering the movement of shingle.

The Core Management Plan for the SPA/SAC identifies the need to provide adequate space and type of habitat on the islands to support the breeding colony – space for nests and normal bird behaviour. Over the decades, the North Wales Wildlife Trust has carried out a range of management activities to do this – including creating the western island from excavated material (late 1970’s), excavated a channel around the main islands to restrict access by people (late 1970s) and most relevant filled in a section of the main island to create further nesting space (1997).



Figure 2: Holyhead sea cadets finishing the brick breakwater around the islands (1979). Photo Credit: Jane Rees

During the summer of 2017, and thanks to the LIFE project, 4 tern rafts were installed near the islands. Although only used in a cursory way in the first year, it is hoped that there will more interest from the terns in 2018.

More significant over the early winter (17/18) the Wildlife Trust got to work on increasing the availability of nesting habitat on the main island. The main island is relatively small (0.4 ha) and includes a low lying area of 0.05 ha i.e. c 12% of the island. It is some 15-20 cm below the level of the islands. This means it is inundated for parts of the year and, critically, not used by nesting terns. It is used by loafing terns and also by a small number of feeding waders throughout the year.

The Wildlife Trust proposed to import varying sized, clean small rock to raise the profile of the low-lying area. Taking material from the ridge itself was definitely not on! The final landform would include small channels similar to elsewhere on the islands and a low lying area of about ¼ of the existing one will remain. Attention was also paid to biosecurity and pollution control measures.

However, the tern colony does not occupy Cemlyn in isolation – the lagoon and shingle ridge are SAC (Special Area of Conservation) and therefore considerations are needed when managing the tern colony. The lagoon contains a wide range of specialist brackish water invertebrates that are either present on or in the lagoon’s substrate. Following a discussion with Natural Resources Wales on how to minimise physical damage to these features and the increased sediment in the water, it was planned to construct a short gangway from the ridge to the island. This gangway would allow stone to be carried across in powered barrow machinery. To cover the area (0.05 ha) and to raise it to the right level approximately 46 tons of material was imported.



Figure 3: Left = Sections of the islands at Cemlyn when flooded are unusable for terns to nest on. Right = The gangway from the ridge to the island. Photo Credits: Chris Wynne

The opportunity provided by the gangway and transport was made good use of by the staff and volunteers. Sea beet on the island has increased considerably over the last decade and effectively occupies nesting space and provides cover for predators. We removed approximately 30% of bushes from some of the traditional common/Arctic tern areas on the east side of the island. This is in an attempt to favour these species nesting in this area.

Through the summer of 2018 we will be watching the use of the newly created areas by terns. But also keeping an eye on the presence of waders in the remaining low lying areas and for any long term impact on the lagoon.

Chris Wynne, Conservation Officer, North Wales Wildlife Trust –
ChrisWynne@wildlifetrustswales.org

Tern Diet

The Roseate Tern LIFE Project collated and reviewed information on the diet composition of terns around the British Isles. This involved investigating the variation spatially, temporally and between species, while also determining how tern breeding success was affected.

Dr Elizabeth Green undertook this role by analysing the 25 year old provisioning study from Anglesey tern colonies. This dataset had not been looked at previously and as a result the consistency of methods and data reporting was unknown. Although, there were limitations in analysing it, there was also some interesting findings (Figure 1).

Between 1990 and the late 2000s Arctic tern chicks at both sites were fed predominantly on sandeels, whereas in recent years, the proportion of clupeids in their diet has suddenly increased. Although sandeels are currently still the most frequent prey fed to chicks, this suggests a recent shift towards a less sandeel-dominated diet. Whether this is the beginning of a long-term shift in diet or short-term variation is unknown.

Another crucial aspect Dr Green's work involved gathering ecological information on key prey species for terns such as the lesser sandeel (*Ammodytes marinus*), sprat (*Sprattus sprattus*) and juvenile herring (*Clupea harengus*). These literature reviews contained current information on the ecology, status, and distribution of these prey species, considered the drivers of inter-annual variation in populations, summarised evidence demonstrating the importance of the species for seabirds and discussed the current and potential impacts of climate change, fisheries and other factors on sandeel populations.

A notable inference from these documents, is that sandeel stocks will probably decline further as their main food source (the copepod *Calanus finmarchicus*) is moving in search of cooler waters, whilst sandeels are bound to their habitat. In contrast, sprats rely on another species of zooplankton which is more resilient to sea surface warming and therefore will probably do better in the future.

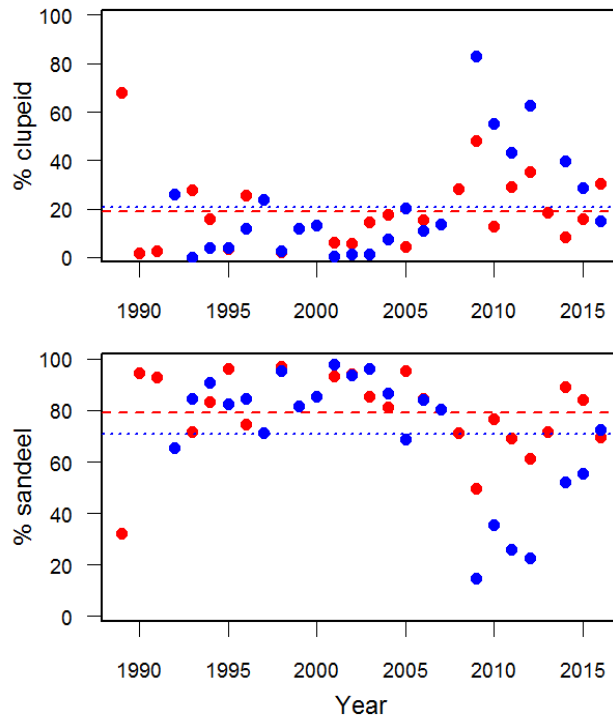


Figure 1: The percentage of prey items fed to Arctic tern chicks during provisioning observations at the Skerries (red) and Ynys Feurig (blue) that were clupeids (top) and sandeels (bottom), for 1989-2016. The dashed red line shows the mean percentage over all years at the Skerries; the dotted blue line shows the mean percentage over all years at Ynys Feurig.. (Green, 2017)

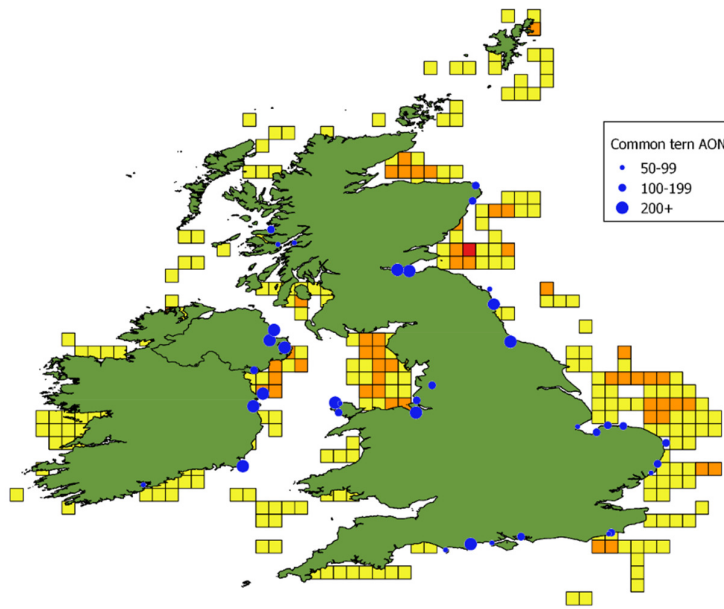


Figure 2: Prey hotspots map showing approximated areas with high catch rates of the three major prey types for terns based on the data presented by Ellis et al. (2012) and Heessen et al. (2015) with active common tern colonies ≥ 50 AON overlaid on it. Red= high catches of 3 prey types; orange = high catches of 2 prey types; yellow = high catches of 1 prey type.

A prey map was produced in order to help identify potential areas where diet is unlikely to be a major limiting factor and as a result areas, where high fishery catch rates of both species overlap were acknowledged as ‘prey hotspots.’ Using this information, could help identify the colonies that are most resilient to fluctuations in prey populations. Places like Shetland, where only sandeels were available, have already seen drastic declines of tern colonies.

The conclusions from these reports have and will continue to inform our strategy on potential diet monitoring and assist in developing recommendations for marine management particularly with regards to the sandeel and alternative prey situation in relation to climate change and fisheries.

If you would like to read these reports, they are available on our Roseate Tern LIFE Project Website: <http://roseatetern.org/documents.html>

Bibliography:

Green, E. 2017. Anglesey Tern Diet Report. Roseate Tern LIFE Recovery Project. RSPB.

Green, E. 2017. A literature review of the lesser (Raitt’s) sandeel *Ammodytes marinus* in European waters. Roseate Tern LIFE Recovery Project. RSPB.

Green, E. 2017. Tern diet around the British Isles: a review of key prey species and potential impacts of climate change. Roseate Tern LIFE Recovery Project. RSPB.

Aerolaser Trial

There are increasing examples of avian predators impeding the conservation of species of a higher priority. As a result the RSPB is running a trial of handheld laser beam devices (Aerolaser® and Agrilaser) as a non-lethal means of displacing large-bodied gull species from supplanting and displacing smaller-bodied species from scarce breeding habitats, as well as reducing predation of such species by gulls, raptors and corvids. The Aerolaser is used for bird scaring at c.18 airports across the world, including five in the UK and the Agrilaser, a less powerful version of the Aerolaser, is widely available from pest control retailers in the UK and is used to deter cormorants at many freshwater fisheries (Fishery Management Advisors Project Review Group Report (2016)).

In 2017, 10 sites (RSPB, National Trust, local authority and National Nature Reserves) were recruited to the trial. Consistent hazing and monitoring protocols were developed and applied on 6 hazing sites with equivalent predation monitoring conducted on 4 control sites. The colonies concerned (including Little tern, Roseate tern, Sandwich tern) involved predation and displacement by large gulls (mainly lesser black-backed and herring gulls) and to a lesser extent by corvids. Provisional analyses of results indicate there is some variation in the response of predators to the laser beam. Avoidance behaviour was exhibited in c70% of instances overall. This appeared to be lowest during the hatching period. The majority of predators moved immediately and often to a different part of the site, while some left the site completely.

There are a number of factors to consider when interpreting results from a trial like this and many sites will vary. For this reason, before we can draw any conclusions we need to repeat the trial in 2018 and carry out more detailed analyses of the resulting dataset. We have recruited some more sites to the trial and the hazing and control sites will be swapped. We hope to be able to determine whether the laser is effective in displacing birds and/or reducing predation, whether there is any evidence of habituation, whether responses vary between species and ultimately whether productivity at a site can be enhanced by targeting these problem species.

We will provide full results of the trial and, if they are found to be safe and effective, we will produce evidence-based guidelines for use of these devices for conservation.

Daniel Hayhow, Conservation Scientist - Daniel.Hayhow@rspb.org.uk

Building First Ever Roseate Tern Terraces in France

Report from the second leg of networking activities in Brittany as part of the LIFE project

While the exchange of knowledge and networking are surely stimulating endeavours, without a formal way of operating, clear set of actions and a follow up, these activities rarely produce a real difference for birds. It takes a lot of commitment from participating organisations and, above all, individuals who take part in such exchanges, to take the relationship to another level. In case of the networking exchanges between French/ Irish and British roseate tern colony managers, we have managed to build a working relationship and bring a colossal change to the management and monitoring practices in France.



Figure 1: Roseate Tern LIFE staff visit Ile aux Moutons in July 2017 (Photo: Yann Jacobs)

So far, French colony managers have had a very much hands-off approach, providing only basic stone shelters and minimum monitoring effort to avoid disturbance. The emphasis has been on “naturalness” of the colonies. This, together with human disturbance and predation, has resulted in a very low year-on-year productivity.

Last year, we have visited all the current and former roseate tern colonies during a five-day trip to Brittany. It was obviously very useful to learn about local constraints, management practices, etc., which allowed us to come up with a set of recommendations for the two main colonies. Moreover, we have built strong relationships, which expand beyond purely professional sphere. Besides being a really friendly bunch of people (us including), dinners, stayovers, picnics with obligatory wine or cider made the whole experience bounding and lingering in our memories. However, what really made a difference was an idea to invite French colleagues to Coquet. It seems that only then the concept of creating artificial nesting habitats and intensifying monitoring efforts landed on fertile soil, which would otherwise be difficult to achieve with any number of presentations and elucidations.



Figure 2: Bretagne Vivante visit to Coquet in 2017. Left to right: Benjamin Callard, Paul Morrison, Isabel Morrison and Daniel Picc (photo: Yann Jacob)

Not surprisingly then, in the end of March 2018, I found myself on the train to Brittany with an excellent company of Paul Morrison (Coquet) and Steven Newton (Rockabill) to help Bretagne Vivante creating their first ever terraces and deploying nest boxes. Working clothes, French berets with the LIFE project logo and other gadgets – we were gearing up for hard work.

After the Île aux Dames colony collapsed in 2011, the main two colonies are currently located in Île aux Moutons (43 pairs last year) in the south coast of Brittany and Île de La Colombière, located near St Malo in the north. We have landed on Île aux Moutons with a bunch of Bretagne Vivante staff and volunteers in a beautiful weather; 100 boxes ready (made by local schoolkids), geotextile deployed to kill the vegetation over winter, shingle from the nearby beach ready. We are keen to work, but not before an obligatory cup of coffee – this is France after all. Steve was orchestrating the location and direction of facing the nest boxes in relation to the planned monitoring hide. The rest of us removed stones, cleared vegetation, created patches of shingle and set the nest boxes. We have decided to go for a combination of patch conditions to check what the birds might prefer, ranging from boxes on shingle, bare ground and treated land. We also removed rock shelters, as they don't provide adequate shelter, compared to nest boxes. The work was a success, everybody was in high spirit, enhanced by excellent picnic, wine and local cider as mentioned above – obligatoire.



Figure 3: Newly created roseate tern terraces on Ile aux Moutons (c) Daniel Piec

The next day, we visited Île de La Colombière – a much smaller colony, which supported 6 pairs in 2017 – hence only 40 boxes. Here too, we were accompanied by the local staff and volunteers. The weather on the north side of Britany was not as forgiving as the day before, our worries deepened when we saw a little grey plastic boat to take us to the island. We had enough skippers between us to decide that after all we can sail. The job was obviously quicker, but we found signs of rats, as the island is close to the shore and accessible by foot in the low tide. The local managers will be working on eradicating the rats before the coming season. Plus, if you need us, we are here to help – the “special” relationship does not end with Brexit.

This is at least our hope – funding for international projects might become increasingly tough to obtain. As part of this project, we will update the International Roseate Tern Conservation Strategy, which will include French colonies. Hopefully, this document will provide a springboard for further cross-border initiatives. For now, we anticipate the results of the breeding success from Brittany.

Ghana

On 24th September 2017, Daniel Piec - the Roseate Tern LIFE Project Manager, travelled to Ghana to meet with Professor Yaa Ntiamoa-Baidu from the Centre of African Wetlands (CAW), who has been involved in conservation of Ghana's biodiversity for over 30 years. The visit was undertaken as part of the LIFE project's action to engage with stakeholders in West Africa to assess conservation need and identify priority actions. The action is based on a bilateral collaboration between the RSPB and the Centre for African Wetlands. In autumns 2016-17, CAW have been surveying the known wintering tern hotspots along the coast and engaging the local communities in order to determine whether illegal trapping is still ongoing and, if so, the numbers of species caught.



*Figure 1: Small fish landing place west of Azizanya harbor where trapping was confirmed by a fisherman
(Photo Credit: Daniel Piec)*

The visit included travelling to several of the roosting sites, investigating if any trapping is occurring and interviewing fisherman present on the beach. Although no trapping was observed during the visit, several locals confirmed that tern trapping is still ongoing, mostly by children. However, the precedence is not as systematic as it was 30 years ago, as many children are now in school and economic growth reduced the need for extra food.



Figure 2: Confirmed trapping incidents in 2017 by both children and adults. The traps consist of two sticks and nylon string with some fish underneath. Most of the birds can see the trap as they try to pick up fish, but every now and then one of them would get tangled.

There was also an opportunity to meet Mr Eric Lartey, who is the Managing Director of Ghana Wildlife Society (GWS), the BirdLife partner in Ghana. GWS is still supported by the RSPB as part of the country programme, but it does not include coastal wetlands, which is instead monitored by CAW. Discussions revealed synergies between tern trapping and the work GWS is doing on conservation of turtles and the exchanging of potentially valuable information across sites and organisations. In addition, Eric pointed out that Wildlife Clubs at schools established in the 1980s and 90s still exist, albeit in smaller numbers. These can be used to raise awareness and educate children in both tern and turtle conservation. Once the locations and scale of the tern trapping problem has been determined, this might be a viable idea to start a small, targeted educational project in places where these two conservation problems co-exist.

The full report is due this spring and will be available to download from the project's website.



Figure 3: Students and project staff at CAW office

Daniel Picc, Roseate Tern LIFE Project Manager - Daniel.Picc@rspb.org.uk

2017 Roseate Tern Breeding Figures

Breeding Locations	2016 Breeding Pairs	2017 Breeding Pairs	2017 Productivity
Europe			
Rockabill, Republic of Ireland	1556	1603	0.83
Lady's Island, Republic of Ireland	209	219	1.01
Dalkey Island, Republic of Ireland	1	0	0
Larne Lough, Northern Ireland	1	1	0
Coquet Island, England	104	111	1.5
<i>Roseate LIFE Project Site Total</i>	<i>1872</i>	<i>1934</i>	
Brittany, France	49-51	53	0.25
Azores, Portugal	532	763	nd
<i>Europe Total</i>	<i>2453</i>	<i>2750</i>	
North East America			
Maine Coastal Sites, Maine	178	245	0.92 – 1.29
Buzzards Bay, Massachusetts	2050	2240	0.60 – 1.29
Falkner Island, Connecticut	30	55	1.05
Great Gull Island, New York	1858	2089	1.44
<i>US Total</i>	<i>4258</i>	<i>4771</i>	
<i>North Eastern United States and Canada Total</i>	<i>4331</i>	<i>4824</i>	
Caribbean Population			
Florida	141	42	0.47
The Virgin Islands (British and US)	1268	854	nd

nd = no data

Europe

Rockabill (Republic of Ireland)

As poor weather prevented an early start to the 2017 season on Rockabill, the planned habitat creation to extend the new terracing was postponed until September. A group of volunteers made up of Skerries Sea Scouts were particularly helpful in preparing the island before the season began by removing tree mallow *Lavatera aborea* and sea mayweed *Matricaria maritima*. Once the weather improved, continuous wardening began 6th May until 8th August.

The first roseate tern egg was found in a nest box on the 13th of May, which is the earliest record since monitoring began in 1989. However no more clutches were found until the 18th after which new clutches rapidly increased in number. In 2017, a total of 1603 roseate tern nests were counted on Rockabill, making it the highest recorded to date and an increase of 47 nests on last year's total. 878 nest boxes were deployed across the island with the overall nest box uptake being 89.4%, which was slightly lower than last year. It should be noted that 129 new boxes were deployed this year, continuing the trend of previous years.

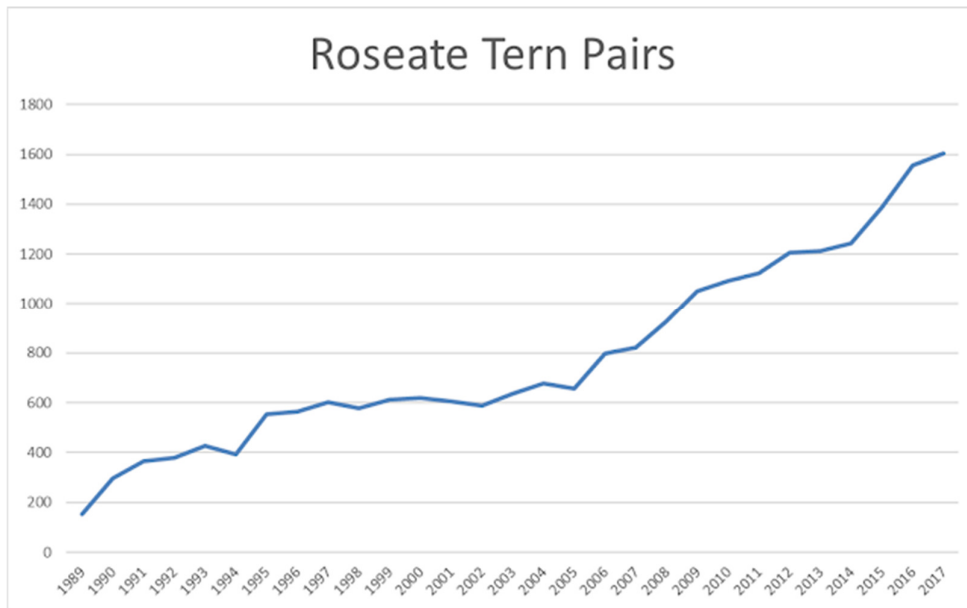


Figure 1: The roseate tern population growth since monitoring began on Rockabill in 1989 to present

The mean clutch size for roseate tern pairs on Rockabill in 2017 was 1.68 eggs (matching 2016), and was higher for pairs using nestboxes (1.76) than those nesting in the open (1.61) in keeping with the usual trend. Mean clutch sizes for both nestboxes and open nests are above the average observed over the previous 10 years (1.62 and 1.50 respectively).

The overall productivity was 0.83 fledged young per nest, which although it was an improvement on last year (2016 had the lowest productivity ever recorded on Rockabill at 0.66); it is still below the previous five-year mean which stands at 0.94. Additionally, although better than 2016, the Linear Growth Rates and Asymptotic Mass for Roseate Tern chicks were well below five-year means in all categories. However, in terms of birds fledged, 2017 has seen the largest numbers yet recorded. This is clearly due to the higher number of birds nesting there.

A total of 2035 common tern nests were recorded on Rockabill in 2017, resulting in the average mean clutch size being 2.40. Unfortunately, they had one of the lowest productivities recorded to date with a value of 0.36. Regarding Arctic terns, there were at least 27 nests found on the 'Rock' with a further 20 pairs attempting to lay eggs on the 'Bill.' The mean clutch size recorded was 1.74 and only one chick is thought to have fledged as gull depredation of both eggs and chicks is continuing to be a serious problem.

Both weather and gull depredation are likely to have played a large part in the discrepancy between open and box nests, but lack of food is still thought to have been the main driver of low productivity across the island for both Roseate and Common Terns.

The majority of disturbance during the season was caused by great black-backed gulls. Depredation from this species has intensified over the last two years and has had a significant impact on all three tern species and kittiwakes throughout the season despite the warden's efforts. Kestrels were another common disturbance, particularly at the end of July and start of August, with a number of successful hunting attempts being made despite being mobbed by terns.

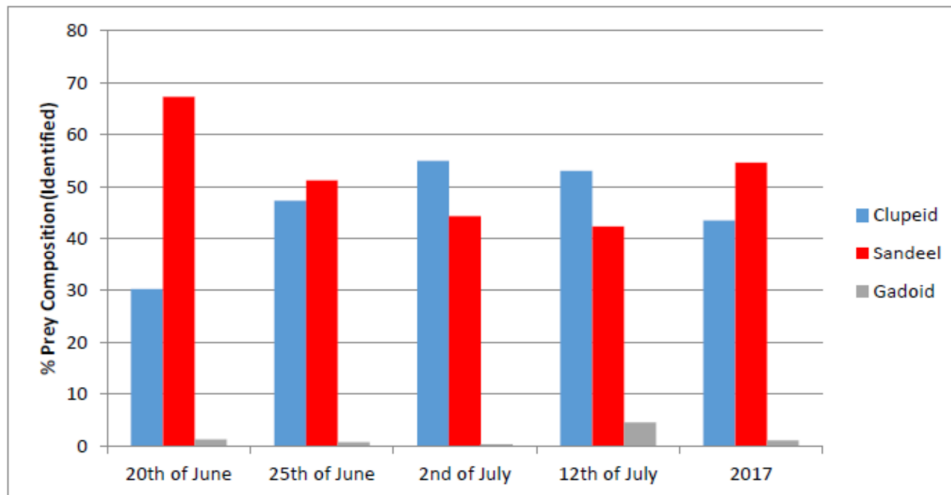


Figure 2: Percentage of identified prey items fed to Roseate Tern chicks in 2017 season during 4 chick provisioning watches and the overall composition from all watches for 2017.

Four all-day (17 hour) watches of roseate tern chick provisioning were carried out in a study enclosure on the 20th of June, 25th of June, 2nd of July and 12th of July, totalling 68 hours. Twenty-seven nests were observed, 22 boxes and 5 open nests from 05:00 to 22:00 in shifts of 2-3 hours. From the identified prey items, sandeels were recorded as the most common prey item (54.7%) presented to roseate tern chicks, followed by clupeids (43.5%) and gadoids (1%). The roseate tern chick provisioning rates peaked during the 17:00-20:00 period. In contrast, clupeids were the most common prey item presented to common tern chicks (52.8%), followed by sandeels (41.6%) and gadoids (5.6%). Two snake pipefish were recorded during the roseate tern feeding studies but none were found in the common tern nests which has happened in 2014, 2015 and 2016. Prior to that they had not been recorded in any numbers on Rockabill since 2007.



Figure 3: Adult roseate tern fitted with a GLS logger in 2017. Taken under NPWS licence

In June, Paul Morrison from Coquet and Dr Chris Redfern from the University of Newcastle visited Rockabill and along with Dr Stephen Newton. They caught a total of 20 adult roseate terns using treadle

traps on nest boxes. This is the first time any roseate terns in the UK and Ireland has been fitted with GLS monitors (0.7g). These devices will allow us to understand more about their migration patterns and the areas where they spend the winter. These tags will need to be recovered to download the data and will ideally be retrieved this 2018 breeding season.

Although the island is not open to the public, on the 9th of July, Her Imperial Highness Princess Takamado of Japan with her entourage, visited the island for two hours. An avid birder, Her Imperial Highness is Honorary President of BirdLife International and an accomplished wildlife photographer. It was a successful visit with the island thronging with tern and black guillemot chicks.



Figure 4: Her Imperial Highness Princess Takamado of Japan meeting Dr Stephen Newton and the wardens on Rockabill. Photo © Dick Coombes. Taken under NPWS licence.

In addition, The Rockabill Roseate Tern Conservation project has also been nominated in this year's Natura 2000 awards, a pan-European award which recognises excellence in the management of Natura 2000 sites. They are currently in second place with voting closing on 22 April 2018. If interested, votes can be cast via natura2000award-application.eu/finalist/3188

Dr Stephen Newton, Senior Seabird Conservation Officer -
snewton@birdwatchireland.ie

Bibliography

McKeon, C., Miley, D., Somers, S. & Newton, S.F. 2017. Rockabill Tern Report 2017. BirdWatch Ireland Seabird Conservation Report.

Lady's Island Lake (Republic of Ireland)

Management and monitoring of the Lady's Island Lake tern colony commenced on the 23rd March and continued until 1st August 2017. Over 300 wooden nest boxes were deployed on 11th April and placed in approximately same positions as those in 2016. Three wooden observation hides were placed on top of wooden pallets and three enclosures were set up to facilitate the collection of biometric data on roseate tern chicks. A three-foot high wire mesh fence, topped by a single electrified wire was put in place on the 4th May to prevent mammalian access to the southern colony.

In 2017, Lady’s Island Lake had 219 pairs of roseate terns nesting on the southern end of Inish, which was a 5% increase (10 nests) from 2016. The first egg was laid on the 8th May, six days earlier than 2016 and the mean clutch size was 1.57 per egg laying pair with a hatching success of 90%. Overall 222 chicks fledged giving the roseate tern colony a productivity of 1.01.

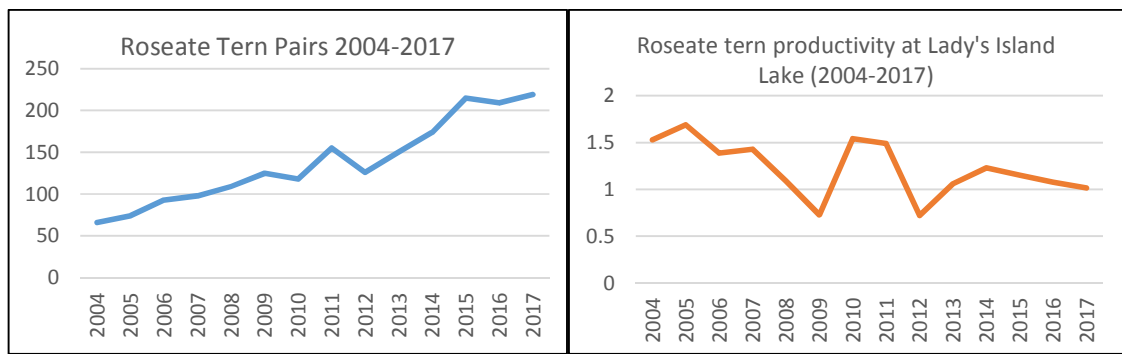


Figure 1: Roseate tern breeding pairs and productivity at Lady's Island Lake

The main laying period was from 8th May to 10th June. A total of 213 roseate tern clutches were designated as primary nests, laid up to and including the 10th June, the cut-off date (34 days after the first roseate egg was detected). Of the 213 nests, 93 were 1 egg and 120 were 2 egg clutches. From 10th June to, outside the cut-off point, a further six clutches were designated as secondary nests, five which were single clutches and one double egg clutch.

	nests	eggs	cold depredated eggs	fledged chicks	dead chicks	clutch size	hatching success
2017	219	343	33	222	88	1.57	90%
2016	209	299	42	225	29	1.43	85%
2015	215	316	29	248	39	1.47	91%
2014	174	293	36	214	42	1.68	88%
2013	150	230	39	159	32	1.53	83%
2012	126	196	58	91	47	1.55	70.4%
2011	155	263	32	231	25	1.7	78%
2010	118	195	10	182	11	1.65	92%
2009	125	210	57	91	62	1.68	72%
2008	109	146	27	119	23	1.34	81.5%
2007	89	153	13	140	33	1.72	76.42%
2006	93	142	13	129	3	1.52	88.7%
2005	74	131	6	125	19	1.77	80.9%
2004	66	118	17	101	19	1.79	69.5%

Figure 2: Roseate tern pairs and fledging counts 2004-2017 at Lady's Island Lake (Daly et al, 2017)

Of the 294 adult roseate tern rings that were read in 2017, 63% belonged to terns which had been born at Lady’s Island Lake, whereas the natal site of the remaining 37% was Rockabill. An added feature for identification is that the special ring are fitted to roseate tern chicks on the left leg at Lady’s Island Lake and on the right leg at Rockabill.

Common and Arctic Terns were censused separately, with a total of 1010 Common and 680 Arctic Tern nests recorded. This gave a combined total of 1690, a 9% decrease on that of 2016. The mean clutch size for Common and Arctic Terns was 2.54 and 1.90 respectively. There were 1674 pairs of Sandwich

terns that nested at Lady's Island Lake in 2017, which was a decrease of 8 pairs from the previous year. Black-headed gulls increased by 177 pairs (7%) to 2606 pairs, while there were 56 breeding pairs of Mediterranean gulls (16 less than in 2016, representing a 29% decrease).

Wexford Harbour

Wexford Harbour used to have an island known as Tern Island which was only one of three sites where all five British and Irish terns have been recorded nesting together. It supported 2000 pairs of roseate terns in 1968, the largest colony ever recorded in Britain and Ireland, until it was washed away in 1977 forcing the terns to relocate to Lady's Island Lake (Cabot, D. and Nisbet, I. 2013).

Since then the sandbars in Wexford Harbour have slowly been accreting and although there were no roseate terns observed in 2017, there was a displaying pair observed on 10th June 2016. The NPWS brief visit in 2017 recorded approximately 200 little terns (possibly 150 pairs) and a quick survey of the colony area yielded 64 nests, a third with just one egg.

Tuskar Rock Lighthouse

Tuskar Rock is a group of rocks topped by a lighthouse 11km off the southeast coast of County Wexford. It is known mostly for the Aer Lingus Flight 712 Crash and hardly visited due to the hazardous conditions. As a result it was not visited during the 1984 or 1996 All Ireland Tern Survey and it has continued to prevent NPWS from getting out there the last couple of years.

On 7th July 2017, several rangers were able to access the island where 20 roseate terns were recorded including an unringed juvenile. In addition there were circa 200 common terns including a minimum of 4 juveniles. Further investigations will be carried out this year, 2018.

Tony Murray, National Parks and Wildlife Services Conservation Ranger – Tony.Murray@chq.gov.ie

Bibliography

Cabot, D. and Nisbet, I. 2013. Terns. The New Naturalist Library. HarperCollins Publishers
Daly, D., Murphy, B., Murray, T. (2017) Lady's Island Lake Tern Report 2017. Annual Reserves Report 2017. NPWS

Dalkey Island (Republic of Ireland)

In 2017, the Dalkey Islands Tern Conservation Project, supported by the EU LIFE funding, had a dedicated part-time tern site warden throughout the nesting season. For the second year in a row there was a large presence of Arctic terns on Lamb Island and there had been sightings of roseate terns on Maiden Rock. Overall the breeding season numbers were encouraging with one of the highest numbers of breeding terns since the initiation of the monitoring project.

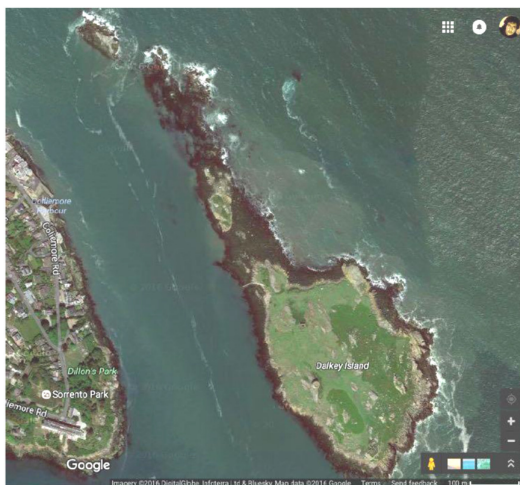


Figure 1: Aerial view of the Dalkey Islands. (c) Google.ie/maps, 2016

Conservation measures were put in place from 18th May, including placing of nest boxes and gravel on both Lamb Island and Maiden Rock. Dedicated colony visits to count nests, eggs and chicks commenced on 20th May and continued until 18th July.



Figure 2: Nest box arrangement on Lamb 2017 (c) A.Butler

This season saw an estimated peak of 128 pairs of Arctic and Common Tern with a minimum of 209 nesting attempts, including 8 attempts on (main) Dalkey Island. From the 209 recorded nests there were a minimum of 416 eggs, giving a mean clutch size of 1.99, typical for Arctic Terns. A total of at least 24 chicks were hatched between Maiden Rock and Dalkey Islands.

Later nesting attempts were mostly on Maiden Rock, after the 12th June, and a peak count of 67 nests were recorded on 20th June. A total of 54 new nesting attempts were recorded between 13th and 20th July, the highest flush count for Maiden Rock was also recorded on that date with 120 birds including loafing/non-breeding birds.

A highly successful season appeared to be on the cards until unknown event/event(s) occurred between late 9th and early 12th June when both nest and adult numbers decreased dramatically on Lamb Island. As the weather over the weekend period was not adverse and many broken egg shells were found we

presume depredation or disturbance had occurred. A second event occurred on Maiden Rock in the early hours of 2nd July, after many pairs which are presumed to have moved location from Lamb after the previous event had attempted to re-nest there. This event was recorded on a Trail Camera, which shows waves washing over the northern section of the rock from the east side, a herring gull was also recorded scavenging the eggs after the storm.

This event effectively ended the season as the few remaining nests were depredated over the coming days, with only a small number of fledglings surviving. At least 4 Arctic Tern chicks fledged giving a productivity of just 0.035 young reared per breeding pair. The first fledglings were noted on 7th July, with a fledgling seen on video on 10th July. However, all but 4 adult terns had left the site by the 11th July.

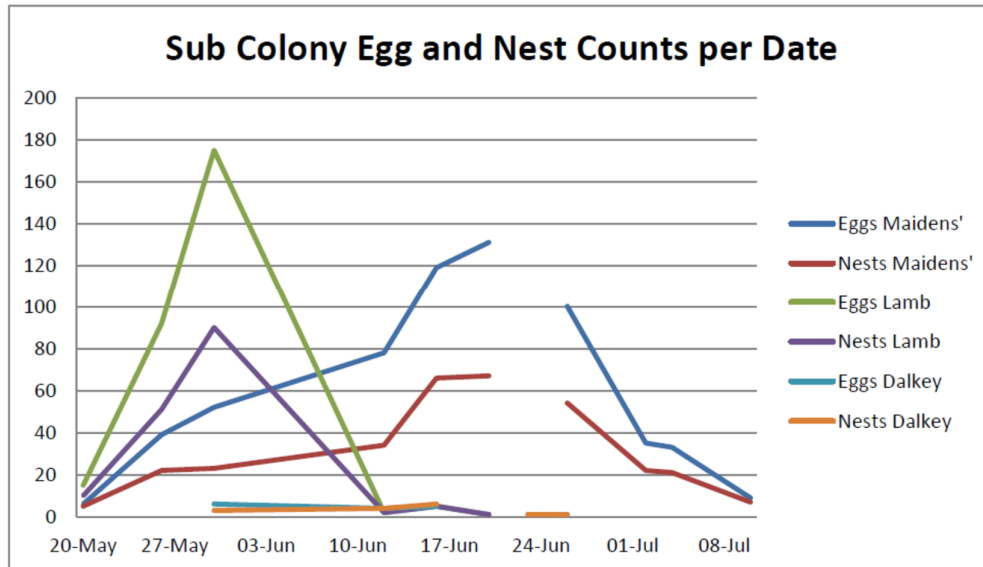


Figure 3: Number of active nests and eggs over the breeding season 2017. It should be noted incomplete counts were not included.

Overall there were a number of potential and probable predators recorded on the Dalkey islands. These included the brown rat which was photographed on Lamb Island and is presumed to be the ‘stasher’ of the dead adult terns. Corvids such as raven, hooded crows and jackdaws were observed throughout the season. Peregrine falcons, turnstones and large gulls were also recorded, including the previously mentioned herring gull that was observed eating eggs on Maiden Rock.

In preparation for the 2018 breeding season, a rodent eradication attempt was set up for the 2017/2018 winter using a grid of bait stations. If it is successful, continued measures will be needed to detect any re-colonists and take appropriate action since rats are able to swim to the island from the mainland.

Dr Stephen Newton, Senior Seabird Conservation Officer -
snewton@birdwatchireland.ie

Bibliography

Butler, A. and Newton, S.F. 2017. Dalkey Islands Tern Report 2017. BirdWatch Ireland Seabird Conservation Report

Larne Lough (Northern Ireland)

Larne Lough Islands Reserve, consisting of Blue Circle Island and Swan Island, is situated within Larne Lough which is designated as an ASSI, SPA and as a RAMSAR site. It is designated as a Special Protection Area (SPA) under the European Birds Directive because of its importance as a breeding site for Sandwich tern, roseate tern, common tern and Mediterranean gull, and for its light-bellied Brent goose wintering population.

As with 2016, a single pair of roseate terns nested on Blue Circle Island in 2017. They were first recorded on 19th May 2017 and although they produced two eggs, their productivity is uncertain. Both eggs hatched, and both chicks survived for at least a week and were subsequently ringed. However, between 21st June and 02nd July the young were displaced from their nest box, at a much earlier age than they left in 2016, and the older of the two chicks disappeared. Despite extensive searching on 2nd July the older chick could not be found and it was not at an age to have fledged. By 10th July the younger chick had also disappeared, also too young to have fledged, and indeed the roseate adults were not present. Whilst no remains were found, it seems likely that these young were predated.

The Sandwich tern nests were counted on 19th May, recording 941 on Blue Circle Island and 169 on Swan Island. Subsequent additional nesting on Swan Island increased the number there to at least 200, giving a total of 1,141 AON (actively occupied nests) for the two islands, a reduction of 7.2% from the 1,229 AON recorded in 2016. Due to the dense vegetation and high mobility of the chicks, it was difficult to make an estimation of productivity on Blue Circle Island. However, the large number of fledged young present from mid-June indicated that this species had a successful year, with food availability appearing to remain good throughout the season. Predation by otter undoubtedly reduced productivity by a significant amount (almost 80 predated young were found), but productivity was probably close to 1.0. The picture on Swan Island was quite different as although a total of 25 predated Sandwich terns were found throughout the season, 140 young Sandwich terns disappeared without a trace between 9th and 16th June. The reason for the disappearance of all the young at that time remains a mystery.

A total of 355 pairs of common terns were thought to have attempted to breed on the two islands (116 on Blue Circle and 239 on Swan) in 2017. This is an increase of 6.6% from 2016 with a larger proportion nesting on Swan Island, in contrast to last year. On both islands the season for this species was protracted, with fresh breeding attempts being made well into July. This prolonged season is probably the result of very heavy predation stimulating multiple relaying. Productivity for common terns was assessed in 2017 with an enclosure created around 18 common tern nests on Blue Circle Island. This yielded a figure of 0.15 which was presumed due to the heavy predation of young and possibly eggs by otter. Otter predation appears to intensify towards the latter half of the breeding season and because common terns are later breeders than black-headed gulls and Sandwich terns, they suffered heavier losses.

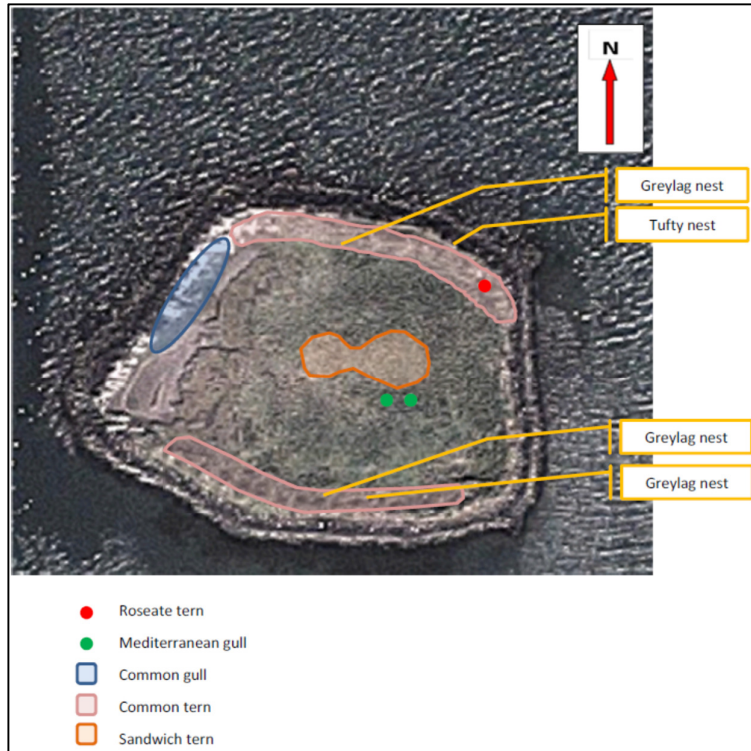


Figure 1: Distribution on Blue Circle Island of nesting RS, MU, CM, CN and TE

Predation has been a particular issue on both Blue Circle and Swan Islands throughout the season. The main method of recording the pressure that predation was exerting on the colonies was the collection of predated remains. With the carcasses being predominantly turned inside out, otter is believed to be the main mammalian predator responsible for impacting the tern’s productivity this year. Predation from gulls was also observed during the site visits, however the warden concluded the avian predation level was acceptable as the density of breeding birds meant they were able to effectively defend their nest and offspring successfully.

The restoration of Blue Circle Island is planned for the next autumn/winter, which should resolve the flooding that currently makes a third of the island unusable in advance of the 2019 breeding season. In addition, temporary anti-otter fencing will be put in place prior to the 2018 tern season.

Matthew Tickner, Reserves Ecologist – Matthew.Tickner@rspb.org.uk

Bibliography

Wolsey, S. (2017). Larne Lough Island Management Report 2017. RSPB

Coquet Island (England)

Building on the information submitted last year:

Wardening: the Coquet team comprised a Site manager, based in Amble supporting residential island staff comprising an Assistant Warden, a seasonal warden (large gull research and management) and a species protection field officer. The paid staff were supported by residential volunteers at the start and

finish of the bird breeding season, along with long term volunteer wardens who helped throughout the year. The residential staff started on Coquet Island at the start of March and finished on 5 October. Thereafter, visits to the reserve was on a daily basis depending on tide and weather, using the RSPB reserve rib “puffling”.

Gull management: the gull management work was conducted by Ibrahim Alfarwi as part of a PhD research project supervised by Newcastle University and was a continuation of the work developed over the past three seasons and consented by Natural England. The main aim of this work was to study the impact of large gulls on the roseate tern colony. In addition, the use of an Aerolaser was monitored as part of a wider project to study the effectiveness of such a device in gull scaring during March, before the tern assemblage returned. A separate Gull management report was submitted to the RSPB at the end of the season and will be incorporated into the reserve annual report. It is anticipated that the gull management work will continue next year along similar lines.

Avian and mammalian predators: the large gulls are the main predator presence on Coquet Island and are dealt with above. In addition, the island’s roseate terns are guarded 24/7 by reserve staff and volunteers, with the help of a sophisticated CCTV system and night hide located near the roseate tern colony. This is to prevent unwarranted disturbance by unauthorised landings and stop egg thieves accessing the reserve. The Police also had in place Operational Orders, which effectively sets up good lines of communication between island staff and the right individuals in the Police who deal with such wildlife crime.

Biosecurity: There was a rat incursion spotted at the start of January which propelled the implementation of the Biosecurity Plan into action. The sole rat was finally caught in March with the help of the Island’s Landowner, the Duke of Northumberland. The plan is in its final draft but due for completion by the end of 2017.

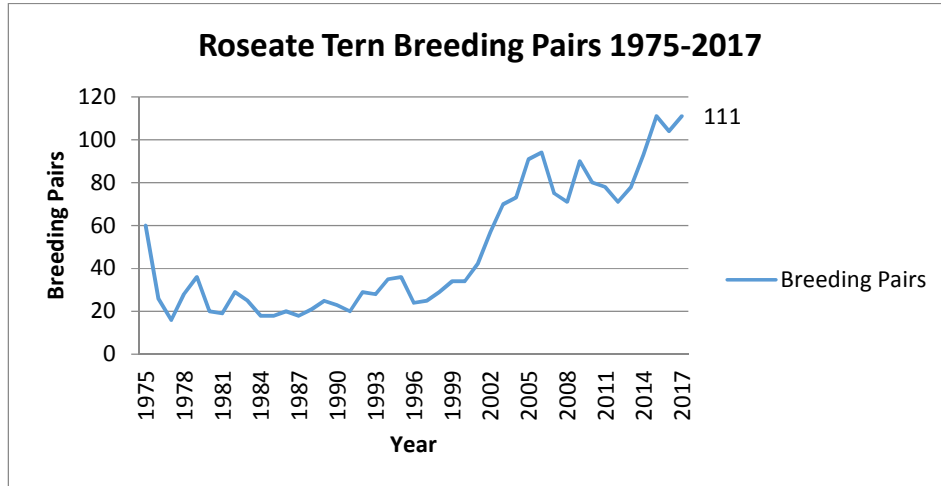
Nesting habitat: The nesting areas used by common terns behind the roseate tern terracing are subject to an intensive grass cutting regime at the start and end of each year. This involved strimming the dense growth followed by raking and then use of a grass cutter. This year, 25 shelter “rafts” were set out in the common tern area, to help subdue rank grass growth into the season and offer shelter for common tern chicks and re-laying terns.

The rosy terraces were expanded a little at the start of the season with the use of plastic recycled interlocking paving slabs, covered with shingle, along with the rest of the terrace area. In total, 216 boxes were set out on the terraces in the same positions as last year, each one secured in place with a rock to prevent them being blown away in bad weather.

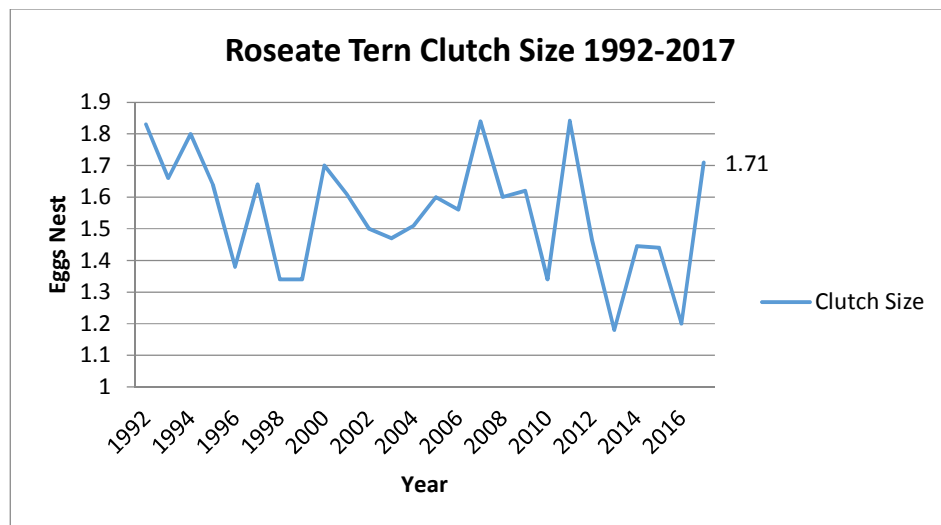
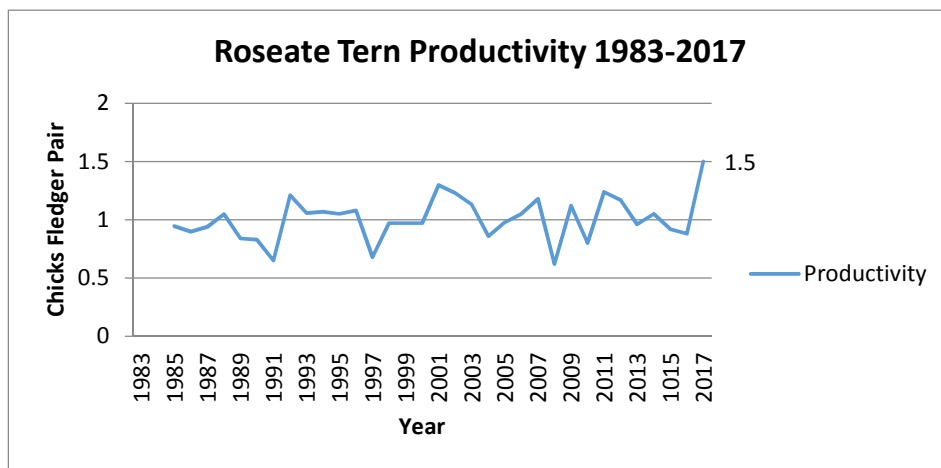
Demographic information and methods: the roseates were monitored in the same way and frequency as in previous years which involved full box checks every seven days to track the progress of nesting, clutch size and hatching, and to streamline visits for chick ringing.



Figure 1: New Terracing for 2018



Conditions this year were favourable, with plentiful food available and good weather. The result was heartening, with 111 pairs recorded and 166 chicks fledging. A productivity of 1.5 was the highest recorded on Coquet. 168 chicks were ringed, using the new “one ring” which combines the BTO address and the special characters for ring-reading at distance. In addition 227 adult rosy ring sequences were read.



A paper on provisioning was completed this year and has been submitted to Waterbirds for publication.

Wildlife cams were set up this year; one looking along the terracing and the other inside a rosy nest box. Images from both were streamed to the WWW using a transmitter on the island to the RSPB office on the mainland and thence to the internet.



Figure 2: Life in a rosy box

Paul Morrison, RSPB Warden - Paul.Morrison@rspb.org.uk

Brittany and Normandy (France)

In 2017, Ile aux Moutons continued to be the stronghold for breeding roseate terns in France, with 46 pairs recorded nesting there. This was the same number of pairs as in 2016. The island also supports two other breeding terns' species: Sandwich terns and common terns. In 2017, there were 2552 pairs of Sandwich terns and 271 pairs of common terns. Unfortunately, it was a poor season for the roseate terns which had only 11 fledglings making the productivity 0.24 juveniles/nest.

The site of Ile aux Moutons is located south of Finistère, near Concarneau and Fouesnant. It is considered to be part of the Glénan archipelago. The monitoring of the tern colony is undertaken by interns/warden, who rotate on/off the island every month between May and August. They have basic accommodation; small equivalent of a bothy. The island is managed by Bretagne Vivante and Conservatoire du Littoral.



Figure 1: Ile aux Moutons (Photo credits: Chantal Macleod-Nolan)

The roseate terns nested along the garden wall predominantly on the outside facing the sea with only 2 pairs nesting inwards. The garden contains the majority of breeding common terns, while Sandwich terns nested both inside and in the vegetated area outside the wall. Roseate terns nested in either wooden nest boxes or rock shelters (created by the wardens). Predation control is undertaken each year to prevent large gulls from nesting within the tern colony by removing their nests. The vegetation is also managed each year and shingle has been added to make the tern-nesting habitat more suitable.

Between mid-April and the end of August, the island receives a large number of visitors aiming to enjoy the sandy beach area. As a result, parts of the island have been roped off to prevent disturbance during the critical breeding season and the presence of the on-site seasonal warden/intern helps reinforce the importance of the no entry areas. In addition, signage has been erected at a viewpoint which provides a detailed explanation on the various ground nesting shorebirds and seabirds present on the island.



Figure 2: La Colombière in the distance, which at low tide is connected to the mainland. (Photo credit: Chantal Macleod-Nolan)

In 2017, the wardens recorded 6 roseate terns at La Colombière along with 74 common terns and 28 Sandwich terns. The wardens recorded 2 fledglings, resulting in a productivity of 0.33 fledglings/nest.

La Colombière is an island which at low tides is connected to the mainland. It also supports breeding Sandwich terns, common terns, oystercatchers and rock pipits. Due to the location and configuration of the island, it is not possible to monitor the tern numbers from nearby, resulting in the key observations

having to be done by boat. This height of the island does not allow the wardens to observe the colony clearly and therefore the numbers reported are only from the outer reaches of the island.

It is a former breeding site for roseate terns and has been used regularly in the last 10 years (consistently between 2007 and 2014), although numbers fluctuate on a year on year basis. In the past, roseate terns have relocated to nest on La Colombière after its main breeding colony at Ile aux Dames had failed, likely attracted there with the prospecting Sandwich and common terns. Since 2010, it has been the second most frequent site in Brittany for roseate terns.

As it is tidal, the island is susceptible to land mammals particularly foxes and rats. The conservation bodies managing the site: Bretagne Vivante and Conseil départemental des Côtes d'Armor undertake monitoring and predation control (including permanent bait stations with bromadiolone present). This device appears to be effective and the island is rat-free. There has never been any proven evidence of passage of mink on the site. Foxes, on the other hand, have been frequently recorded at this archipelago and on the nearby coast. During the LIFE Dougall 2005-2010, different solutions were trialled as a preventive measure (live trapping on Ebihens Island, scent repellent) however they concluded that the most effective method was the presence of a night warden.

Avian predators have been a limiting factor at this site since 2015, due to a pair of peregrine falcons, which nest on Agot Island (located 3.5 km from La Colombière). In 2017, the peregrine falcon's nest failed early in the season, which meant the terns were able to fledge some young. In addition, this year, the wardens recorded tern egg predation by turnstones.

Human disturbance is also a major threat to the site, with the public able to access the island at low tide from the beach. At high tide, a 100-metre perimeter, which is marked by yellow buoys, allows boats to know that there is no access however, this is not always adhered to.



Figure 3: Roseate Tern LIFE staff visiting La Colombière in July 2017 and looking back to the mainland as tide rises (Photo credit: Yann Jacob)

There was an additional roseate tern pair recorded in the Chausey Archipelago, in Normandy, however there was no monitoring on this site meaning the outcome of that breeding attempt is unknown (Groupe Ornithologique Normand, *comm. pers.*). Overall the productivity of roseate terns across France was 0.25 fledglings/nest.

Chantal Macleod-Nolan

(Source: Yann Jacob, Tern Regional Coordinator - yann.jacob@bretagne-vivante.org)

Azores (Portugal)

In 2017, a total of 891 roseate tern breeding pairs were recorded in the Azores, which was 35% higher than the 2016 census (538 pairs).

The Azorean population of roseate terns was distributed across 25 colonies, of which 16 sites contained between 1 and 10 breeding roseate terns. There were only 3 colonies over 101 pairs and a single colony which fell within 51 and 100 pairs. The remaining 5 colonies all between 11-20 pairs. Overall the western group of islands support 65% of the roseate tern population, with the eastern group containing only 3% in 2017 (Figure 2).

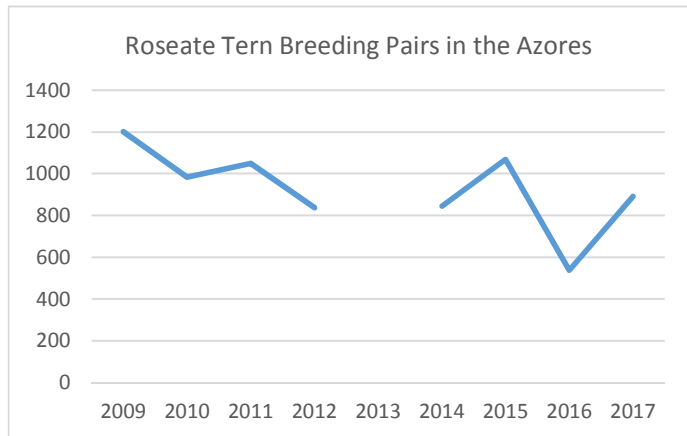


Figure 1: 8 year population trend of roseate terns breeding in the Azores (NB, there were no surveys undertaken in 2013)

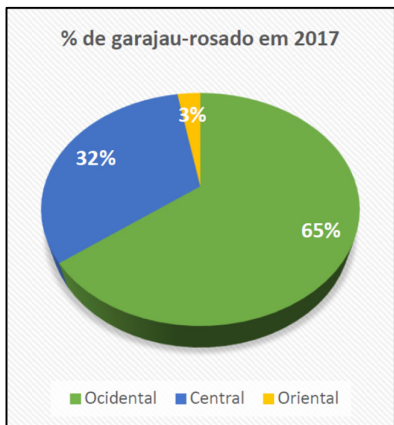


Figure 2: Relative breeding population across the three island groups in the Azores

Across the central group of islands, there were fewer roseate terns recorded nesting there in 2017 than previous years (Table 1 & Figure 3). This was a result of colony on Ilhéu da Praia (n = 58 in 2017) at the island of Graciosa having declined by more than 50% since 2016 (n = 180). Meanwhile, the population on the island of Flores increased due to the colony at Ponta do Burquilhão growing from 108 pairs in 2016 to 240 pairs in 2017.

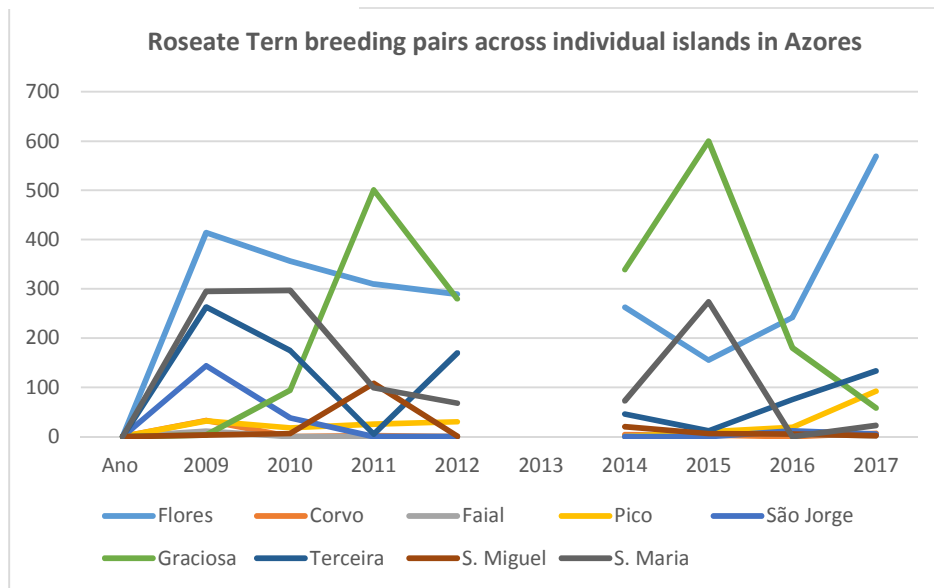


Figure 3: Roseate Tern breeding pairs across individual islands in the Azores

Table 1: 8 year dataset of the roseate tern population across the individual islands in the Azores

	Flores	Corvo	Faial	Pico	São Jorge	Graciosa	Terceira	São Miguel	São Maria	Total Roseate tern pairs in Azores
Year/Island Group	Western	Western	Central	Central	Central	Central	Central	Eastern	Eastern	All islands
2009	414	33	11	32	144	3	263	3	295	1201
2010	356	0	0	18	38	94	175	6	297	984
2011	310	2	0	25	0	501	5	108	99	1050
2012	289	0	0	30	0	280	170	1	68	838
2013										
2014	263	4	0	0	0	339	46	20	73	845
2015	155	3	8	10	0	600	12	6	274	1068
2016	242	0	5	19	12	180	75	5	0	538
2017	569	7	2	92	5	58	133	2	23	891

Contendas Islets

The Contendas islets, located off the coast of Terceira Island in the Azores archipelago are an important nesting site for roseate and common terns (Figure 4). The 3 small islets are about 2 metres apart from the island's shoreline, as they were formed of an eroded peninsula. They comprise different types of tern nesting habitat: rocky area with scattered endemic fescue clumps; plateau and slopes with dense herbaceous vegetation, some eroded areas of bare soil.



Figure 4: Contendas Islets (Photo Credit: Malgorzata Pietrzak)

The Contendas islets and adjacent areas have been classified as *Special Protection Area* in 1990 (Birds Directive) and in 2011 they were included in the *Habitats or Species Management Protected Area*; and in the *Resources Management Protected Area*, managed by the Terceira's Natural Park under the Regional Directorate for Environment.

Since 1989, Contendas has held on average 12,6% of the Azorean breeding population of roseate tern and in the year 2000 this value was the highest at 45%. During 2005 and 2006 no roseates bred at Contendas. Over the 2007-2017 period numbers have fluctuated between a minimum of 4 pairs in 2007 and a maximum of 263 in 2009.

Over the last three years there has been a positive trend in tern nesting pairs. In 2015 there were 8-12 pairs of roseate terns nesting and 51-56 of common. The roseate terns were breeding only at the outer rocky islet; no birds bred at the middle islet or at the islet closer to land. In 2016 there were 67 pairs of roseate terns and 100 pairs of common terns. The roseate terns nested in two of the islets. In 2017 there were about 133 pairs of roseate and 133 pairs of common terns, breeding in all three islets.

In the past years the management efforts at Contendas islets have consisted of control of predators (gulls and rats) and habitat management (vegetation control and wooden nesting boxes placement).

Due to a growing population of yellow-legged gulls in Terceira island (foraging in the municipal landfill), the gulls have expanded their breeding sites to the Contendas islets. The impact of gulls increased steadily since 2003 when the first pair of yellow-legged-gull was detected breeding in the islet. Over the recent years gull numbers increased and the pressure over the terns become very negative. Since 2009 there had been efforts to discourage gulls from nesting there by making their eggs unviable through shaking. Since 2015 eggs and nest have been taken out and destroyed. The control actions start in the beginning of April and are repeated every 2 weeks in an attempt to discourage gulls from further nesting and force them to abandon the islets before tern's arrival, which in most cases has been successful. In the beginning of the gulls breeding season in 2015 there were 14 couples of gulls nesting, a year later 8 couples in and in the past breeding season only 5 couples. There is usually a persistent couple of seagulls present in the islets, but the majority has left by the time terns start nesting.

Rats used to be present on the islets, preying on terns' eggs, the rodents were the target of eradication in 2006-2008 and they were detected and eliminated again in 2010. Rat bait stations have been deployed annually in the spring, as the islets are susceptible to rodent infestation at any time due to the proximity of the coast (Figure 5).



Figure 5: Rat stations on the Contendas Islets. (Photo Credit: Malgorzata Pietrzak)

In 2016, the thick vegetation on the plateau of the islet was cut, a strip of anti-weed fabric was placed, and a layer of grit was deposited to cover its black sheet (Figure 6). 20 nest boxes and shelters (boxes with 1 side open) were positioned. Just 2 weeks later the plateau (but not the boxes) was filled with nests of roseate terns (more than 80 nests with 1-2 eggs counted), however 2 weeks later no traces of nests or eggs were found, and we suspected a predatory event by gulls. Later on, wildlife cameras were put up, however they didn't capture any predatory acts although in some nests the eggs were missing (batteries worn out fast, snapshotting was too slow).



Figure 6: Clearing the top of the islet in preparation for the tern season. Left – cutting the vegetation. Right - laying grit and nest boxes on top of a strip of anti-weed fabric. (Photo Credit: Malgorzata Pietrzak)

In 2017 wildlife cameras were placed again just before tern arrival and chicken eggs were deployed in sight of every camera (Figure 7); and this time, predation by gulls was registered. Later on, the predation of tern eggs in the plateau by gulls was also recorded. The plateau seemed to be very exposed and terns preferred to nest on a densely vegetated slope and at the base of the islets, on the rocky area with fescues.



Figure 7: Setting up the wildlife camera to record predation attempts prior to tern arrival using chicken eggs (Photo Credit: Malgorzata Pietrzak)

At the plateau, 2 nest boxes out of 20 available were occupied by nesting terns for the first time, one had an egg (probably of roseate tern) and the other was used by a common tern chick for sheltering.

In late July, during a visit to the islets after the breeding season we registered 13 dead chicks, 16 dead fledglings and 7 dead adults. In case of the dead chicks and fledglings there were no signs of predation. The adult terns were in advanced stage of decomposition, so it was not possible to access the cause of death. The weather conditions were very favourable during the nesting season, and many successful fledglings were observed. Regrettably, there are no scientific data for productivity, survival rates etc. due to the lack of trained human resources, as well as due to the difficult nesting site access and a risk of trampling nests concealed in vegetation.

During the nesting season, the terns' colony is monitored from shore for about an hour once a week with the aid of a telescope. For in-situ management a boat is hired and wildlife cameras are set up to monitor a sample of nests. In spite of that, there are many factors of unknown effect on terns' colony: fishermen in the nearby coast, underwater spearfishing in a surrounding bay; starlings are frequent visitors to the islets and little egrets are becoming a frequent sight too. Volunteer observation would be of great help to get to know the tern colony, their disturbances and habits.

Malgorzata Pietrzak, Regional Directorate of the Environment, Government of the Azores –
malgorzata.pietrzak@azores.gov.pt

Vanda Carmo, Regional Directorate for Maritime Affairs, Government of the Azores -
Vanda.AS.Carmo@azores.gov.pt

Bibliography:

Government of the Azores. 2017 Report. Implementação da Diretiva-Quadro da Estratégia Marinha Censo de Garajaus (*Sterna hirundo* e *Sterna dougallii*) na subdivisão da ZEE Portuguesa da Região Autónoma dos Açores

North East America

Maine Coast Islands (Maine)

The National Audubon Society Seabird Restoration Program (SRP) manages seven seabird nesting islands off the coast of Maine, USA, in cooperation with the Maine Department of Inland Fisheries and Wildlife and the Maine Coastal Islands National Wildlife Refuge (Figure 1). These seven islands provide habitat for mixed colonies of Common, Arctic, and Roseate Terns, with three islands supporting consistent Roseate Tern populations (Stratton Island, Jenny Island, and Eastern Egg Rock). Roseate Terns occasionally nest in small numbers on the other four islands. Other nesting species vary by island, but include Atlantic Puffins, Black Guillemots, Razorbills, Common Eiders, Laughing Gulls, and Leach's Storm-petrels. Each year during the seabird breeding season, field crews of 2-5 people live on each island to protect, monitor, and study the seabird populations.

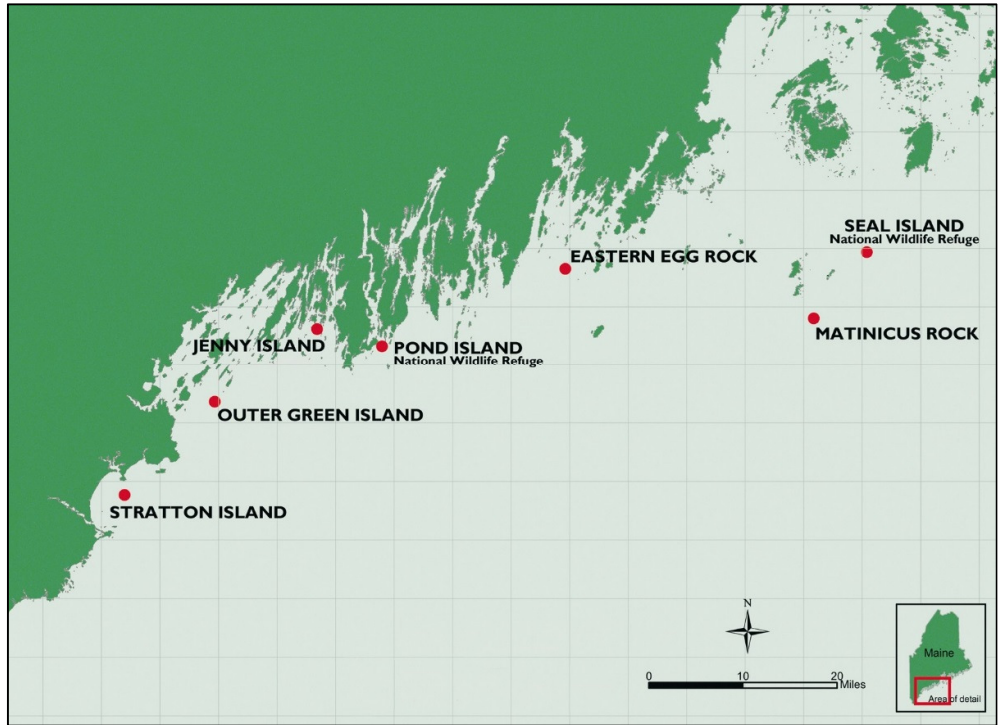


Figure 1. Locations of tern colonies managed by the National Audubon Seabird Restoration Program in the Gulf of Maine, USA.

Six of the seven tern colonies managed by SRP were restored between 1980 and 2002 using social attraction (decoys and playback of colony sound recordings) and intensive gull control. The remaining colony, Matinicus Rock, maintained its tern colony throughout the 1900s, likely due to protection provided by the presence of lighthouse keepers living on the island. Once restoration efforts in Maine began, Roseate Tern populations quickly increased, reaching a peak of 273 pairs in 2001. The population declined from 2001 to 2012, when the population stabilized for several years before increasing again in 2017 (Figure 2).

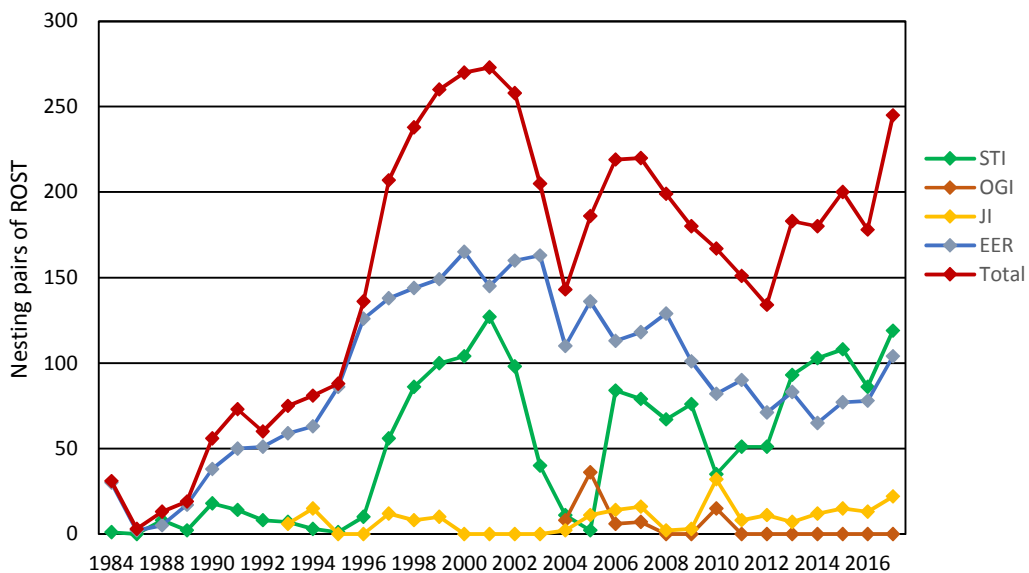


Figure 2. Population trends of Roseate Tern colonies managed by the National Audubon Society Seabird Restoration Program in the Gulf of Maine, USA, 1984-2017. STI: Stratton Island, OGI: Outer Green Island, JI: Jenny Island, EER: Eastern Egg Rock.

Management

Factors affecting Roseate Tern populations in Maine include predation by gulls, Black-crowned Night-herons, Great Horned Owls, and mink; nest-site competition with Laughing Gulls (at Eastern Egg Rock); and habitat degradation resulting from invasive vegetation. Predator management is conducted as needed (under federal and state permits) and includes lethal control, live-trapping and relocation, gull nest destruction, and non-lethal harassment. To reduce nest-site competition with Laughing Gulls, gull nests are removed weekly in areas where tern and Laughing Gull nesting habitat overlaps. This effort has reduced, but not eliminated, nesting Laughing Gulls in the targeted area. Habitat enhancement projects have included placing vegetation barriers, experiments with planting native plants, and providing nest shelters for Roseate Terns. Use of nest shelters varies by colony, and the shelters tend to be used only when natural shelter (large rocks, logs, etc.) is lacking. Wooden nest boxes and rock “caves” (Figure 3) have both been placed or built in suitable habitat to provide shelter. Rock “caves” are utilized at higher rates than wooden boxes.



Figure 3. Rock “caves” built to provide nesting habitat for Roseate Terns at Stratton Island, Maine. Left: a line of rock caves next to a vegetation barrier early in the breeding cycle. Right: Close up of rock “caves” during incubation.

Monitoring and Research

Annual monitoring of Roseate Terns in Maine includes nest counts, productivity estimates, banding and band resighting, and diet studies.

In 2017, the Roseate Tern population increased at all three colonies, for a total of 245 breeding pairs. Productivity was good overall, ranging from 0.92 chicks fledged per pair at Jenny Island to 1.29 at Eastern Egg Rock (Table 1).

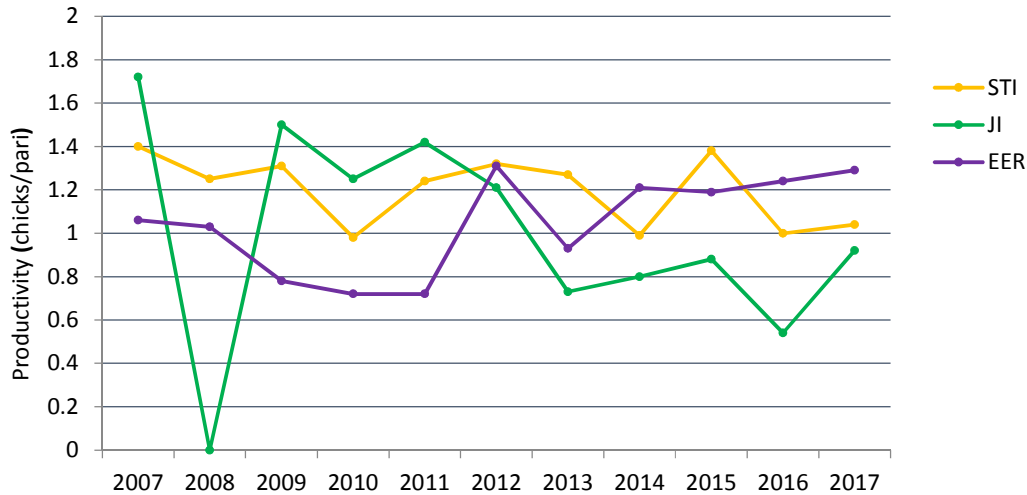


Figure 4. Productivity trends of Roseate Terns at Stratton Island (STI), Jenny Island (JI), and Eastern Egg Rock (EER), Maine, 2007-2017.

Tern chick provisioning studies have been conducted on Maine coast islands since 1986. Each year, summaries of the diets of Common, Arctic, and Roseate Tern chicks are compiled at each colony. An analysis of this long-term dataset is being conducted by Keenan Yakola, a master’s student at the University of Massachusetts Amherst and the DOI Northeast Climate Science Center (discussed below).

Diet Study Analysis

Background:

SRP has been collecting Common, Arctic and Roseate Tern observational chick diet data since the late 1980’s in the Gulf of Maine, USA (GoM). However, the full time-series of this data has yet to be fully explored and analyzed, as much of the historical data remained in “paper form” until this past year. As part of his master’s thesis at the University of Massachusetts Amherst, Keenan Yakola has now digitized and standardized the full time-series of data and has begun to investigate the chick diet of these three species in the GoM across the seven nesting colonies managed by SRP. His first step was to describe the diets of these three terns and to compare diets across species, islands and years. His next step is to investigate how changing environmental conditions in the region may be influencing these species’ diet. The following report is adapted from a presentation given at the Roseate Tern Recovery Meeting in Westborough, Massachusetts in November 2017 and includes some of Keenan’s preliminary data analysis and will solely focus on Roseate Terns across four of the seven islands managed by SRP. A more in depth and detailed description of this work will appear in his thesis which he hopes to complete in the Fall of 2018.

SRP Observational Diet Collection Methods:

When egg laying begins, biologists living seasonally on each island select around sixteen nests per tern species that will be monitored until chicks fledge or the nest fails. The selected nests are always near to and easily visible from one of the multiple bird blinds located in the nesting colonies. Each nest is assigned a number and color code that distinguishes it from surrounding nests. When chicks begin to hatch, each chick receives a unique nine-digit band issued by the Bird Banding Laboratory to keep track of individuals. In addition, the chicks are marked with their respective nest color with a non-toxic permanent marker. To identify individual chicks within a nest the “A” chick is colored on the head, the “B” chick on the back, and the “C” chick on the breast. Every week each nest is observed for a total of 12 hours by conducting three-hour-long observation periods using binoculars. When a feeding is delivered to a chick, the observer records the following information: the time, the species of the prey item, the size of the prey item, the individual chick receiving the prey item, and the parent that delivered the prey item. A further description of these methods is presented in Hall et. al., 2000. At the end of each season island supervisors prepare season reports which include the summary of all delivered prey items during chick provisioning studies. Data are summarized by the percentage of each prey item (or prey group) by island, tern species, and year.

Roseate Tern Diet in Maine:

SRP has been collecting Roseate Tern chick diet data in the GoM through observational studies across four different nesting colonies. These include Stratton Island, Outer Green Island, Jenny Island and Eastern Egg Rock (Figure 5). Between all four nesting colonies 50 island-year combinations of data have been collected since 1990 (Table 1).

Table 1: Summary of Roseate Tern chick diet data collection efforts by SRP in the GoM.

Island	Alpha Code	Species	Time Series	No. Years of Data
Eastern Egg Rock	EER	ROST	1990 – 1991, 1993 – 1995, 1999 - 2017	24
Jenny Island	JI	ROST	2007, 2012, 2016, 2017	4
Outer Green Island	OGI	ROST	2005, 2007	2
Stratton Island	STI	ROST	1990, 1993, 1995, 1999 – 2002, 2004, 2006 - 2017	20
All Islands & Species			1990 - 2017	50

After summarizing diet data for ROST across these four islands using the annual means of each prey species or major species group (methods adapted from Hall et al., 2000), it was quickly realized that chick diet varied greatly both between years and by colony location. The most variation in Roseate Tern chick diet between years and islands occurred in two prey species, sandlance, *Ammodytes sp.*, and hake (likely White Hake, *Urophycis tenuis*) and primarily between two islands, EER and STI (Figure 1). The mean amount of sandlance in chick diet on EER over the past 24 years is only 6.3% whereas the 20-year mean on STI is 57% of chick diet. It is clear that sandlance is a very important prey item to ROST nesting on STI, yet on EER the major prey species is hake, which comprises 46% of the 24-year diet mean (Figure 5). Making similar conclusions regarding OGI and JI are more difficult as data has been collected from these two islands for fewer than five years. However, both sandlance and hake are essential prey items at these two colonies.

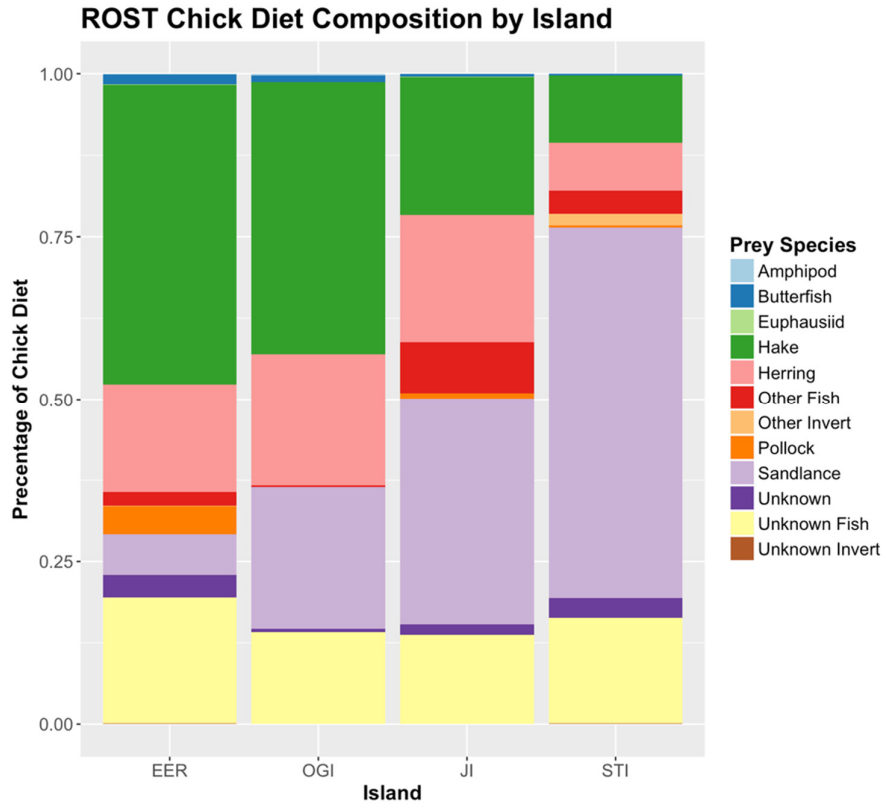


Figure 5: Stacked bar chart illustrating the percentage of each major prey species or group in Roseate Tern chick diet across each of the four islands. Values are means calculated across all years of data collection for each island. See Table 1 for specific years of data collection.

Other published reports of ROST chick diet in the Northwest Atlantic have presented data suggesting that ROST are specializing on sandlance (Safina et al., 1990; Heinemann, 1992; Rock et al., 2007; Goyert, 2015). However, in the GoM at EER, the percentage of sandlance in ROST chick diet has remained under 25% of the diet across all 24 years of data collection (Figure 6). A closer look at the yearly percentage of sandlance at the STI colony reveals that there is much more variation from year to year compared to EER, but the annual percentage of sandlance is typically above 50% in most years (Figure 6).

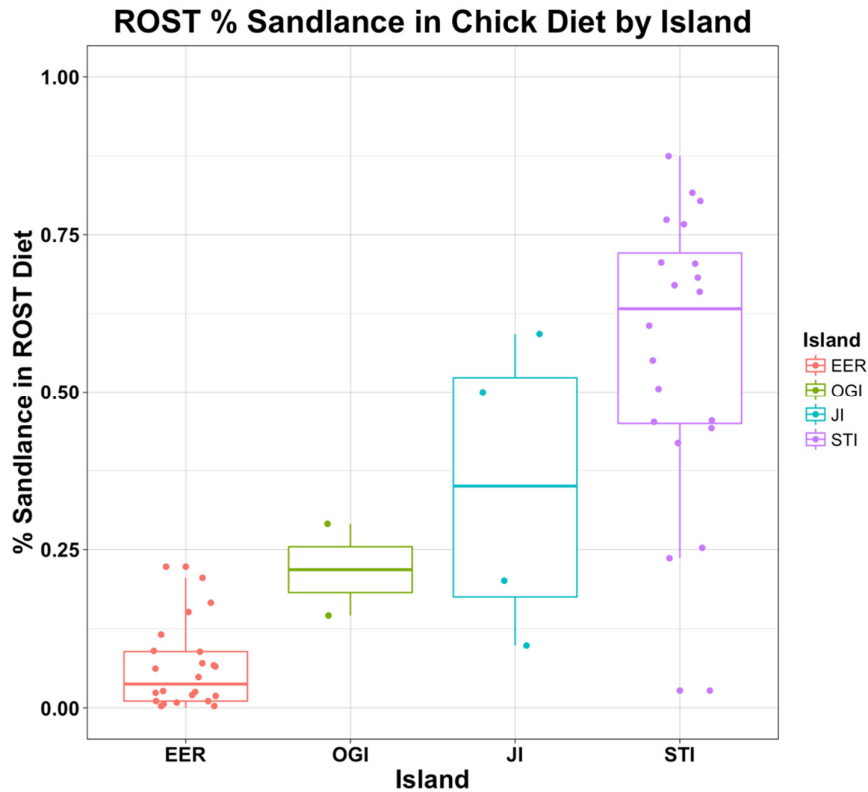


Figure 6: Boxplot of the percentage of sandlance in Roseate Tern chick diet across four different nesting colonies in the GoM. Each point represents a single year of data from each island-year combination with an added “jitter” of points to better help visualize the data.

These findings raise a lot of questions. Why do such differences in ROST chick diet between islands exist? Why are ROST on EER not eating (or not finding) sandlance? Do other species on these same islands show similar dietary trends? How much do these drastically different diets impact annual reproductive success? What is driving observed annual variations in sandlance from year to year in chick diet?

The multi-decadal time series collected by SRP on tern chick diet is allowing researchers to investigate many of these questions and will be vital to the conservation of these species, as well as to the protection of their forage fish prey.

Stable Isotopic analysis of seabird eggshells

Rachel Bratton, an Undergraduate student at the University of Massachusetts Amherst completed a Five College Coastal and Marine Sciences Program (<https://www.fivecolleges.edu/marine>) internship this past summer in collaboration with Project Puffin and the Northeast Climate Science Center. Her summer internship and Honors Thesis work (graduation date spring 2018) will evaluate the pre-breeding foraging ecology of seabirds nesting on Maine Coastal Islands National Wildlife Refuge. Stable carbon and nitrogen isotopes in eggshell tissues collected during the 2016 and 2017 nesting seasons will test 1) inter-specific differences among Arctic tern, Common tern, Roseate tern, and

Atlantic Puffin populations nesting on shared islands?; 2) intra-specific differences of Arctic tern, Common tern, and Roseate tern populations nesting across different Maine Coastal Islands in the same year?; 3) inter-annual differences among seabird populations nesting on shared islands?; and 4) of isotopic signals by hatch date within species? Results will provide new insights into the habitat and trophic level at which these seabirds species are feeding just prior to nesting in the Gulf of Maine.

Preliminary results from 2016 and 2017 on two Maine Coastal National Wildlife Refuge Islands (Eastern Egg Rock and Seal Island), found differences in Arctic terns foraging behavior across islands and years and suggest they may forage at lower trophic levels and more depleted (offshore) environments compared to other tern species.

Paula Shannon, National Audubon Society Seabird Restoration Program, Seabird Sanctuary Manager, Maine Coast Sanctuaries. pshannon@audubon.org

Keenan Yakola, University of Massachusetts Amherst, DOI Northeast Climate Science Center, and the National Audubon Society Seabird Restoration Program. kyakola@umass.edu

Michelle D. Staudinger, Ph.D. Science Coordinator, DOI Northeast Climate Science Center. Adjunct Assistant Professor, Department of Environmental Conservation University of Massachusetts Amherst - mstaudinger@usgs.gov

References:

- Goyert, H.F., 2015. Foraging specificity and prey utilization: evaluating social and memory-based strategies in seabirds. *Behaviour*. 152, 861–895.
- Hall, C.S., Kress, S.W., Griffin, C.R., 2000. Composition, Spatial and Temporal Variation of Common and Arctic Tern Chick Diets in the Gulf of Maine. *Waterbirds*. 23, 430–439.
- Heinemann, D., 1992. Foraging ecology of Roseate Terns breeding on Bird Island, Buzzards Bay, Massachusetts. Unpublished report to the U.S. Fish and Wildlife Service, Newton Corner, Massachusetts, USA.
- Rock, J., Leonard, M., Boyne, A., 2007. Foraging Habitat and Chick Diets of Roseate Tern, *Sterna dougallii*, Breeding on Country Island, Nova Scotia. *Avian Conservation and Ecology*. 2, 4.
- Safina, C., Wagner, R.H., Witting, D.A., Smith, K.J., 1990. Prey Delivered to Roseate and Common Tern Chicks ; Composition and Temporal Variability. *Journal of Field Ornithology*. 61, 331–338.

Buzzards Bay (Massachusetts)

In 2017, the islands across Buzzards Bay supported a total 2,240 ‘peak season’ pairs of roseate terns (2,050 in 2016), making it the highest number of roseate terns that we have ever recorded nesting. Buzzards Bay surpassing the 2,118 pairs in 2000.

Bird Island



Figure 1: Bird Island on 11 April 2017, post-construction. (Photo Credit: M. Moore.)

The construction of the Bird Island Habitat Restoration Project completed in April 2017 with a few design modifications that were made after the first construction season in 2016. This included adding a ring of cobble around the island to provide adults terns with a less vegetated provisioning area for chicks and chinking voids in the revetment with stones to prevent entrapments of common terns. In addition to completing the revetment prior to the 2017 breeding season, MassWildlife also provided nourishment of the interior with sand and gravel, and planting of native plants (see Figure 2), mostly seaside goldenrod (*Solidago sempervirens*) and American beachgrass (*Ammophila breviligulata*).



Figure 2: Southwest section of Bird Island on 16 May 2017 (left) and 13 July 2017 (right). (Photo Credit: C. Mostello/MassWildlife)

Overall the modifications, functioned as desired however, there were unexpected issues in other areas. The fine material caused water to percolate slowly through the fill impeding drainage and created substantial puddling after rainfall. In addition due to the low relief of the island, it did not move laterally very quickly and throughout the season much of the island's surface remained damp with algae growing in some areas. This particularly affected roseate terns because the nest box clusters had coincidentally been placed in some of the worst areas and evaporation under the box was low. As a result, the wardens moved many unoccupied nest boxes from the flooded or saturated areas to encourage roseate terns to nest in safer areas. A second issue was the volume of fill. A design modification made after the first construction season was raising the elevation of the northern half of the island by 1 foot to reduce overwash; however, there was a deficit of material and certain areas were prone to puddling or tidal overwash.

MassWildlife have been working with the Army Corps and the U.S Fish & Wildlife Service to resolve these issues before the 2018 nesting season. In September, some of the cobble ring (which fortuitously turned out to be a good reservoir for excess rainwater) and was partially reconfigured into narrow (3'-wide) rock-filled drains that extend from the areas with pooling water to the main cobble ring (see Figure 3). Two 10'-wide drains near the northwest and northeast points of the cobble ring connect it to the transition stone along the revetment, thereby conducting water off the island. We are currently exploring options to raise the elevation in other fill-deficient areas and cap areas that flooded with high permeable fill to provide a well-drained surface while the fines in the material below wash out over time. Over winter the situation will be monitored to ensure that the island is functioning as desired before the terns return to nest.



Figure 3: Cobble-filled drainage ditches on Bird Island and material excavated from the ditches used to raise elevation of a low spot (which appears mostly unvegetated) on the eastern section of the island, 17 October 2017. (Photo Credit: C. Mostello/MassWildlife)

As a result of the flooding events, both roseate and common terns nested later on Bird Island than on Ram Island (a reversal of the typical order). This was presumably due to the saturated substrate and that terns were reluctant to put down eggs. A lack of nesting material and cover may have also played a role.

Overall there were 595 pairs of roseate terns nesting on Bird Island in 2017, which was a 48% deduction from in 2016 (1,153 pairs). Hatching success was atypically low because of the widespread flooding of nests, but food was adequate; resulting in a productivity of 0.6 fledglings/nest and 0.8 fledglings/pair; the latter value excludes pairs whose nests that failed early and probably relaid. Predation was relatively low during most of the nesting season, however after most of the terns had fledged; an unknown species of raptor (possibly a peregrine falcon) was recorded consuming terns on the top of the lighthouse.

Fewer common terns also nested there as well with 1,652 pairs in 2017 (2,193 pairs in 2016) however as food resources were relatively abundant, productivity was good with 1.00 fledglings/nest.

Ram Island

The roseate tern numbers skyrocketed in 2017 to 1,555 pairs (886 in 2016), which made it the highest ever recorded number at this island by a wide margin, besting the 988 pairs in 2000. This increase likely occurred due to the terns spurning the wet conditions on Bird Island. Food appeared to be adequate for roseate terns and productivity was very good with 1.16 fledglings/pair. No major predation event were recorded on Ram Island this year. Common terns also had a good year with numbers stable at 3,545 pairs (3,527 in 2016) and a productivity of 1.21 fledglings/nest.

Penikese Island

After a discouraging 2016 due to predation, the situation on Penikese Island completely turned around this year, we presume due mainly to scrupulous efforts to break-up nests of black-crowned night herons, the primary offender last year. Tern refugees from Bird Island apparently buoyed the numbers. Roseate terns jumped up to 90 pairs (11 in 2016) and productivity was very good 1.20 fledglings/nest. Common

tern numbers climbed to 784 pairs (531 pairs in 2016) and productivity was excellent with 1.85-2.16 fledglings/nests.

Year	Bird Island		Ram Island		Penikese Island		Total		
	COTE	ROST	COTE	ROST	COTE	ROST	COTE	ROST	COTE + ROST
1998	1,903	1,113	1,307	543	137	-	3,347	1,656	5,003
1999	1,836	1,148	1,887	630	101	-	3,824	1,778	5,602
2000	1,880	1,130	2,030	988	126	-	4,036	2,118	6,154
2001	2,136	1,062	1,890	626	278	-	4,304	1,688	5,992
2002	1,702	505	2,307	952	279	-	4,288	1,457	5,745
2003	2,054	904	2,000	557	661	251	4,715	1,712	6,427
2004	1,761	554	2,938	936	631	9	5,330	1,499	6,829
2005	1,857	680	2,278	724	758	76	4,893	1,480	6,373
2006	1,866	1,111	2,129	463	756	48	4,751	1,622	6,373
2007	1,863	919	2,214	661	889.5	102	4,966.5	1,682	6,648.5
2008	1,576	747	2,354	566	1,130.5	66	5,060.5	1,379	6,439.5
2009	1,805	708	3,961	588	1,138.5	43	6,904.5	1,339	8,243.5
2010	1,945	735	3,466	584	1,073	37	6,484	1,356	7,840
2011	1,872	937	3,345	377	1,206	34	6,423	1,348	7,771
2012	1,902	814	2,693 ^a	439	636.5 ^a	9	5,231.5 ^a	1,262	6,493.5 ^a
2013	2,500 ^b	772	3,525	535	673.5	0	6,788.5	1,307	8,095.5
2014	2,391	1,121	3,790	682	915.5	20	7,096.5	1,823	8,919.5
2015	2,247	1,127	3,330	735	1,217	23	6,794	1,885	8,679
2016	2,193	1,153	3,527	886	531	11	6,251	2,050	8,301
2017	1,652	595	3,545	1,555	784	90	5,981	2,240	8,221

^a Minimum estimate; censuses were conducted immediately after major overwash events that destroyed hundreds of nests.

^b Extrapolated total count from sample; adjusted using best professional judgment.

Figure 4: Estimated “peak-of-season” numbers of pairs of Common (COTE) and Roseate (ROST) Terns at Bird, Ram and Penikese Islands, 1998 – 2017.

Overall despite the drop in number of terns on Bird Island, our three-island ‘system’ enable terns to redistribute within Buzzards Bay and number remained high. Roseate tern number continued to build for the fifth year in a row and we exceeded the highest population estimate by 120 pairs (Figure 4). Because Ram Island is so small and habitat is rapidly eroding, we never considered that under existing conditions we would see over 1,500 pairs of roseate terns there!

Carolyn Mostello, Massachusetts Division of Fisheries & Wildlife, Buzzard Bay Tern Restoration Project Leader – carolyn.mostello@state.ma.us

Bibliography

Mostello, C. 2017. Buzzards Bay Tern Restoration Project: 2017 Field Season Reports and Summary of Accomplishments, 1999 – 2017. Massachusetts Division of Fisheries and Wildlife

Falkner Island (Connecticut)

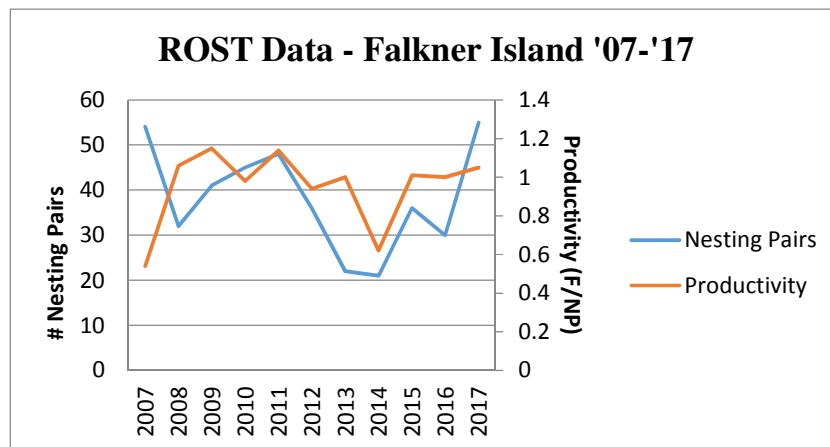


Falkner Island looking at the eastern side and the north spit

Falkner Island Unit of Stewart B. McKinney National Wildlife Refuge located 3 miles off the coast of Guilford, Connecticut at $41^{\circ} 12' 41.52''\text{N}$ and $72^{\circ} 39' 18.372 39' 18.34 \text{ W}$. The tern colony at Falkner Island has been studied since 1978. Acquired by the United States Fish & Wildlife Service in 1985, the island is home to the largest breeding common tern colony and only breeding roseate colony in Connecticut. Falkner is approximately 5 acres and is composed of rocky beaches adjacent to steep vegetated slopes - or as on the eastern and northern sides of the island – erosion control rip-rap which leads to the top of the island. For a list of other bird species on the island, see <http://ebird.org/ebird/hotspot/L3986792>.

The roseate tern population on Falkner Island was once composed of over 200 pairs (1978). However over the past 40 years, numbers have decreased significantly to below 50 pairs from 2008-2016 (see Figure 1). There may be several reasons for this decline at a meta-population level; USGS is now researching what these causes might be. At a site level, black-crowned night heron depredation, habitat loss, and competition from common terns have been targeted as causes for the decline. This year, the island saw an increase in roseate nesting pairs (55 pairs) due to management techniques implemented to exclude common terns from prime roseate nesting areas. This technique included setting out nesting boxes densely packed into the area and placing large rocks in any of the open space outside of the boxes.

Figure 1. Roseate tern population and productivity on Falkner Island from 2007 to 2017



Issues and Solutions:

- *Depredation* - Since 2006, the Stewart B. McKinney NWR staff has been actively controlling predators using lethal and non-lethal methods. This requires a crew to be present on the island 7 days a week and 24 hours a day in order to deter depredation. In correlation with this, we have seen ROST productivity increase from 0.34 in 2006 to a stabilized value of ~1.0.
- *Prey Fish Availability*: In 2014, the ROST productivity was 0.62-0.67 about a 40% decrease. This was likely due to prey fish shortage and competition for resources with the more aggressive common tern. The crew on Falkner Island has been collecting information about prey fish. In 2017, the common terns had very poor productivity at 0.55 fledges/np down from the previous year, 0.75 f/np. However, the ROST productivity was a little over 1 f/np. The provisioning study revealed that the ROST foraged for sandlance most often (48%) and the common tern were foraging for bluefish (42%). More needs to be known about where the terns on Falkner are going for prey. The Refuge and partners have applied for funding for a nanotag survey to locate these foraging areas and if funded, this study will take place in FY18.
- *Competition with Common Tern*: As stated previously, common terns compete aggressively for food and space with the roseate tern. In 2017, the staff managed to exclude common terns from most of the areas that roseate terns favor. This seemed to be an effective method and will be utilized and improved upon for the 2018 field season. For more information on the method, see page 1 and photo below.
- *North Spit Degradation*: With help from Ecological Services (T&E), the Refuge talked with the State and the Army Corps of Engineers to start planning for the restoration of prime roseate habitat on Falkner Island using clean dredge material. This project is in the initial stages.



Common tern exclusion technique in prime roseate tern habitat

Kris Vagos, Refuge Wildlife Biologist - [Kristina Vagos@fws.gov](mailto:Kristina.Vagos@fws.gov)

Great Gull Island (New York)

This was an exceptionally good year for the Roseates on Great Gull Island (GGI). We had the highest nest count ever! We also had the largest number of HY birds given Plastic Field Readable rings (PFRs). Disturbance from predators was minimal and the weather was excellent. There appeared to be an excellent supply of bait fish, particularly *Ammodytes*, and the birds were often observed feeding very near the island.

Each year Helen Hays, working with volunteers, occupies the island from the end of April or early May through the first week in September. Management projects are undertaken on weekends in spring and fall. Thanks to funding from a Cooperative Recovery Initiative grant and the help of volunteers, two additional terraces with nest boxes were put in place not far from ones installed two seasons ago. Some new blinds were built and older ones repaired.



Figure 1: The Terrace D photo shows our older terraces with boxes near a retaining wall (all well-used by Roseates) and a new terrace to the far left- not yet well-used. (Photo Credit: Kevin Rogers)



Figure 2: Terrace Q with boxes: newly built, along with many others; the Roseates began using these the first season, with more birds moving in this year. (Photo Credit: Kevin Rogers)

Methods for nest counts, chick banding, and adult trapping were the same as those described in the 2016 Annual Roseate Tern Newsletter. We found a total of 314 nests in boxes this season, up slightly from the 2016 total of 295. We hope that as young that hatched in these boxes return to breed, they will use more of the nest boxes.

Our total count of marked nests on 8 July was 1703. We estimate that this represents 80% of total nests, bringing our 2017 number of nests (and pairs) to 2,089. This is the highest total since we started routine nest counts in 1988. Mean clutch size for the first 1,030 nests was 1.7.

We ringed a total of 1600 Roseate chicks. Each received a Bird Banding Lab band on one leg and a PFR band, dark blue with white letters, on the other. Estimated productivity this season was 1.44 chicks per nest. Taking advantage of the excellent blinds, observers on GGI were able to resight large numbers of our Hatching Year (HY) birds.



Figure 3: Hatching year Roseate with PFR blue band E38 (Photo Credit: Peter Paton)

We trapped 217 adults: 157 were retraps and 60 were given BBL and PFR rings. Observers resighted many ringed adults as well as a remarkable number of two-year-olds. They also documented birds from other colonies visiting GGI late in the season.



Figure 4: View of GGI from a boat showing the rocky shoreline where most Roseates nest among the boulders, and 2 of the many blinds (hides) used for observations. (Photo Credit: Peter Paton)

Catherine Neal continued the GSI nest mapping project begun in 2014. With help from the rest of the Roseate team, GPS locations and habitat descriptions were recorded for all 2,089 Roseate nests. Nest distribution will be compared with earlier years.

Pam Loring reports that this nesting season 30 Roseate Terns and 30 Common Terns on GGI were fitted with digital VHF transmitters (nanotags) as part of a collaborative movement study with the USFWS Division of Migratory Birds, the University of Rhode Island, and the University of Massachusetts Amherst. This study is funded by the Bureau of Ocean Energy Management and aims to estimate the exposure of high-priority avian species to offshore wind energy areas in the U.S. Atlantic, from Massachusetts to Virginia.



Figure 5: V73 shows nanotag antenna (Photo Credit: Peter Paton)

Helen Hays, Director of the Great Gull Island Project - hays@amnh.org

Grace D. Cormons, Roseate Team Field Lead on Great Gull Island – cormonsg@gmail.com

Caribbean Roseate Tern Population

Florida (U.S.)

The roseate tern in Florida is a federally threatened species and is part of the Caribbean population. All nesting in Florida is in the Florida Keys and the Dry Tortugas National Park which are located at the extreme southern end of Florida. The roseate tern in Florida is designated a federally threatened species by the U.S. Fish and Wildlife Service. Their primary habitat is on sand and coral rubble on offshore islands, tar and gravel rooftops, and abandoned bridges.

Management for roseate terns on rooftops is difficult, especially when on private property. Emergency repairs of air conditioning units or the roof itself may cause the entire colony to abandon if the work is not done quickly or in the morning when temperatures are cooler. Further, strong rains can sometimes flood eggs on poorly drained roofs. Additionally, not all residents are sympathetic about having terns nesting atop their building. They frequently complain about the birds defecating on their vehicles and sidewalks. Predation from mammals is not an issue but terns are vulnerable to fish crows (*Corvus ossifragus*) which are abundant in urban areas.

Management for roseate terns at the Dry Tortugas National Park includes restricting park visitors from entering the nesting areas. Large educational signs and law enforcement are very effective. There is also ongoing control of domestic rats on all the islands. Unfortunately, erosion from strong summer storms as well as vegetation succession has led to loss of open sandy areas which are the main nesting areas for this species. Roseate terns in Florida do not like to nest in vegetation but prefer open areas. Over-wash from winter storms or hurricanes will occasionally create habitat on these islands. Laughing gulls are occasional predators of roseate tern chicks but there is currently no gull control.

There is no management of the roseate terns on the abandoned bridge. The bridge is cut off on both ends and is over water. Further, the bridge is crumbling and no longer structurally stable so accessing it by boat would be dangerous. Fortunately, that makes it impossible to have human disturbance.

As a result of habitat loss, predation, and hurricanes, the Florida population of roseate terns has drastically declined in the last 10 years (Figure 1).

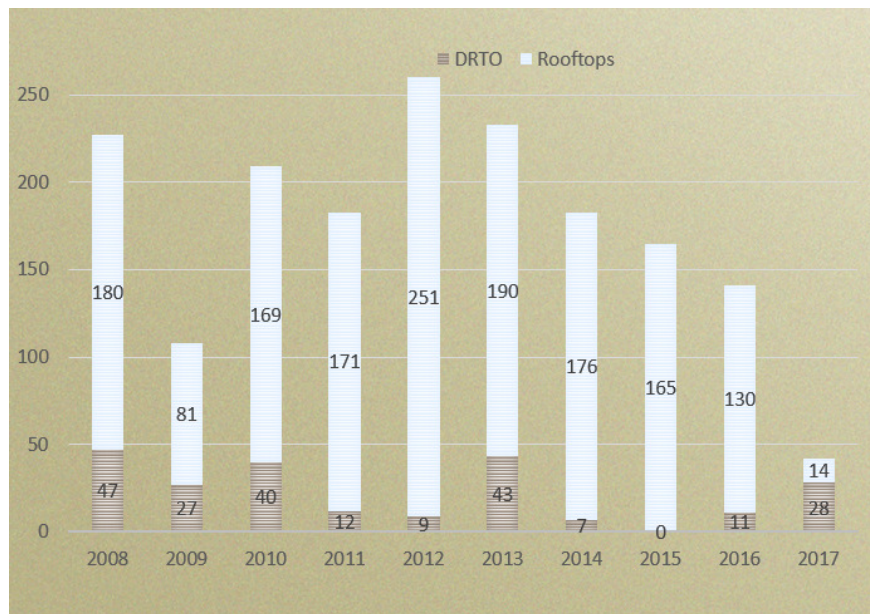


Figure 1. Roseate tern nesting pairs in Florida, 2008-2010 at the Dry Tortugas National Park (DRTO) and on rooftops and bridges (bridges are lumped under rooftops).

2017 Report

In 2017, roseate terns nested on a sand and coral rubble beach at the Dry Tortugas National Park, two rooftops and an abandoned bridge (Figure 2).

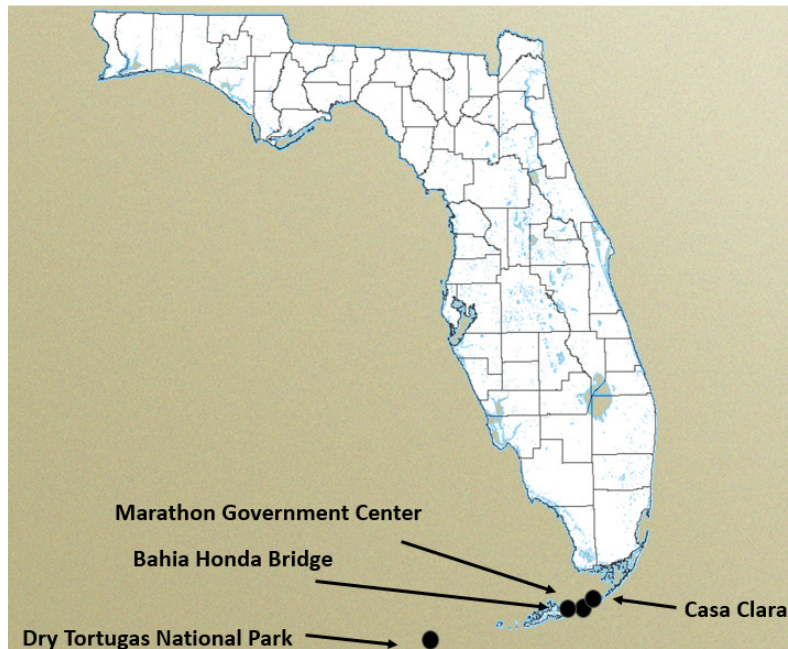


Figure 2. Roseate tern colonies in Florida, 2017

- 1) The Dry Tortugas National Park is located 112 km west of Key West in the Gulf of Mexico. The park is managed by the National Park Service. Sooty terns (*Sterna fuscata*) and brown noddies (*Anous stolidus*) nest near the roseate terns but not within the section of the island.
- 2) Roseate terns nested on two roof colonies on Vaca Key in the middle of the Florida Keys. One building is a private residential condominium and the other is a state government building. The roseate terns nest with least terns (*Sternula antillarum*).
- 3) Roseate terns also nested on an abandoned bridge next to Bahia Honda State Park. The bridge contains concrete debris and asphalt from the buckling of the rails and road surface which provides a nesting substrate for least terns and the roseate terns.

The total nesting pairs of roseate terns in Florida were 42 and were located at four colonies. All counts are direct counts of nests on the ground and roof colony. Nests on the bridge are counted by counting incubating adults using a spotting scope. Twenty-eight of the pairs were on the ground colony (Dry Tortugas National Park) and 14 were on the bridge and rooftops. Unfortunately, productivity for the entire Florida population was low and estimated as a minimum 0.47 fledged young/nesting pairs. Mean clutch size and survival rates were not calculated since these colonies are only visited two to three times per season. The number of chicks or eggs on the bridge cannot be calculated because of the distance between the location of the nests and available viewing spot. Banding was only conducted at one rooftop and at the Dry Tortugas National Park. Only twenty chicks were banded, 17 of which were at the Dry Tortugas National Park.

Due to the drastic decline of the roseate terns in Florida, a couple of management actions are being attempted. An artificial platform was installed at Geiger Key, just outside Key West, to attract roseate terns to nest but it was only utilized by least terns for nesting. Another larger and taller platform is being planned possibly for the 2018 nesting season. Social attraction equipment (decoys and recorded calls)

may be placed at the Dry Tortugas National Park to try to attract more nesting pairs. Placement of such equipment was successful in 2006 so the hope is that this can be repeated (Figure 3).



Figure 3. Recorded calls and decoys (not shown) placed at the Dry Tortugas National Park in 2006 to attract roseate terns.

Ricardo Zambrano, Regional Biologist, Florida Fish and Wildlife Conservation Commission – Ricardo.Zambrano@MyFWC.com

The Virgin Islands (British and United States)

Movement among colonies in the Virgin Islands is not well-understood. It is likely that Roseate Terns in the United States Virgin Islands (USVI) and British Virgin Islands (BVI) are one continuous population, although they are managed separately. Roseate terns are listed as Threatened in the USVI under the U.S. Federal Endangered Species Act, and are protected in the BVI through the Royal Society for the Protection of Birds. In the Caribbean, Roseate Terns have high rates of colony-site turnover. Between these two territories there are ~27 potential colony sites, with varying yearly frequency of use. Typically, between 5 - 10 colony sites are occupied yearly, with individual colony sizes ranging between 5-1000 breeding pairs.

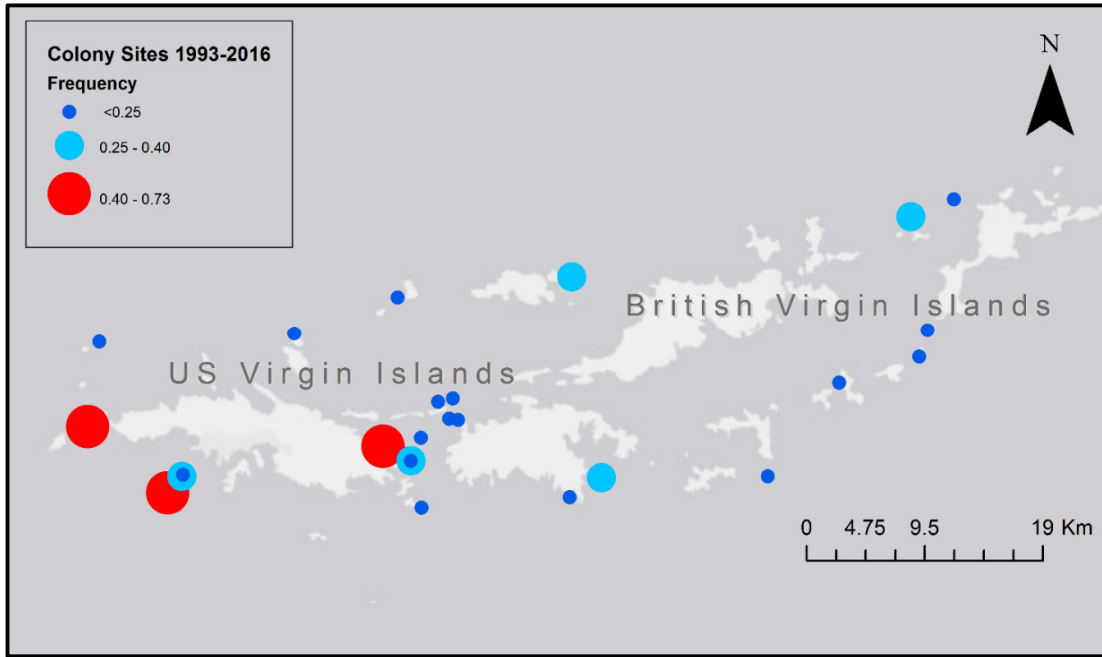


Figure 1: Locations and frequency of use of 24 primary roseate tern nesting cays in the United States and British Virgin Islands between 1993 - 2016.

Nesting cays vary widely in vegetative composition and appearance; however, cays tend to be small (0.1-5.6 hectares), with patchy vegetation, low species diversity, and no native mammalian predators. Roseate Tern colonies tend to be established on unvegetated slopes. Colonies are monotypic in the Virgin Islands, although other colonially-nesting seabirds may be present on nesting cays, include Bridled Terns, Sooty Terns, Sandwich Terns, Royal Terns, Laughing Gulls, and Brown Boobies. Caribbean Roseate Terns don't lay eggs in or under vegetation, and will not use nest boxes if made available, possibly due to elevated temperatures in nest boxes.



Figure 2: Typical Virgin Islands Roseate Tern colony site. June 2017, Kalkune Cay, U.S. Virgin Islands. Photo: Paige Byerly

Full monitoring for the two territories was begun in 1993 by Judy Pierce, and was restarted in 2016 following a 5-year hiatus. Currently population monitoring is conducted by the USVI Division of Fish and Wildlife (DFW) and the BVI's Jost Van Dykes Preservation Society (JVDPS). Peak season total breeding pair abundance declined 33% between 2016 (1268) and 2017 (854); however, given the high yearly fluctuations in population size, more years are needed to accurately assess population trends.

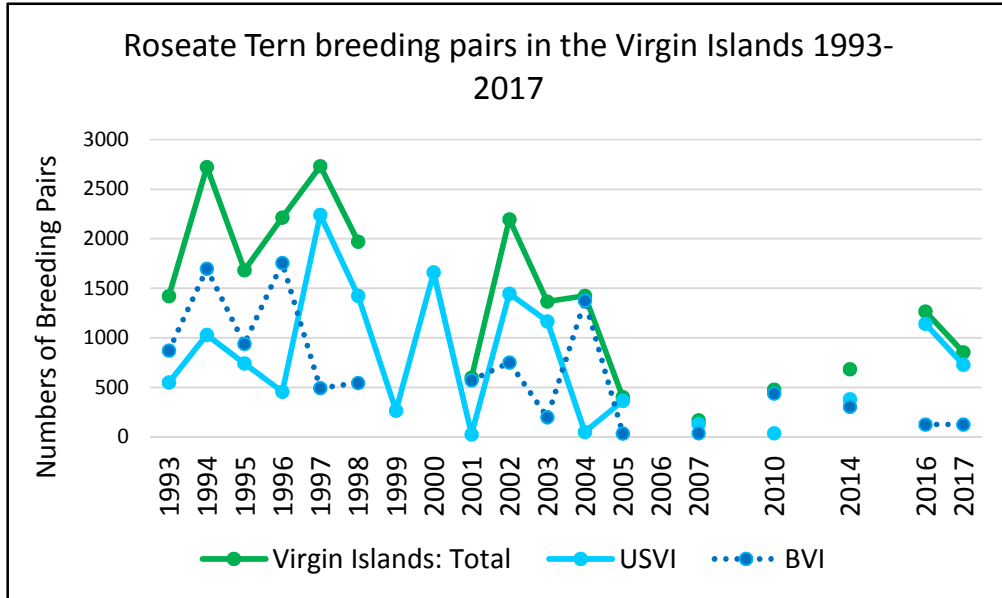


Figure 3: Counts of Roseate Tern breeding pairs in Virgin Islands colonies from 1993-2017, with both combined totals (Virgin Islands: Total) and totals split out by territory (US Virgin Islands and British Virgin Islands). 1993-2010 totals from Pierce (2009).

Apart from population monitoring, management of colony sites has been limited during the last 10 years. In the USVI, colonies are overseen by the DFW, and most colony sites are protected wildlife refuges with limited or no public access. In the BVI, colonies are overseen by the BVI Department of Conservation and Fisheries, the BVI National Parks Trust, and the JVDPS. Colony site use is mixed—some colony cays are privately owned, some are national parks, and some are open-access. In the USVI, lethal goat and rat removal has been largely successful on offshore nesting cays, although rat re-eradication may be necessary on some cays due to recurrent colonization. In 2016, the JVDPS began goat and rat eradication on several important colony cays through a Darwin Initiative grant, with efforts ongoing through 2018.

Apart from non-native mammalian predators, potential adult and nest predators include Laughing Gulls, Red-tailed Hawks, Peregrine Falcons, crabs, and red ants. Historically, egg collection by humans was believed to be a primary colony threat (Pierce 2011), but best evidence suggests that this cultural practice has been discontinued and is no longer a conservation concern.

2017 Report

USVI:

Population estimates take place during peak nesting, when most eggs have been laid, but before peak chick hatching, usually between May 15th - June 5th. Colony sites are first located by visiting each potential colony cay via boat and looking for signs of nesting activity. When colony sites are not safely accessible, colony counts are estimated by boat through counts of visible adults seen incubating eggs.

Otherwise, colonies are entered by biologists and nests are manually counted. Due to the sensitivity of Caribbean Roseate Terns to disturbance and the potential for colony abandonment, counts are conducted as quickly as possible, and are conducted only between 0630 and 1100 to minimize heat stress to eggs. Colony sites are divided into sections, and all nests in each section are tallied. An additional 20% is added to the total estimate to account for low nest detectability due to rough terrain (Pierce 2009).

In the USVI, 7 colonies were established in 2017. The earliest established colony, on Congo Cay, was abandoned by June 2nd due to heavy rat predation. Congo was not included in the total yearly nest count, as it is suspected that the colony re-nested on Carval Rock and Shark Island. Shark Island was also abandoned post nest-initiation, possibly due to high egg predation, but was included in the count.

Table 1. 2017 peak season Roseate Tern nest counts in the United States Virgin Islands.

	Carval Rock	Flat Cay	Kalkune	Congo	Shark Island	LeDuck	Pelican
Survey Date	June 5, 2017	May 31, 2017	May 31, 2017	May 17, 2017	June 5, 2017	May 30, 2017	June 2, 2017
Total nests counted		26	109	50	19	412	8
+20% Adjustment		5	22	10	4	82	2
Estimated nests*	40	-	-		-	-	
Total Counts	40	31	131	60**	23	494	10

* Some portions of colonies were in areas that were inaccessible. In those cases, nest counts were estimated

** This colony was abandoned and it was suspected that it re-nested on Carval Rock and Shark Island.

In addition to population estimates, a two-year research and monitoring initiative was started in 2017 through a partnership between the DFW and the University of Louisiana at Lafayette (UL-Lafayette). Primary goals of the initiative include assessing productivity and predation rates to identify potential limiting factors of population growth. As continuous population monitoring through the season is not feasible due to colony sensitivity and difficulty of accessing nest cays, monitoring is done through motion-activated game cameras. In 2017, we installed 10 cameras in 4 colonies, for a total of 32 nests continuously monitored through the breeding season. Adult terns showed no signs of being disturbed by cameras, and no nests were abandoned post-camera installation.

Table 2. Results of camera trap monitoring of four roseate tern breeding colonies during the 2017 breeding season in St. Thomas and St. John, U.S. Virgin Islands.

Cay	Start Date	End Date	Colony Size	#Nests	Hatch Success	Egg Predation	Fledge Success	Chick Predation	Nest Success
Flat	5/31/17	7/17/17	31	3	1	0	1	0	1
LeDuck	5/30/17	7/17/17	494	10	1	0	0.7	0.3	0.7
Congo	5/17/17	6/5/17	60	10	0.1	0.9	1	0	0.1
Shark	6/5/17	7/17/17	23	9	0	1	0	NA	0
Total	-	-	708	32	0.35	0.47	0.77	0.1	0.29

Average egg predation was high (47%) and average nest survival rate was low (29%), indicating that egg predation may be inhibiting population growth in the Virgin Islands. Primary egg predators detected on camera included rats, Laughing Gulls, and Yellow-crowned Night-Herons.



Figure 4. Laughing gull predation of a roseate tern egg on Shark Cay, St. Thomas, United States Virgin Islands. The egg is visible in the laughing gull's bill.



Figure 5. Brown rat (*Rattus rattus*) predation of a roseate tern nest on Congo Cay, St. John, United States Virgin Islands. Previously depredated and broken eggs are visible around the parent tern.

Camera monitoring will continue through 2018, with a goal of doubling the number of cameras deployed in colonies. A rat was detected on a cay previously believed to be rat free (Shark), and management plans for 2018 also include re-evaluating invasive predator presence on primary nesting cays.

BVI:

In the BVI, colonies are located by surveying potential colony sites by boat. Breeding pair sizes are estimated by approaching colony sites by boat, counting all visible adults seen incubating eggs, and adding 20% to the nest count total. In 2017, two colony sites were located, Cooper Island (n=15) and Guana Island (n=111). A pilot study for future colony monitoring was also begun in 2017 through a partnership between the JVDPS and UL-Lafayette. Four nest cameras were installed in BVI, with a total of 10 nests monitored. No predation was detected and nest survival was high (93%); however, because cameras were installed after peak hatch date, results are likely not reflective of predation rates and nest success across the entire breeding season.

Restoration of a historically important Roseate Tern nesting cay, Green Cay, was begun by JVDPS in 2017. Restoration efforts included rat abundance estimates and lethal goat and rat removal (the latter via A24 rat traps). Invasive species removal will benefit other avian species, as rats and goats strip

native vegetation, altering island habitat quality. Similar restoration was undertaken in 2016 on the Seal Dog Islands in BVI and was largely successful, although attempts to attract Roseate Terns to nest on the island through use of decoys failed. Plans to increase research and monitoring efforts over 2018 breeding season are underway.

Paige Byerly, PhD Student, University of Louisiana at Lafayette --pabyerly@gmail.com

Daniel Nellis, Biologist, USVI Division of Fish and Wildlife -

danielnellis@dpr.vi.gov

Susan Zaluski, Director, Jost Van Dykes Preservation Society--susan@jvdps.org

Bibliography

Byerly, P.A., D. Nellis, and P.L. Leberg. Roseate Tern (*Sterna dougallii*) colony site-selection and productivity in the United States Virgin Islands: Year One Project Report. Final Report. U.S. Fish and Wildlife Service.

Nellis, D, P.A. Byerly, S. McKinley, and R. Zambrano. 2017. 2017 mid-season nest counts of Roseate Terns (*Sterna dougallii*) in the United States Virgin Islands. Final Report. U.S. Fish and Wildlife Service.

Pierce, J. 2009. U.S. Virgin Islands. *In* An inventory of breeding seabirds of the Caribbean, P.E. Bradley and R.L. Norton (Eds.). The University Press of Florida, pp. 99 to 111.

Roseate Tern Use of Staging Sites in the North-eastern United States

History of the U.S. Geological Survey's CRTMP Roseate Tern Staging Site Studies

The Cooperative Roseate Tern Metapopulation Project (CRTMP) was conceived to identify factors limiting population growth and to develop information and management techniques that would help promote the recovery of the Northwest Atlantic Roseate Tern (ROST) breeding population in the US and Canada. Since its start in 1987, it has been directed by Dr. Jeff Spindelw at the Patuxent Wildlife Research Center (formerly part of the U.S. Fish & Wildlife Service [FWS], but now part of the U.S. Geological Survey). A main element in the CRTMP has been the development of multistate capture-mark-reencounter (CMR) methods to examine various aspects of the population dynamics of this species (Spindelw et al. 1995, 2002, 2008, 2016; Lebreton et al. 2003; Nichols et al. 2004), and contributions of this research to the management and recovery of ROSTs breeding in Massachusetts (MA), New York (NY) and Connecticut (CT) during the first 12 years of the CRTMP were summarized by Nisbet and Spindelw (1999).

CRTMP cooperators began colorbanding adults with unique 4-band combinations of a metal Bird Banding Laboratory (BBL) band and three colorbands, and chicks with a BBL on one leg and a single colorband on the other leg denoting which colony site it was from in 1988. In part because of high rates of colorband loss, we switched and started using 4-character metal field-readable (MFR) bands on ROST chicks in 1992 at CRTMP colony sites and also colony sites in the Gulf of Maine and Canada. Adults also were given MFR bands in 1992, although cooperators at some sites continued to add

colorbands to result in 4-band combinations at Great Gull Island, NY, and 6-band combinations at Falkner Island, CT (1993-2003) and Buzzards Bay, MA (2004-2010). Beginning in 2011 we started using 3-character plastic field-readable (PFR) bands at most ROST colony sites in the NW Atlantic. The use of other colors of PFR bands on Common Terns (*S. hirundo*) began in 2013 in MA and they have now been used on COTEs at several colony sites in Canada, New Hampshire (NH), NY, New Jersey, Maryland, and Virginia.

While the overall goals have remained essentially the same, the geographic scope of the CRTMP has expanded over the past 30+ years from the original four study colony sites in the MA-CT area to now include colony sites throughout the entire breeding range from CT & NY in the west to northern Nova Scotia (NS), Canada, and also to include research being done at ROST staging sites in southern Maine (ME), NH, MA, Rhode Island (RI), and NY. Potential threats to terns at staging areas include hurricanes, human-related and natural disturbances of staging flocks, loss of prey fish habitats due to sand-dredging projects, and the operation of offshore turbines for wind energy.

Staging site research done prior to 2011

Some staging site work was done in the 1990s (Shealer & Kress 1994, Trull et al. 1999, Watson & Hatch 1999) before the ROST population decline began in 2000, but then relatively little work was done on this part of the ROST life cycle for the next few years. A major reason for the development of the Staging Site Studies (SSS) aspect of the CRTMP was the proposal to build 124 offshore wind turbines in the Horseshoe Shoals area of Nantucket Sound, MA. This area lies between the large ROST colony sites in Buzzards Bay, MA (BBMA) and Great Gull Island, NY (GGNY), and the main staging areas on the outer parts of Cape Cod (CCMA) - several of which are located within Cape Cod National Seashore (CCNS) which is managed by the U.S. National Park Service (NPS) - south to the Nantucket-Muskeget Shoals area of MA. Although the developer of this proposed Cape Wind Energy Project announced in December 2017 that he was giving up on building it, a smaller 5-turbine offshore array was constructed by another developer and began operating in 2017 south of Block Island, RI.

After preliminary work was done by Spindelov in the mid-2000s, the new ROST SSS research was expanded to include collaboration with Dr. Becky Harris and Ellen Jedrey with the MassAudubon Coastal Waterbird Program (MACWP). The MACWP obtained outside grant funding for a two-year study in 2008-2009 of the use of staging sites by COTEs and ROSTs, especially adult ROSTs with 6-band combinations from BBMA and young Hatch Year (HY) ROSTs with MFR bands from throughout the breeding range.

In 2008 with a crew of eight people we found much higher numbers of staging terns on outer Cape Cod sites and fewer terns at a southeastern BBMA staging site in Falmouth and at Plymouth Beach in western Cape Cod Bay than had been reported in prior years. Between 2,000-20,000 terns were observed in 3 primary areas: Hatches Harbor just south of Race Point at the northwestern tip of CCMA, the Nauset Estuary area in Eastham, and the South Beach-Monomoy area in Chatham (Fig. 1). For the former two areas (both within CCMA) we documented staging terns in numbers never before reported (10,000-20,000). We also recored disturbances to staging terns from dogs, beachgoers, vehicles, and boat traffic at some sites. We saw hawk-like “kettling” by terns following some disturbances and flight heights of 500-1,000 feet when terns were flying overland at several sites and also near dusk. We also followed into September the movements of many individuals from Nantucket to the Nauset Estuary and/or Hatches Harbor.

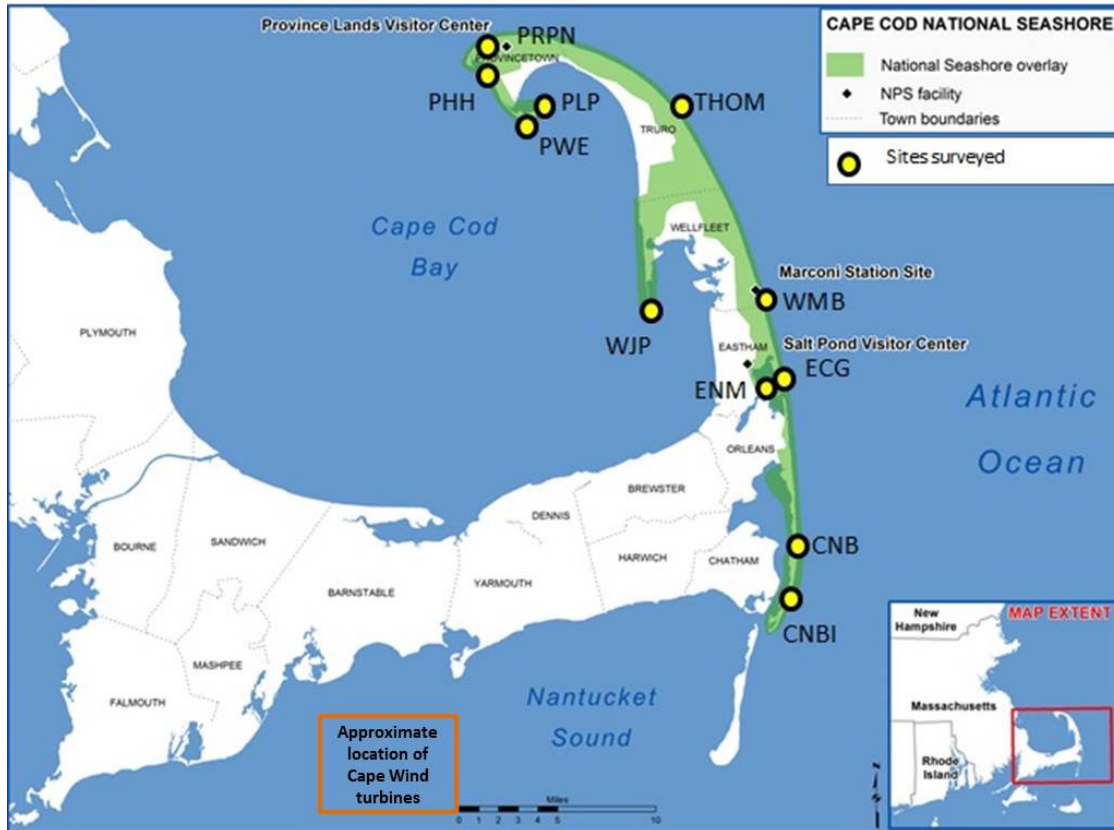


Figure 1: Roseate Tern (ROST) staging sites on the outer part of Cape Cod, Massachusetts (CCMA) within Cape Cod National Seashore (CCNS), and the approximate location of the proposed Cape Wind Energy Project in Nantucket Sound. Staging sites surveyed by the Parental Care Study Team for 2014-2015 included in the Provincetown/Truro area: Long Point (PLP), Wood End (PWE) Hatches Harbor (PHH), Race Point North (PRPN), and Head of the Meadow Beach (THOM); in the Wellfleet/Eastham area: Jeremy Pt. (WJP), Marconi Beach (WMB), Coast Guard Beach (ECG), and the Nauset Estuary Complex (ENM); and in the Chatham area: Chatham North Beach (CNB) and Chatham North Beach Island (CNBI). Although not labeled on the original figure produced by Kayla Davis for her MS thesis at Virginia Tech, other important CCMA staging sites outside of CCNS used by ROSTs include (a) the eastern side of Buzzards Bay off the southwestern part of the town of Falmouth, (b) the (ever-changing) area around what is now North and South Monomoy Islands (shown as a single long island south of the town of Chatham in this figure) and South Beach Chatham (south of CNBI), and (c) the Nantucket-Muskeget Shoals area that forms the southeast border of Nantucket Sound as shown in the “map extent” insert. The northern tip of Block Island also appears south of mainland Rhode Island in the insert.

In 2009 when people working at Country Island, NS began putting solid and bicolored butt-end celluloid colorbands on some of their ROST chicks, our observations on CCMA showed they actually had three times as many fledglings as they were able to determine at their colony site (Jedrey et al. 2010). We again found high numbers of staging terns on the outer Cape and on 20 September estimated that just before dusk about 20,000 terns came in and landed on the Wood End flats to the west of Provincetown Harbor before they left after dark to find a nocturnal roost site.

A trip by Jedrey and Julie McKnight of the Canadian Wildlife Service (CWS) in August 2010 to Sable Island off the coast of NS resulted in the resighting of a colorbanded adult from BBMA that had gone ~800 km in the ‘wrong direction’ before starting its migration to South America. Observations of MFR- and 6-banded adults at staging sites in Puerto Rico led to new insights about ROST behavior during spring migration (Hays et al. 2010, Spindelw 2017, Spindelw and Lugo 2017). These results and those mentioned in the preceding two paragraphs demonstrated the need to switch to a new colorbanding

scheme that would allow us to quickly identify, track the movements, and observe the behaviors of Hatch Year (HY) birds as well as adults after they have left their colony sites.

Research since the use of 3-character plastic field-readable colorbands began in 2011

Because trapping adults is not being done at some colony sites and it is very difficult to identify individuals by reading the MFR bands we used from 1991-2012 at distances of more than 20 m, the expansion of the CRTMP research to include ROSTs at staging sites and at colony sites in the northern part of the breeding range has been made possible by the use of PFR bands which can be placed on young chicks before they become mobile enough to leave their nest sites and move to new hiding places, and then be read with spotting scopes at distances of up to about 50 m. We started using PFRs in 2011 at eight of the small- to medium-sized colonies spanning the breeding range from CT to NS.

After the end of foundation funding to MACWP, the bulk of the CCMA fieldwork for 2011-2013 was done by Spendelow. In 2011 Spendelow did fieldwork on 63 days from 15 July to 20 Sep. and had assistance from David Monticelli from Belgium for the last six weeks of this period. We identified as HYs 16 of 27 (59%) of the ROST chicks given PFR bands in CT and 144 of 244 (59%) of the chicks given PFR bands in NH, ME & NS, and also 11 of 16 (69%) of the adult ROSTs given PFRs in Canada. We found evidence of temporal variation in resighting rates in the Nantucket-Muskeget area of HYs coming from the northern colony sites, and more than 20% of all PFR-banded chicks from the NH-NS colonies were seen as HYs in a 5-hour period on 9 Sep. 2011 at Hatches Harbor.

In 2012 Spendelow had 50 days of fieldwork from 24 July to 16 Sep. and as a result of funding from the CWS had some assistance for the last few weeks by Kate Strang & Cris Luttazi (MACWP) and Jen Rock (CWS). In 2012 we identified as HYs 24 of 36 (67%) of the ROST chicks given PFR bands in CT, 218 of 287 (76%) of the chicks given PFR bands in NH, ME & NS, and 15 of 16 (94%) of the adult ROSTs given PFRs in Canada. We again found evidence of variation in the use of staging sites by individuals based on colony site of origin, and - similar to what had occurred in 2011 - more than 20% of all ROST chicks given PFRs in 2012 were seen in a 5-hour period on 8 Sep. 2012 at Hatches Harbor. One unexpected result was that two 1-year-olds from the 2011 cohort were seen, with one of these Second Year (SY) ROSTs observed both on Spendelow's first (25 July) and last (11 Sep.) trips to the Provincetown/Provinceland area staging sites in CCNS.

In 2013 PFR bands also were used on some ROST chicks and adults at GGNY, on adult Common Terns (COTEs) at Monomoy National Wildlife Refuge (NWR), MA, and on COTE chicks at two sites in NS. Spendelow had 51 days of fieldwork from 24 July to 18 Sep. and again had assistance for the last few weeks by Karli Rogers (NPS) and Cris Luttazi (MACWP) as a result of funding from CWS. In 2013 we identified as HYs 32 of 50 (64%) of the ROST chicks given PFR bands in CT & NY and 179 of 290 (62%) of the ROST chicks given PFR bands in NH, ME & NS. ROSTs showed lower use of Hatches Harbor and higher use of the nearby Race Point North Beach in 2013, most likely as the result of the formation of a spit on the Race Point North area which probably resulted in a reduction in disturbance from fewer CCNS beachwalkers to the spit at high tides.

High resighting rates of ROSTs with PFR bands from all sites where used in 2011-2013 helped us convince the NPS of the importance of CCNS to staging terns and to get NPS to fund two years of fieldwork (2014-2015) that included two graduate student projects. Melissa Althouse categorized the causes and quantified the rates of naturally-occurring and human-related disturbances to mixed species of flocks of terns at sites with varying levels of management activities (Althouse et al. 2016), and (building on prior work done at a colony site on near- and recent fledglings [Watson et al. 2012]) Kayla Davis studied the behavior of HY ROSTs and their care-giving parents at staging sites and how disturbance may impact the pre-migratory condition of the HYs (which could impact their overwinter survival and eventual recruitment into the breeding population).

Having the equivalent of a full-time crew of 7-8 people doing “identification and general behavior” resighting in 2014-2015 allowed us to again collect data on within-season movements of individuals, but this time of both adult and HY ROSTs from the entire breeding range rather than just the colorbanded adults from BBMA that we had followed in 2008-2009. All the 2014-2015 within-season movement data have yet to be formally analyzed, but Kayla Davis is looking at the movements of HYs with CMR modeling.

In 2014 Monomoy NWR began putting PFR bands on ROST chicks and adults, GGNV greatly increased its use of PFR bands on ROSTs, and Spindelw began fieldwork on 22 June, a month earlier than in 2012 & 2013 so he could start looking at the use of staging sites by younger nonbreeding adults before the HYs and their parents began to arrive. We have not done a formal analysis yet, but having both more sets of eyes looking for PFRs and increased coverage of staging sites on a daily basis seems to have resulted in more sightings per individual. However, the increase in the number of hours of observation did not seem to have as great an impact on the overall percentages of young identified as in 2014 we identified as HYs 544 of 706 (71%) of the chicks given PFR bands in CT & NY, 7 of 11 (64%) of those from Monomoy, MA, and 221 of 292 (76%) of the chicks given PFR bands in NH, ME & NS. Also of note was that 0 of 60 COTE chicks, but 14 of 17 (82%) of ROST chicks from Country Island, NS were seen as HYs on CCMA.

In 2015 Spindelw had 84 days of fieldwork from 20 June to 24 Sep. but saw fewer younger nonbreeding adults with PFRs (4 in 2015 vs. 20 in 2014) before the HY ROSTs started to arrive on 11 July. Also, although we had the equivalent of one more person doing general observations on a daily basis starting in mid-July and we saw as HYs 100% of the 14 ROST chicks given PFR bands at Monomoy, overall we saw slightly lower percentages from the other areas: 565 of 905 (62%) of the ROST chicks given PFRs in CT & NY and 225 of 305 (74%) of those from NH, ME & NS. Compared to 2014, in 2015 we saw as HYs more COTES (6 of 52 = 12%), but a similar percentage (7 of 8 = 88%) of ROSTs from Country Island, NS.

A new multi-year PWRC Study Plan entitled “Evaluation of Potential Impacts of Offshore Wind Energy Projects in the Northeastern U.S. on Endangered Roseate Terns: Who is at Risk and When” was approved in 2016. This work uses data from multiple resightings of many individuals with PFR bands to examine temporal and geographic variation in the use of staging sites by ROSTs of different ages and breeding status (e.g., HY birds; nonbreeding 1-, 2-, and 3-yr-old adults; failed and successful breeders that are not caring for an HY; and successful breeders giving postfledging care to HY ROSTs) coming from now a total of 12 colony sites in different parts of the breeding range.

NPS funding for fieldwork ended after 2015. Therefore, while FWS staff on Nantucket and several volunteers at sites in CACO assisted in the SSS fieldwork, observations to identify PFR-banded individuals on CCMA in 2016 were done mostly by Spindelw with 74 days of fieldwork from 29 June to 12 Sep. We did not see as many large mixed-species flocks as in years past and, as might be expected, identified lower percentages as HYs (566 of 995 [56%]) of the chicks given PFR bands in CT & NY, 7 of 16 [56%] of the chicks from MA, 157 of 307 [51%] of the chicks from NH & ME, and 31 of 54 [57%] of the chicks from NS) of ROSTs as had been seen by the larger crews working in 2014-2015. However, despite the fewer hours of observation, many more young adult ROSTs were seen in 2016 (13 SYs and 274 TYs) than were seen in 2015. Also, we documented several cases of ROSTs making trips between CCMA and Seavey Island, NH in 2016.

In 2017 Spindelw started late and had 68 days of fieldwork from 15 July to 27 Sep., but people at several colony sites made observations later than they had in years past and Catherine Neal and Ian Putnam from GGNV spent about four weeks assisting with the observations on CCMA through 15 Oct. All the 2017 observations made at other sites had not been received as of 10 Jan. 2018, but the 2017 SSS data so far appear to be different in several ways from those from prior years.

In 2017 we had more than 20 cases of HYs from GGNY being seen on CCMA and then moving back west to GGNY and/or RI. We also noted many ROSTs originally from the NH-ME area apparently spending relatively little time on the outer parts of CCMA and shifting to spend more time staging in the waters off RI and Long Island, NY. We were able to document a ROST originally banded as a chick in NS passing at least nearby (if not through) the RI turbine array to stage around GGNY. We do not know how long this individual stayed at GGNY, but think that a combination of our relatively inexpensive (low tech) resighting studies and more expensive projects involving radio-tagged birds to record where they are in 3-dimensional space throughout the more than 4-month staging period are needed to properly judge the risk of offshore wind-energy generation to this endangered population.

Dr. Jeffrey A. Spendelow, Research Wildlife Biologist, USGS-Patuxent Wildlife Research Center
- JSpendelow@usgs.gov

Bibliography

- Althouse, M.A., J.B. Cohen, J.A. Spendelow, S.M. Karpanty, K.L. Davis, K.C. Parsons, and C.F. Luttazi. 2016. Quantifying the effects of research band resighting activities on staging terns in comparison to other disturbances. *Waterbirds* 39:415-419.
- Hays, H., G. Lugo, and G. Cormons. 2010. Puerto Rico – stopover for migrating Roseate Terns. *North American Bird Bander* 35:127-131.
- Jedrey, E.L., R.J. Harris, and E.A. Ray. 2010. Roseate Terns – citizens of the world: the Canada to Cape Cod connection. *Bird Observer* 38:146-150.
- Lebreton, J.-D., J.E. Hines, R. Pradel, J.D. Nichols, and J.A. Spendelow. 2003. Estimation by capture-recapture of recruitment and dispersal over several sites. *Oikos* 101:253-264.
- Nichols, J.D., W.L. Kendall, J.E. Hines, and J.A. Spendelow. 2004. Estimation of sex-specific survival from capture-recapture data when sex is not always known. *Ecology* 85:3192-3201.
- Nisbet, I.C.T., and J.A. Spendelow. 1999. Contribution of research to management and recovery of the Roseate Tern: Review of a twelve-year project. *Waterbirds* 22:239-252.
- Shealer, D.A., and S.W. Kress. 1994. Postbreeding movements and prey selection of Roseate Terns at Stratton Island, Maine. *Journal of Field Ornithology* 65:349-362.
- Spendelow, J.A. 2017. Rapid 3-week transition from migration to incubation in a female Roseate Tern (*Sterna dougallii*). *North American Bird Bander* 42:62-64.
- Spendelow, J.A., and G. Lugo 2017. First evidence that paired Roseate Terns travel together during spring migration. *North American Bird Bander* 42:60-62.
- Spendelow, J.A., J.D. Nichols, I.C.T. Nisbet, H. Hays, G. Cormons, J. Burger, C. Safina, J.E. Hines, and M. Gochfeld. 1995. Estimating annual survival and movement rates of adults within a metapopulation of Roseate Terns. *Ecology* 76:2415-2428.
- Spendelow, J.A., J.D. Nichols, J.E. Hines, J.-D. Lebreton, and R. Pradel. 2002. Modelling postfledging survival and age-specific breeding probabilities in species with delayed maturity: a case study of Roseate Terns at Falkner Island, Connecticut. *Journal of Applied Statistics* 29: 385-405.
- Spendelow, J.A., J.E. Hines, J.D. Nichols, I.C.T. Nisbet, G. Cormons, H. Hays, J.J. Hatch, and C.S. Mostello. 2008. Temporal variation in adult survival rates of Roseate Terns during periods of increasing and declining populations. *Waterbirds* 31:309-319.

Spendelow, J.A., D. Monticelli, J.D. Nichols, J.E. Hines, I.C.T. Nisbet, G. Cormons, H. Hays, J.J. Hatch, and C.S. Mostello. 2016. Roseate Tern breeding dispersal and fidelity: responses to two newly restored colony sites. *Ecosphere* 7(10):e0150. 10.1002/ecs2.1510.

Trull, P., S. Hecker, M.J. Watson, and I.C.T. Nisbet. 1999. Staging of Roseate Terns *Sterna dougallii* in the post-breeding period around Cape Cod, Massachusetts, USA. *Atlantic Seabirds* 1:145-158.

Watson, M.J., and J.J. Hatch. 1999. Differences in foraging performance between juvenile and adult Roseate Terns at a pre-migratory staging area. *Waterbirds* 22:463-465.

Watson, M.J., J.A. Spendelow, and J.J. Hatch. 2012. Post-fledging brood and care division in the Roseate Tern (*Sterna dougallii*). *Journal of Ethology* 30:29-34.