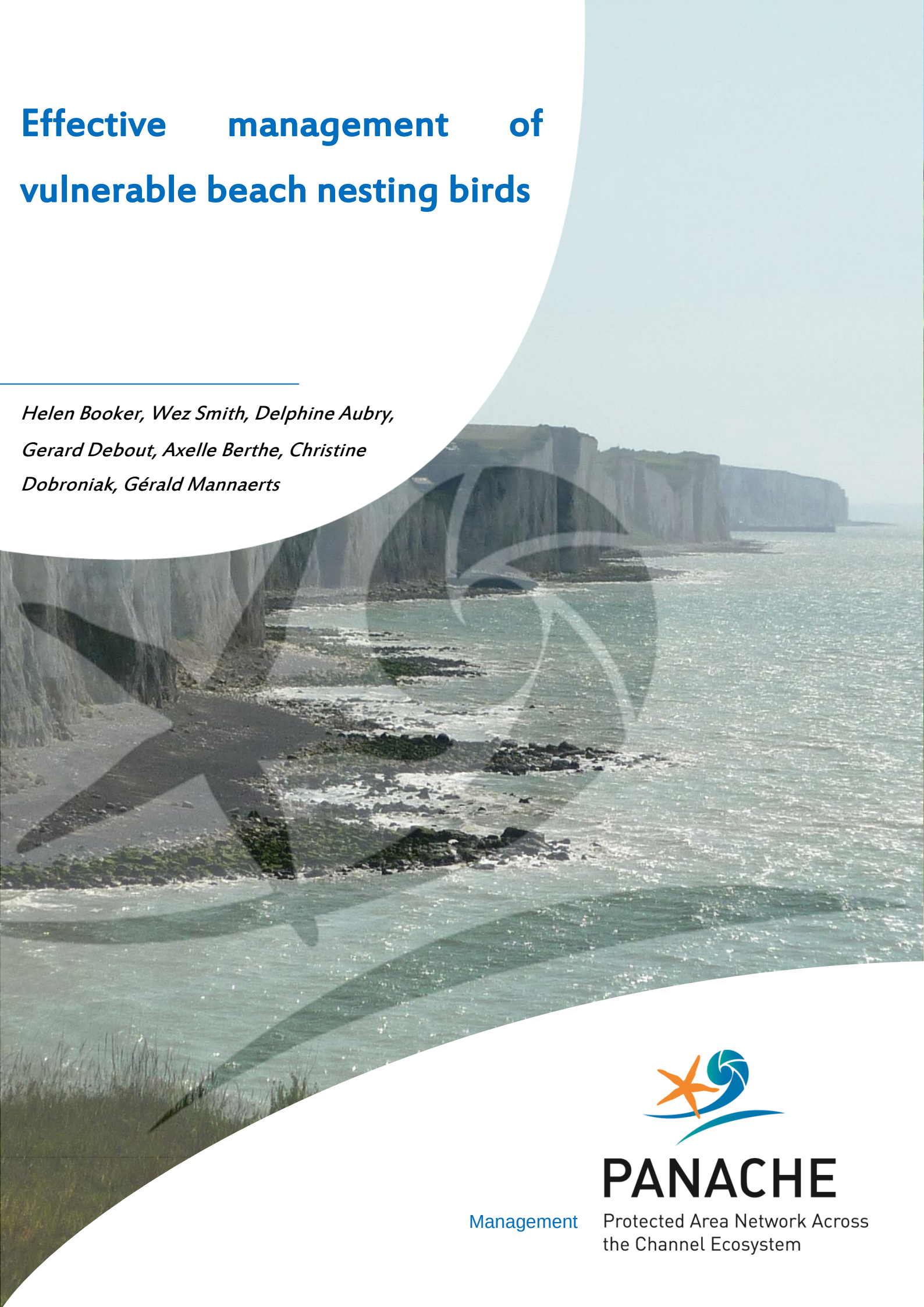
Effective management of vulnerable beach nesting birds

Helen Booker, Wez Smith, Delphine Aubry, Gerard Debout, Axelle Berthe, Christine Dobroniak, Gérald Mannaerts



PANACHE

Management

Protected Area Network Across the Channel Ecosystem

Effective management of vulnerable beach nesting birds

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Prepared on behalf of / Etabli par

by / par

Author(s) / Auteur(s) : Helen Booker, Wez Smith, Delphine Aubry, Gerard Debout, Axelle Berthe, Christine Dobroniak, Gérald Mannaerts

Contact : helen.booker@rspb.org.uk; gerard.debout@orange.fr

In the frame of / dans le cadre de

PANACHE
Protected Area Network Across the Channel Ecosystem

Work Package 3

Work quotation: Booker, H., Smith, W., Aubry, D., Debout, G., Berthe, A., Dobroniak, C., Mannaerts, G., 2014. Effective management of vulnerable beach nesting birds. Report prepared on behalf of Royal Society for the Protection of Birds, Agence des aires marines protégées, Groupe ornithologique Normand et le Grand Port Maritime de Dunkerque for the Protected Area Network Across the Channel Ecosystem (PANACHE) project. INTERREG programme France (Channel) England funded project 51 pp.
Cover photo: Ludivine Têtu / Agence des aires marines protégées

This publication is supported by the European Union (ERDF European Regional Development Fund), within the INTERREG IVA France (Channel) – England European cross-border cooperation programme under Objective 4.2. “Ensure sustainable environmental development of the common space” - Specific Objective 10 “Ensure balanced management of the environment and raise awareness about environmental issues”.
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Effective management of vulnerable beach nesting birds

Gestion efficace des oiseaux vulnérables nichant sur les plages

ABSTRACT

Several bird species nesting directly on beaches et laying their eggs on the ground, without any protection, are especially vulnerable to environmental conditions (erosion, storm, wind,…) but also to predation and human activities.

Even if they developed numerous techniques to deal with this changing environment or avoid predators, quick changes that occur actually, in conjunction with a drastic loss of “natural” habitats, place a great burden on these species.

Trough 4 study cases, two in France and two in England, the partners of the PANACHE project tried to find the best suitable ways to protect little terns and Kentish plover where they still try to nest.

Results, variable depending on the site and the species, highlight recommendation and perspectives to better protect them in the future.

KEYWORDS: little tern, Kentish plover, nest, beach, disturbance, protection

RÉSUMÉ

Plusieurs espèces d’oiseaux, nichant sur les plages et déposant leurs œufs à même le sol, sans aucun matériau sont particulièrement vulnérables aux conditions environnementales (érosion, tempêtes, vent,…), mais aussi à la prédation et aux activités humaines.

Bien qu’ils ont développé de nombreuses méthodes pour faire face à cet environnement changeant et éviter les prédateurs, les changements rapides qui se produisent actuellement, accompagnés par d’une réduction des zones « naturelles » habitables pèsent très fortement sur ces espèces.

Au travers de 4 études de cas, deux en Angleterre et 2 en France, les partenaires du projet PANACHE ont tenté de trouver les meilleurs moyens de protéger les sternes naines et les gravelots à collier interrompus sur les zones qu’ils fréquentent encore.

Les résultats, variables selon les sites et les espèces, mettent en avant les recommandations et perspectives pour améliorer leur protection.

MOTS-CLÉS : sterne naine, gravelot à collier interrompu ; nid, plage, dérangement, protection

Contents

I. Introduction

Several bird species nest on beaches and lay their eggs directly on the ground, without any materials. They have therefore had to specifically adapt in order to survive in this situation.
Their early breeding period avoids the most risky period for marine storms and if their nest is nonetheless flooded, these species are capable of laying "replacement" eggs at another site in the days that follow. In fact, their mobility enables them to adapt to habitat changes from one year to the next.
But while "natural" hazards can, despite everything, make a breeding season completely fail, it can be balanced by better success in subsequent years.

At present, the urban development of sea front areas puts these species under great pressure and reduces their fallback areas, despite the public policies in place to protect the coast (such as the coastal act (*loi littorale*) or the Conservatoire du Littoral in France). Beaches are frequented more and more as coastal tropism increases, thus causing greater disturbance to nesting species. Their camouflaging ability works against these birds, and each year numerous eggs are crushed by strollers or birds are forced to regularly leave the nest, leaving the eggs at the mercy of predators and the cold.

II. Study cases

2.1 Little Terns

2.1.1 Description of the species

The Little Tern (*Sternula albifrons*) is part of the order Charadriiformes and belongs to the family Sternidae. Like all terns, it has long slender wings, a forked tail and short yellow legs with small webs. It is the smallest of the family (22 to 24cm), with a wingspan of approximately 48cm. It weighs barely 50 grams. The post-breeding moult takes place from August to December: the crown is then brown black mixed with white, with a grey mark in front of the eye, and the beak is black. The prebasic moult takes place from January to March. Departures from their breeding site take place between the end of July and the end of September. French breeders mostly spend winter in Western Africa between November and the end of March. They can be found from Senegambia to Ghana and Cameroon, but some travel as far as South Africa; others meanwhile, stay in Mauritania. Little Terns use certain sites to moult. In fact, an Italian study has shown that the closer the moulting site is to the breeding site the better the survival of the year's juveniles (Tavecchia Giacomo, Baccetti Nicola & Serra Lorenzo, 2006).

Terns breed all over Europe, with numbers of between 30,000 and 47,000 pairs. The largest populations are found in Russia and Italy (more than 5,000 pairs in these countries), as well as in Spain, Great Britain and France (more than 2,000 pairs).

In France, the population (maritime and continental) is 2,000 to 2,300 pairs. Until 2010, the largest colony was located at Loon-Plage (North) with over 350 pairs. The Mediterranean coast is home to half of the French population, from the Pyrénées-Orientales to Camargue and to the salt marshes of Hyères (approximately 1,000 pairs). The species also breeds every year in Brittany, but the numbers are low (30 to 60 pairs). As for the continental population, it mainly nests on the Loire and is estimated at 700-800 pairs (Dubois Philippe J., Le Maréchal Pierre, Olioso Georges, Yésou Pierre, 2008). The French population has apparently been increasing since the 1980s. The results will be confirmed by the creation of the Observatoire ornithologique (Birds Observatory) for the Channel and the North Sea, led by the Agence des Aires Marines Protégées (French MPA Agency).

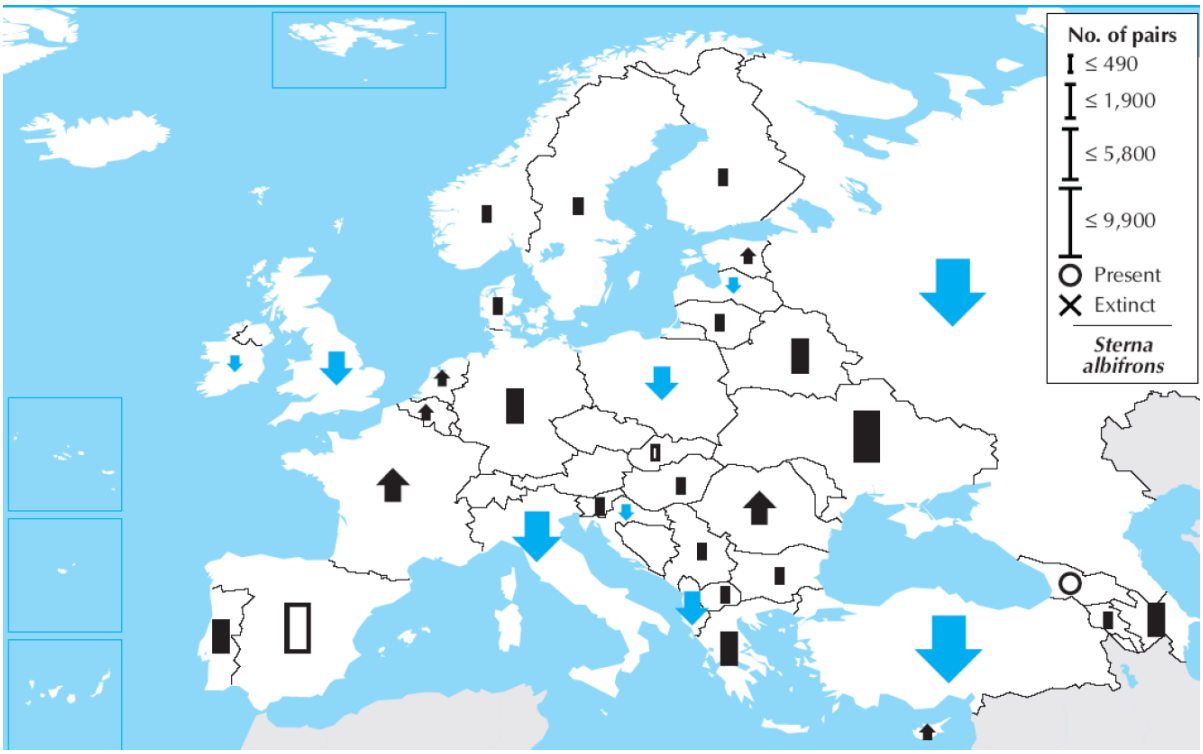


Figure 1: Populations of Little Terns in Europe (Rainette)

The UK population of little terns is around 1,900 pairs. In the breeding season they form small colonies mainly concentrated in the south-east corner of England. Their nest is a shallow scrape in sand or shingle beaches, spits or inshore islets. Chesil Beach in Dorset hosts the only colony in SW England.

The environments frequented are very characteristic, although a diversification has recently been seen. To breed, the species needs bare sandy islets located in river channels or on the coast. Artificial environments such as salt marshes, former gravel pits or artificial rafts may also be used. Installation in this kind of man-made environment is proof that the species can adapt. However, the vegetation at these artificial breeding sites must remain limited (recommendation by Birdlife International) with less than 30% coverage and a low height (less than 20cm) to avoid other species (common black-headed gull for example) moving in and driving out the Little tern.

On the sand banks of the coast and rivers, vegetation is not a problem as limiting factors such as storms, spring tides or swells regulate its growth. However, other human-induced problems are found. These areas incessantly remodelled by the elements create new sand banks and islets, which the species particularly likes. The Little Tern therefore nests very close to the water, in frequently modified, pioneer environments (Ligue pour la Protection des Oiseaux).

At certain breeding sites, it has been seen that a "pioneer" individual can serve to attract others to the colony. Thus, the more the number of birds at a colony rises, the more they are encouraged to settle in (Daniel Muselet, 1990).
Courting begins around mid-May, with acrobatic flights and offerings of small fish. Once formed, the pairs immediately choose the location for the nest, a tiny scrape lined with shells and plants, preferably in the pebbles or sand, at the extreme limit reached by waves and tides.
They breed for the first time at the age of 2 or 3, and mating can last for a very long time (up to 3 mins). The laying of two eggs (or sometimes 3 or 4) takes place at the end of May or early June.
As soon as she has laid the first egg, the female will brood for 20 to 22 days, the incubation period before the chicks hatch. The female is fed by the male who relieves her from time to time.
In general, colonies of Little Terns have fewer nests than those of other species, but they spread over a larger area. Distance between nests is 2 to 3 metres on average, unless they are isolated by vegetation, in which case it is reduced to 1.20-1.50m. Loyalty to the breeding site can be very high provided the site does not undergo any major changes; but there are also exchanges between colonies that may be around ten kilometres apart, and sometimes even 200km and more. Offspring leave the nest very early; they are very mobile and difficult to watch as a twig or a hollow in the ground is sufficient to conceal them. They grow up very fast, so much so that their parents soon no longer need to keep them warm under their wings. When they are 15 to 17 days' old, they practice flying, and around the 28th day they are ready to fly (Géroudet Paul, Cuisin Michel).
During the breeding period, most breeding adults (90%) look for food less than 4km from the nest, so a nearby food source is essential to successfully raise the offspring (Bogliani et al, 1993). The terns tend to choose their prey (size and species) according to the age of their little ones and it is therefore very important, in areas regularly changed by man, to have good knowledge of the habitats used to feed this species, in order to adapt the management and conservation.

2.1.2 Threats and protection

Nesting on beaches, they come into contact with increasing human activity, and the largest colonies are also close to some of the most densely populated areas of Britain. Today, little terns are unlikely to nest successfully without special measures to protect their nesting beaches. At sites where there is no particular protection, the colonies of Little Tern are declining significantly. This explains why a considerable portion of colonies breed in protected areas and/or in areas where adequate management or active monitoring is applied.

They are also particularly vulnerable to predation by foxes, crows, kestrels and other predators, and as they are pushed into few and smaller colonies, predation becomes a more serious issue. Sea level rise may also be an issue for some colonies, reducing suitable nesting habitat and increasing the risk of catastrophic flooding.

Little terns are amber listed under the Birds of Conservation Concern1 because of moderate long term breeding range decline and breeding localisation. Little terns are listed on Annex 1 of the Birds Directive and on Schedule 1 of the Wildlife and Countryside Act 1981.

It is also important to note that at the wintering sites in Western Africa, this species is often caught by inhabitants even though awareness campaigns have helped to reduce this practice.

The Little tern is protected and is listed in Annex I of the Birds Directive and Appendix II of the Bern Convention. Most of the species' nesting sites benefit from strong protection (nature reserves, biotope protection by-laws, etc.). Some sites, however, are not covered by any regulations since, owing to its pioneering nature, the species readily chooses its breeding site according to the circumstances (land modified by man for example), making its protection more complicated. Successful conservation of the species will be achieved by maintaining the attractiveness of breeding sites, their multiplication (appropriate development of gravel pits) and their surveillance.

Regularly referred to in various articles (Bernard Bril, Jean-Philippe Siblet and others) or reports (LPO, Bretagne Vivante), the main cause of breeding failure in Little terns and terns in general is disturbance caused by man. Depending on the breeding sites, the tools used to fight human disturbance may be:

- fencing (depending on the sites)
- planting of thorny bushes
- installing prevention notice boards during the breeding period
- installing physical equipment (wire, etc.) to delimit the colony during the breeding period
- organising prevention days.

2.1.3 Chesil Beach

a) Initial condition

The little tern colony at Chesil beach on Crown land between Weymouth and Portland has been monitored for many years with numbers reaching a peak of 100 pairs in 1997. However, lack of resources to protect the colony led to decline and over the subsequent decade the colony had reduced to just 10 pairs by 2008 and no breeding was attempted in 2009. The colony was at risk of being lost altogether. High levels of breeding failure due to predation and disturbance were identified as the causes of the decline. Fox and occasionally crow predation were the principal causes of egg losses, with kestrel predation affecting chick survival. Human disturbance has become a lesser issue following local efforts to raise awareness over recent decades.

[1] Eaton MA, Brown AF, Noble DG, Musgrove AJ,Hearn R, Aebischer NJ, Gibbons DW, Evans A and Gregory RD (2009) Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds 102, pp296-341.

A project led by RSPB with local partnership support and funding was established in 2009 to provide 24 hour wardening and an electric fence around the colony. The project managed to improve the situation in 2010 with nine fledglings produced by 12 pairs. At the time this represented the best productivity since detailed records began in 1976. The following year in 2011 there was a further increase to 18 pairs which yielded 12 fledglings. Then in 2012, the number of breeding pairs rose again to 21, however there was a fall in productivity with nine fledglings counted leaving during the season. The low productivity was the result of poor hatching success, exacerbated by the cold and windy summer weather in 2012. The drop in productivity was, as in the previous year, deemed to be a result of the very poor weather during June, with winds recorded up to 70 mph. This led to over 60% hatching failure due to chilling. Low hatching success had been experienced over many years although its true extent was masked by high predation levels. The large pebbles and resulting gaps between them, facilitated the cooling of embryos. An innovative response was needed to reduce the cooling problem and increase hatching success. The two seasons under the PANACHE project enabled solutions to be trialled, while also continuing the vital wardening scheme and maintaining the protective fence.

b) Actions

Wardening & volunteers

In each year, a seasonal Project Officer and three Project Assistants were recruited to manage and deliver the day to day protection project.

In both 2013 and 2014, an appeal for volunteers was made in a pre-season press release which generated substantial interest. In total there were 30 - 40 people involved in wardening shifts in each of the years. This translated into over 1200 hours of volunteering time given each year. The Project Officer issued a weekly email to keep past and present volunteers and project partners informed about progress at the colony. A volunteers' thank you evening was held at the Chesil Beach Centre at the end of each season.

Two project assistants were stationed on the beach during the hours of darkness and made regular patrols with torches in order to deter and chase off foxes. The night shifts were in place to cover the most high risk times from incubation until the majority of chicks had fledged and the main predation threat had passed.

During daylight a single warden was responsible for preventing disturbance from beach users and chasing off crows, gulls, kestrels and peregrine falcons as necessary.

As the 2014 season progressed there were often two wardens based on the beach in order to prevent predation from kestrels and gulls; on occasions, as many as four wardens were present. Deploying wardens on the Fleet foreshore was vital in deterring predators from taking chicks once they had migrated to the water's edge.

In both years, the visiting of little tern nests was carried out on a regular basis to monitor progress of the colony and check for any signs of predation, laying or hatching of eggs. Detailed records of disturbance were also kept by the team. Nest monitoring activities were carried out under Schedule 1 licence.

A project hide was positioned on the beach along with a wooden walkway to aid access and help beach users avoid the colony. These were dismantled and stored at the end of the season.

Management measures to prevent egg chilling

In 2013, the use of sand was trialled in an attempt to reduce the number of hatching failures due to chilling. Two techniques were adopted. The first was to place patches of sand (approximately 0.25 sq metres in size and held in place by hanging basked liner/coconut matting to allow drainage) around the colony in the hope that terns would choose to nest on them. The second was to put sand, under licence, under a sample of nests where the eggs had been laid on pebbles. The remaining clutches were left on pebbles as a control.

In 2014, sixty new sand patches were added. An improved design was adopted this season using plastic plant pots to contain the hanging basket liner and sand. This allowed for efficient application of the patches to the fenced area. This technique also allowed for patches to be made up ahead of time should any terns choose to nest onto the pebbles rather than a pre-installed sand patch. The sand patches were installed 3 May. Last season's sand patches were also uncovered and reused bringing the total number of patches on the beach to 80 by the end of the nesting period.

At the end of each season, the sand patches were covered with plastic and left in situ for next season. All patches were covered in protective plastic sheeting and buried in the beach, all marked with wooden stakes.

Fencing

The electric fence, outer rope exclusion fence and interpretation were erected in mid April each year with help from the RSPB Dorset reserves team and their volunteers, along with several little tern project volunteers. Plastic bottles were applied to fence posts to deter avian predators taking up sentry positions from which to observe the colony.

Once the chicks started leaving nests the fence was turned off during daylight hours in order to prevent the potential for electrocution.

Video monitoring

One camera was deployed in the colony in both years. This was placed such that observations of nests could be made. In 2014 it was later deployed on the foreshore to help monitor the progress of

chicks, fledglings and adults. Images were relayed to the hide, the RSPB Weymouth Wetlands Centre and also to the Dorset Wildlife Trust's Chesil Beach Centre Café.

c) Breeding and productivity results

In 2013 there were 25 pairs nesting, followed by 33 pairs in 2014.
A detailed log was compiled of sightings of little terns in the area and surrounds during the build-up to the breeding season. The first birds were seen on 24 April in 2013, but earlier on 7 April in 2014, followed by a slow build-up in numbers until nesting began in mid May. Of interest, in 2014, a young bird was observed on the colony foreshore on several occasions throughout the season. It was clear to see the individual was not in adult breeding plumage so perhaps had returned early and was prospecting.
The first egg was laid on 19 May in 2013 and on 16 May 2014. The last clutch was completed on 3 July in 2014 and much earlier on 12 June in 2013. The 2013 season was over by mid August whereas in July the fence was removed and site cleared by 25 July.
In terms of breeding outcomes, in 2013, 12 pairs chose to nest on sand. Eight clutches had sand placed underneath them, and nine were left on the pebbles. Of the 13 eggs laid by 8 pairs on pebbles, just 3 eggs from 2 pairs hatched (23%). 35 of the 39 eggs on sand hatched (90%). An estimated minimum of 30 chicks fledged in 2013 giving a productivity of 1.2 fledged chicks per pair, the highest since detailed records began in 1976 and considerably more than the previous highest figure of 0.75 achieved in 2010.

In 2014, only nine pairs laid on pebbles, the remainder were on pre-installed sand patches. Under licence, clutches on pebble scrapes had sand placed under the eggs once the birds were observed to be settled and the weather was good. All readily accepted their new nest scrapes within minutes. A higher preference was shown by the terns for scraping on sand over pebbles with 72% choosing sand. In total 77 eggs were laid by the 33 pairs of which 74 were incubated. Of note, eight were three egg clutches compared to just a single three egg clutch the previous year. The remaining clutches all contained two eggs. This suggested that food availability in the area was ample and the birds' condition on arrival was good. Of the 74 incubated eggs, 68 hatched, a success rate of 91%.
In both years, two pairs of little terns nested outside the electric fence. These birds were moved (under licence) onto patches of sand and the eggs hatched successfully. The scrapes were too far from the main fence to consider an extension to the fence without considerable disturbance being caused to the colony, so they remained outside the fenced area.

Figure 2. Three one day old chicks in 2014. M. Vaughan

Of note in the 2014 season was the movement of chicks within the colony. As chicks developed and moved off the nest scrapes, initial movement was towards the Lyme bay side of Chesil beach up the pebble bank. This gravitation switched as the season progressed with a majority of chicks moving towards the fleet foreshore on the opposite side of the colony. This coincided with the first fledglings becoming free flying. The stimulus of fledglings waiting on the fleet foreshore for feeding may have attracted younger chicks. This movement and subsequent aggregation of chicks to the foreshore made the potential for predation, particularly by gulls, a greater risk.

It is estimated that as many as 60 chicks fledged. This is based on the observed predation incidents. Three fledglings were observed being predated after they were on the wing. No chicks are believed to have died of weakness as no dead chicks were found in nests.

60 fledglings from 33 pairs produced a productivity figure of 1.8 fledged chicks per pair for 2014, which was the highest number of fledglings and once again the best productivity for the colony since records began in 1976.

Figure 3. Chick close to fledging, M. Vaughan

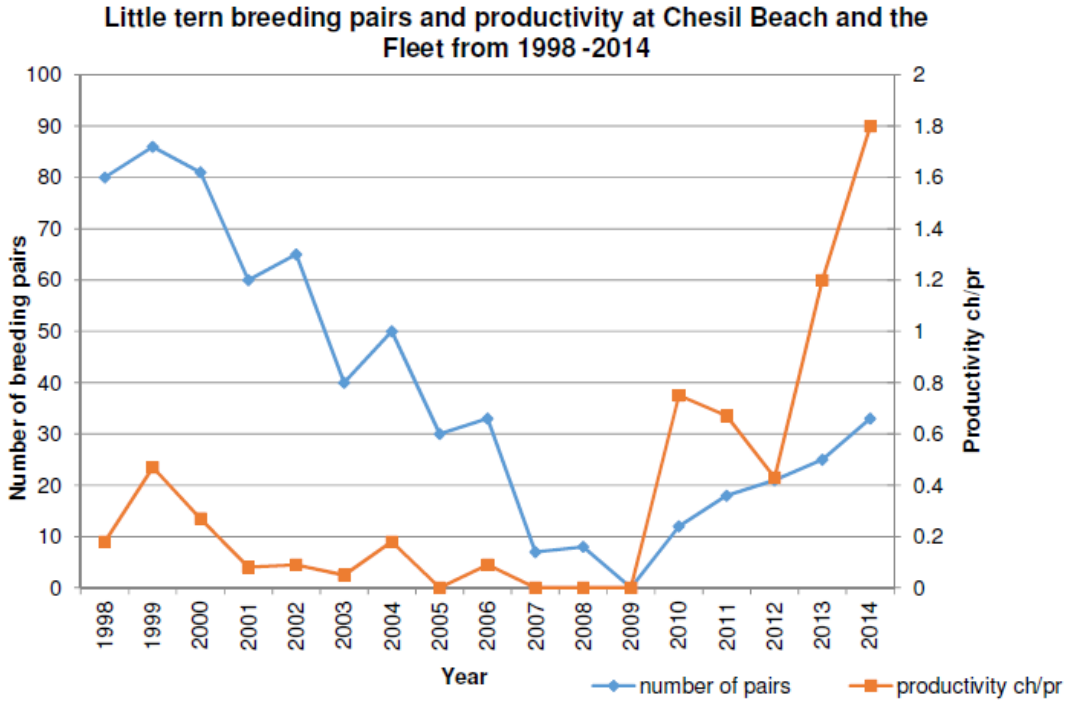


Figure 4. Breeding pairs and Productivity

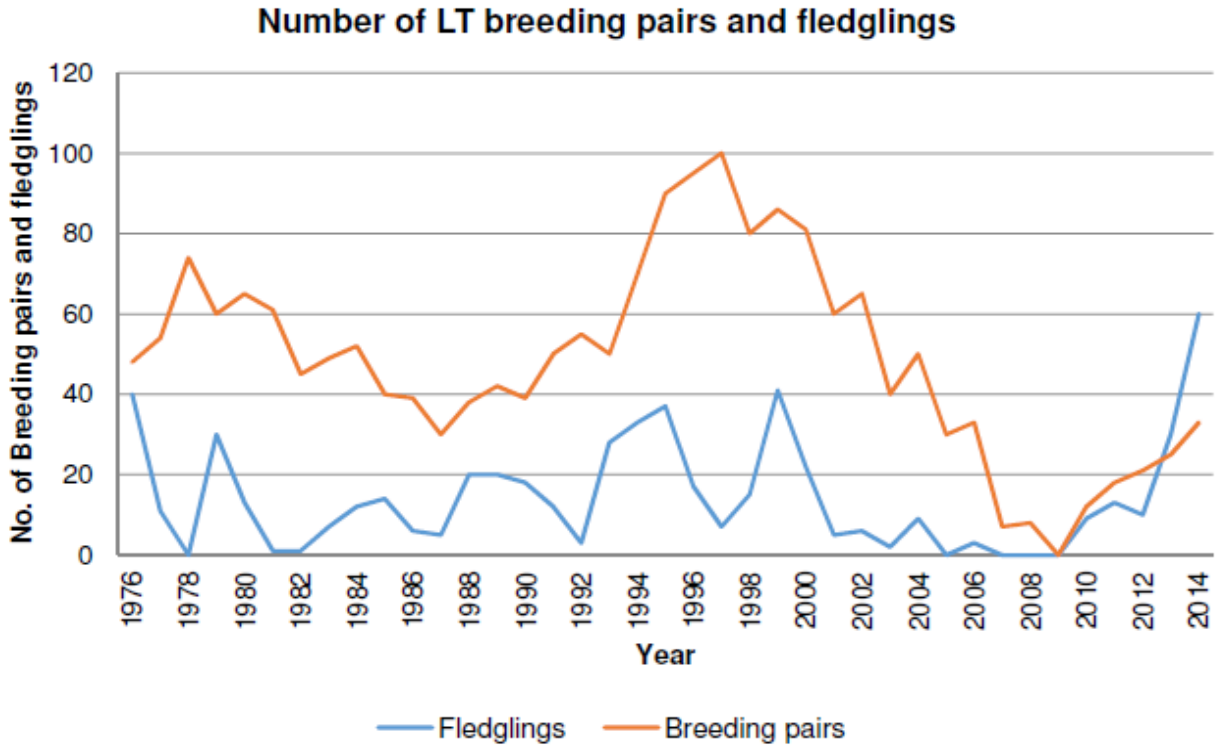


Figure 5. Number of breeding pairs and fledglings since records began for Chesil Beach

Feeding appeared good throughout the 2014 season with ample fish being brought in during courting, incubation and chick provisioning. Fishing was mainly taking place Lyme Bay but later

in the season, as with previous years, switched to the Fleet and Portland Harbour. Feeding appeared to be mainly whitebait such as young herring. Sand eel and goby were also seen being fed to chicks as the season progressed.

Overall, with the combination of wardening, electric fencing and the insulating sand patches, the little tern colony at Chesil Beach is recovering. It will be vital to secure the resources to maintain the management to achieve the colony's potential and boost the prospects for the species.

2.1.4 Langstone Harbour

a) Initial condition

The Little Tern breeding colonies in Langstone Harbour are spread out over a series of islands in its north (within an RSPB reserve) and a former Oyster farm on the west of Hayling Island (now known as the west Hayling local nature reserve and currently managed by the RSPB on behalf of Havant Borough Council). The nesting colonies on the harbour islands all occupy shingle ridges between the sea and saltmarsh behind. Although at high tide these are completely cut off from the mainland, at low tide it is possible for mammalian predators and people to walk across and gain access. The RSPB have owned the islands since the 1970's and have endeavoured to enforce a no Access policy with mixed results.

Monitoring of Little Terns nesting in Langstone Harbour has been carried out since 1979 with a gradually decreasing trend starting in the late 1980's. In 1989 there were 171 pairs of little terns breeding in the harbour. This had slowly plummeted since then to a low point of 40 pairs breeding in 2008. The causative factors in the decrease were found to be multiple. The main issues were storm surges (which have the power to wipe out an entire breeding season in one tide) and mammalian predation specifically foxes accessing from the mainland. On top of these there were other smaller factors such as human disturbance at breeding sites, changing food supply and the presence of other nesting species in certain areas.

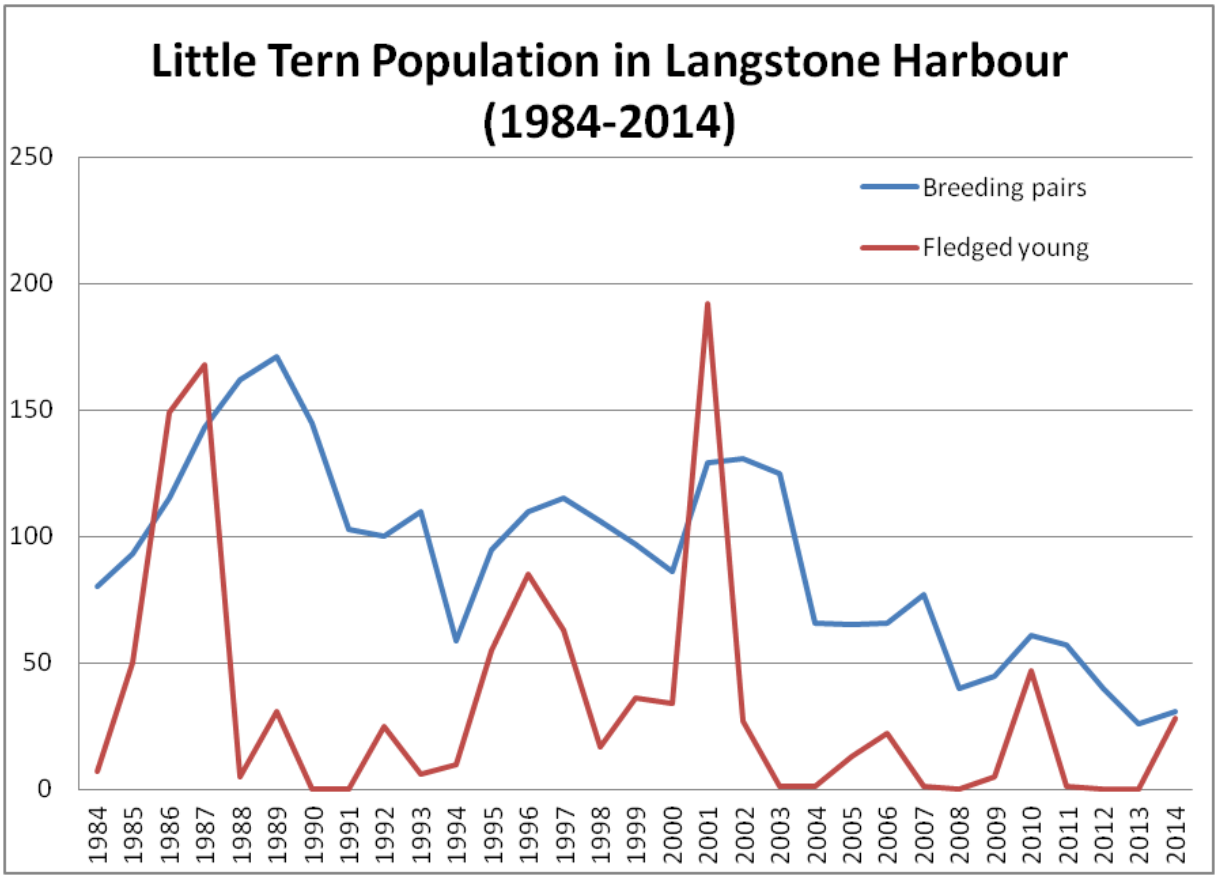


Figure 6. A chart showing the number of breeding pairs of little tern and fledged young in Langstone Harbour from 1984 to 2014.

b) Actions

Shingle Recharging.

In an effort to combat both the mass failures caused by tidal surge and the lack of available habitat, with Interreg Panache funding, a program of shingle recharging was initiated in the spring of 2013. The ethos behind this was to replace shingle which had been washed away over the years in storm surges, thus slightly raising the elevation of the little tern nesting areas and giving them relative safety during surges in future breeding seasons.

Due to the sensitive nature of the site, there were several constraints that needed to be worked within. The ones that most affected the work plans were the yearly time window for operations and the precision needed for placing shingle.

Langstone Harbour is an important wildfowl wintering site and so large scale operations were ruled out before mid February due to the disturbance it would cause. This left a window of opportunity of approximately two months before mid April (due to returning terns). Further

complicating this was the need to work on spring tides due to the depth of water around the islands which meant we would only get two attempts per spring.

Spatially, the shingle beaches on the islands occupy a space of only a few metres sandwiched between protected saltmarsh habitat and protected intertidal mud. This meant we had to be very specific in our placement of shingle and necessitated the use of bulk bags for each load rather than larger quantity methods.

Once finalised, the operations plan for each site could be broken down into the following steps:

- A hopper barge was loaded with bulk (approx 850kg each) bags of shingle locally and bought to the islands vicinity along with another barge containing a static crane and an 360 excavator which could be offloaded.
- At high tide at the beginning of the spring cycle, the hopper barge was bought as close to the work site as possible with the crane barge positioned alongside.
- The excavator was offloaded and positioned on the work site.
- The crane was used to take bags from the hopper barge and offload them on the island where the excavator could reach them.
- The excavator then placed the bulk bags exactly where required before upending them to release the shingle.
- Once operations began, they continued at both high and low tide until completed (with the hopper barge leaving at high tide when necessary to reload and then coming back in on the next high).
- When works were completed (which had to be before the end of the spring tide cycle to prevent getting stranded), the excavator was reloaded and the barges drawn back to the main channel from which they could safely navigate.

Figure 7. Excavator in the process of placing shingle bags within permissible parameters on Bakers Island, 2014.

In this way, the shingle at the nesting sites was raised by 1m-1.5m and extended to areas where the shingle was previously unsuitable for nesting.

In March 2013, approximately 750 tonnes of sand and shingle were bought to South Binness island to recharge it's western ridge, a favoured little tern nesting spot. The shingle itself was sourced from one of the two harbour based aggregate companies using similar grade flint to that which it was replacing. Later, in April, a smaller scale shingle recharge took place at the West Hayling Local Nature Reserve. In this case, approximately 100 tonnes of shingle were placed on the end of a disused Oysterbed bund to create a more desirable Little Tern breeding area.

It was necessary to complete the recharging work over the course of two seasons due to the limited number of spring tides with favourable weather. This being the case, work commenced on Bakers Island in March 2014 and finished in April. Approximately 500 tonnes of shingle were used here in a more difficult working condition to extend the safe tern nesting area by some 200%.

As with 2013, a second section of the West Hayling Local Nature reserve was also worked on in April

2014, using 100 tonnes of shingle and creating further safe nesting habitat.

Anti Predator Fencing

To combat the issue of fox predation, a new system of fencing was trialled and improved around the main colony sites. Based on RSPB research (Ausden et al 2011) focussed on increasing breeding productivity amongst waders, an 8 strand electrified fence was decided upon. This was powered by an energiser running off a standard car/leisure battery connected to solar panels which acted to recharge it. The fencing system was first set up by a staff and volunteer team in April 2014 (after recharging work was completed). It functioned perfectly for the entire duration of the breeding season without requiring replacement and was believed to benefit not just the nesting terns, but other shingle nesting birds as well.

Decoys

In order to increase the likelihood that little terns returning from their wintering grounds nested within the 'safer' areas created by shingle recharging and fencing, 'decoys' were used to simulate a breeding colony already in situ. These were a mixture of two styles of artificial little tern, a professionally manufactured model and a plaster produced model which members of staff, volunteers and the local community helped to paint. Both were placed within the prepared colony sites leaving sufficient space for little terns to nest in-between them without (approximately one every 6-8 metres due to standard little nest spacing).

Figure 8. A hand made, painted little tern decoy

Wardening

To reduce the risk of human disturbance and to build a good monitoring record of the sites as the seasons progressed, wardening by staff and volunteers was increased. This was carried out in two areas. For some staff and a selection of volunteers, boat based wardening allowed the island sites to be observed almost daily during the breeding season. In order to make this feasible, selected volunteers were given Royal Yachting Association training in Powerboat use and navigation to a level two standard. Whilst out on patrol, staff and volunteers engaged members of the public, recorded nesting and reacted to any preventable situations which arouse thus greatly enhancing the breeding potential of the colonies.

Likewise, at the West Hayling Local Nature Reserve, volunteers and staff attended the site on a daily basis. Whilst there, they used high powered telescopes to show members of the public a close up view of the nesting colony from a safe distance and also monitor individual nests.

Public Engagement and Education

In order to increase public support for breeding seabirds locally and therefore decrease the amount of human disturbance little terns faced, a people engagement project was initiated throughout the Havant, Hayling and Portsmouth areas. A People Engagement officer was recruited both the breeding season in both 2013 and 2014. Along with a team of volunteers, they worked with school parties, youth groups, community association and visiting tourists to both increase awareness of our nesting seabirds and how individuals can help safeguard their future.

Events Held	33
Events attended	17
People directly engaged (not including school children).	8200+
Schools visited	16 (as of December 2014)
School children engaged	Just under 2000

Table 1. A chart showing the number of people engaged with the project in 2013/2014

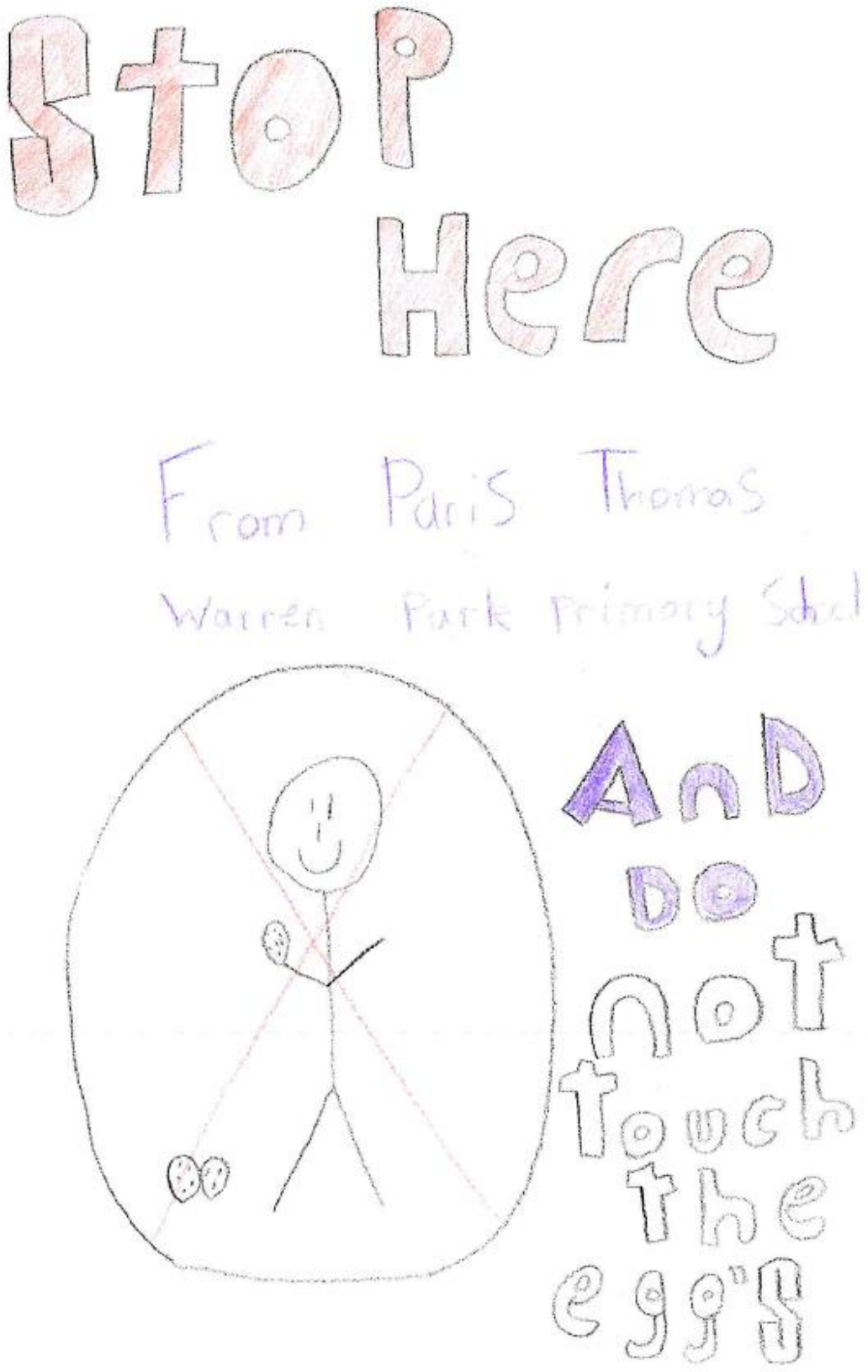


Figure 9. A poster produced by school children to illustrate the problems little terns may face

c) Results

2013

The 2013 breeding season began later than usual. External factors were almost certainly the cause of this with a very harsh and delayed winter. Nevertheless, by the middle of May there were at least 85 Little Terns present in the harbour and they were regularly seen with fish courting. The occupying of scrapes however didn't begin until the end of May.

At the Hayling Island Site, there was interest by Little Terns shown in late May but this dissipated at the start of June before any eggs were laid (almost certainly due to human disturbance).

On South Binness Island (the location of that year's shingle recharge) Little Terns were settled by late May with the first egg recorded on May 22nd and groups of 60+ seen around the shingle recharge area. By June 10th, there were a total of 17 occupied scrapes with the following clutch sizes:

- 1 Egg: 10 nests.
- Eggs: 5 nests.
- Eggs: 2 nests.

Sadly, this represented the peak of nesting activity as the colony failed and by June 24th there were only two occupied scrapes remaining (both of which had been abandoned by June 26th). When the scrapes were examined, the evidence strongly suggested avian predation with the likely predators being either carrion crow or larger gulls (Larus sp).

Bakers Island also held a strong interest for groups of courting little terns throughout late May and June although activity was significantly less than that on South Binness and only two pairs were observed as potentially nesting.

In late June and July there was renewed interest at the Hayling Island site but despite this area being fenced off and signage being in place to guard against human disturbance, nothing came of this interest.

2014

The winter of 2013/14 saw at least 12 major storms and associated tidal surges effect the channel coastline beginning with the St Judes Storm of October 27th 2013 and ending with the St Valentines Storm of February 14th 2014. Large scale changes took place in Langstone Harbour as a result of these. The shingle areas of the harbour islands which form the heart of the seabird colonies were completed inundated by storm surges on several occasions with both positive and

negative results for the years breeding seabirds. On a positive note, new areas of fresh shingle were created whilst the vegetation covering of the present shingle was scoured completely clean. The main ridge on South Binness was scoured clean and extended northwards onto the saltmarsh by 5-10 metres across it's whole western face. Bakers Island saw it's shingle beach moved inland by a similar amount leaving a newly exposed area of harbour mud as well as a newly shingle covered area of saltmarsh.

The seasons first returning little terns were seen on April 17th with 22 passing over Bakers Island calling whilst cockle shell habitat creation was being finished. True to their characteristic of only occupying territories approximately 3 days before egg are laid, the main roost developed on South Binness before territories were formed on both islands in quick succession beginning on May 15th.

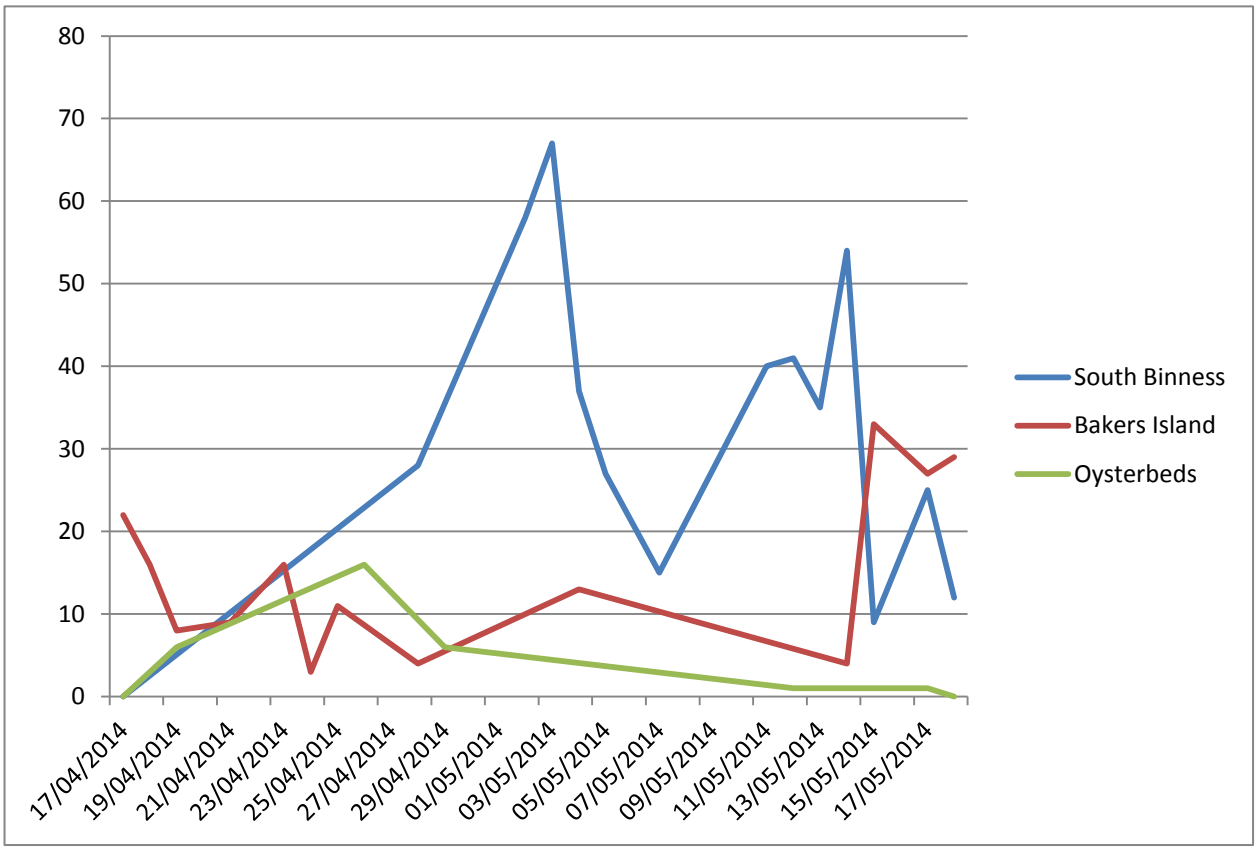


Figure 10. A graph showing the number of little terns present at each harbour location in spring 2014

Date	South Binness	Bakers Island	Oysterbeds	All (Total)
17/04/2014	0	22		22
18/04/2014	0	16		16
19/04/2014	0	8	6	14
20/04/2014				
21/04/2014	0	9		9
22/04/2014				
23/04/2014	0	16		16
24/04/2014	0	3		3
25/04/2014	0	11		11
26/04/2014			16	16
27/04/2014				
28/04/2014	28	4		32
29/04/2014			6	6
30/04/2014				
01/05/2014				
02/05/2014	58	0		58
03/05/2014	67			67
04/05/2014	37	13		50
05/05/2014	27	0		27
06/05/2014				
07/05/2014	15	0		15
08/05/2014				
09/05/2014				
10/05/2014				
11/05/2014	40	0		40
12/05/2014	41	0	1	42
13/05/2014	35	0	1	36
14/05/2014	54	4		58
15/05/2014	9	33		42
16/05/2014				
17/05/2014	25	27	1	53
18/05/2014	12	29		41
19/05/2014	18	21		39

Table 2. A chart showing the number of little terns present at each harbour location in spring 2014 The decrease in the number of little terns present between May 5th & 11th was coincidal with a storm system passing through (which also limited observation opportunities via boat).

Figure 11. A little tern nesting (top) with its mate to the left and a decoy in situ below. Electric fencing & a chick shelter are also visible.

The first eggs were suspected on May 19th at both Bakers Island/South Binness and verified on May 23rd.

Date	South Binness	Bakers Island
23/05/2014	7	6
01/06/2014	12	9
08/06/2014	15	14
11/06/2014	15	16

Table 3. A chart showing the number of active nests as the colonies grew in May/June 2014

All but four nests were sited within the areas of habitat creation and so at a safe height if a storm surge developed. Likewise, only nine nests were outside of the area protected by electric fencing.

The monitoring methodology was as mixture of the methods highlighted in the Joint Nature Conservation Committee's seabird handbook (Walsh et al,1995). On most day's during the breeding season, boat based monitoring was carried out to check on the health of the colony and occasionally full counts were taken as displayed here. Once nesting commenced (but before hatching), individual nests were monitored via flush count but with at least 4 days between each visit. On

these occasions, numbered/lettered monitoring stones were placed next to each active nest to help in the recording process.

Fox activity was witnessed in early May before nesting began and in July after nesting finished but not during the breeding season. In both cases, the remains of fox killed gulls were found on South Binness and Bakers Island but no intrusion was picked up within the electrified areas on camera (or evidenced in other ways).

Crow predation of Ringed Plovers was also noted in early May within the little tern colony area. On three occasions the predator was personally seen off and then not seen again throughout the season.

The first hatchings took place June 11th on South Binness and June 13th on Bakers Island. Once chicks began to hatch, flush counts of nests were stopped and the only disturbance which took place was minimal electric fence maintenance (limited to under 15 minutes) and nest camera data gathering from those cameras easily accessible from the shore.

Figure 12. Some of the first chicks to hatch on Bakers Island, here seen <24 hours old

The colony proceeded without any major incidents and the first fledgling was see taking off from South Binness Island on June 27th after which numbers gradually built, peaking at 28 across both islands on July 9th.

Colony	27/06/2014	07/07/2014	09/07/2014
Bakers Island	0	9	17
South Binness	1	10	11

Table 4. A chart showing the results of Fledgling counts in Langstone Harbour, Summer 2014

Figure 13. A newly fledged little tern takes to the air in Langstone Harbour

After July 9th, number gradually decreased with only 20 Little Terns (adults and fledglings) present in the harbour by July 24th and the final few departing in early August.

Colony	Pairs	Fledglings	Productivity
Bakers Island	16	17	1.06
South Binness	15	11	0.73
Both (Total)	31	28	0.90

Table 5. Little tern productivity data for Langstone Harbour in 2014

Although the numbers of fledged young and nesting adults were lower than historical records, the productivity score for Langstone Harbours little terns in 2014 was the fourth highest recorded. It is hoped that with continued care and attention these successes may continue in the future and help the population begin to recover to its former level.

2.1.5 Clipon Beach

a) Context

Figure 14: Location of Clipon beach and neighbouring sites

Figure 15: Clipon beach (samphire area in the foreground, tern bay bar in the middle ground)

Clipon beach is located in the North of France along the North Sea. It is situated on land belonging to the Grand Port Maritime de Dunkerque (GPMD, Dunkirk Port) near the jetties of its Avant-port Ouest (western outer harbour). It is an area gained over the sea around the middle of the '70s following the extension of Dunkirk port to the west. The local hydro-sedimentary dynamics contributed to shaping this area which features ideal habitats for the nesting of Little terns. It is in fact integrated into the perimeter of the Special Protection Area (SPA-FR3112006) of the Bancs des Flandres Natura 2000 site under the Birds Directive.

Clipon beach therefore comprises a sandy foreshore crowned with artificially created environments (rubble and stone deposit areas) to the east of the tip of Clipon which are favourable for Little Tern nesting (spit, bay bar or sand bank). The backshore is marked by the presence of a salt marsh area on which samphire has developed, itself crowned with a dune ridge.

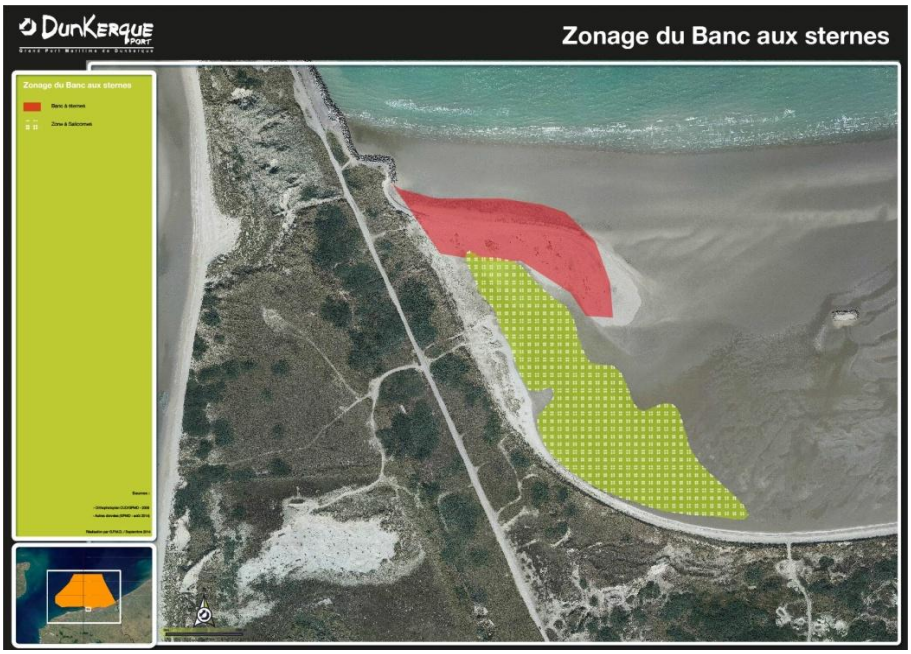


Figure 16: Zoning of Clipon beach and the Terns bank

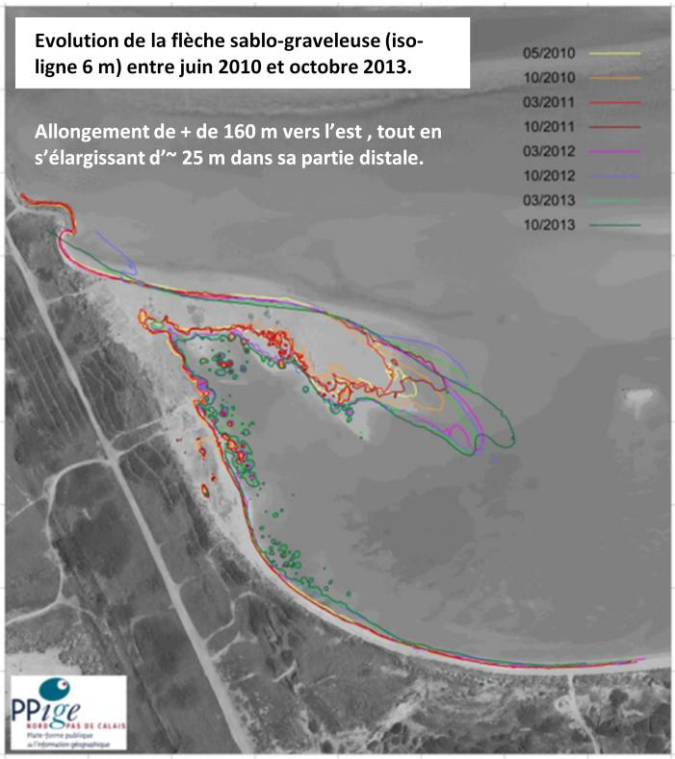


Figure 17: Change in the sand-gravel spit (isoline 6m) of the "Terns zone" between June 2010 and October 2013.

Surveys on Clipon beach and particularly on the sand/gravel spit, the nesting site, have been carried out since 2010 by the Université du Littoral Côte d'Opale within the framework of monitoring of Unité de Gestion Sédimentaire 4 (UG4, Sediment management unit) managed by GPMD. These surveys were partly funded as part of the PANACHE programme. The analysis of changes to the Terns zone since the beginning of the surveys in June 2010 shows a real pattern of accumulation.

However, it is not regular insofar as periods of erosion and accumulation alternate. A map of changes to the sand/gravel spit of the Terns zone since spring 2010 has been developed, selecting the 6m spot height which corresponds approximately to the altitude of the base of the spit. This cartographic representation provides an assessment of changes to the spit which has lengthened by almost 160m to the east since March 2011 while widening by some 25m in its distal part (Héquette, 2014).
This accumulation of sand on the sandy bay bar sector combined with natural incipient dune-type vegetation growth has led to a deterioration of the habitat propitious to Tern nesting in recent years.

Prior to 2012, Clipon was an area visited by an initiated public owing to its remoteness from urban areas and its location in the port environment. However, some leisure activities were carried out, such as hunting, horse-riding, kite-surfing, stand-up paddling and walking. The building of the methane tanker terminal by the GPMD (platform developer) and DK LNG (energy operator) as of 2012, very nearby, almost completely put an end to those activities by prohibiting access to the area by road. This contributed to user desertion of the site, and improved the peacefulness of the breeding area. Nuisance (noise, dust, visual disturbance) caused by the construction work was managed and placed under close surveillance by DK LNG and GPMD as well as by Government services.

Figure 18: Work site of the methane tanker terminal and Clipon beach

b) Change in the population of colonies:

Since it settled at the site in 1989, growth of the Little Terns colony had been considerable, reaching 385 pairs in 2005, making it the largest colony in France. But more recently, the species has declined sharply since the colony has been deserted since 2010; this desertion continues today (Dupriez, 2014).

The nesting pattern has no doubt been similar over the past five years with a first attempt at nesting on the sandy Clipon spit at the start of the nesting period which failed each time for various reasons including disturbance, tides, and predation, causing considerable tension in the colonies. This first attempt is often followed by a second with the colony moving to several nearby sites, i.e. the original Clipon islet, Ruytingen breakwater and even the work site areas of the methane tanker terminal which also cause nesting failures.

Figure 19: Ruytingen breakwater nesting area

It shall be noted that the Ruytingen breakwater area appears to suit the Little Terns' nesting process. This site was sanded up as part of the methane tanker terminal construction work in 2012 and, like Clipon spit, comprises rubble and shingle. It is reported that the decline in the Clipon colony began well before the start of work on the methane tanker terminal. However, the construction work contributed to its fragility by indirectly affecting the dynamics of its habitat (Communication from local nature societies: GON, Goéland, Le Clipon).

Figure 20: Grand-Fort-Philippe nesting area

These same failures have led the colony of terns to more faithfully frequent other sites not far from Clipon, namely the Grand Fort Philippe and Oye-Plage colonies.

The Grand-Fort-Philippe breeding site is characterised by the

presence of a shelly sand bank exposed to spring tides, particularly due to its slight slope and the absence of shingle which reduce the force of the waves. Furthermore, this site is subject to disturbance from strollers, with or without dogs, and beach-goers, etc. Despite various failures, the Grand-Fort-Philippe colony has become a colony in its own right, rather than a substitution colony.

Figure 21: Oye-plage nesting area

The terns have settled at Oye-plage on the Casino beach since 2012. The number of pairs gradually increases between the end of May and early June to reach a peak number of approximately 70 nests.

This high figure can be explained by the drops in numbers at the two other sites and the transfers of pairs to Oye-plage.

Some 200 individuals occupied the beaches from Dunkirk to Calais during the 2012, 2013 and 2014 breeding seasons. The Little terns' current situation and future prospects are causes for concern in the area. Clipon is no longer a major breeding site for the Little Tern and continues to be less and less attractive for the species. In addition, the Grand-Fort Philippe colony has variable numbers over the years whereas the Oye-plage colony has served, for the second year running, as the main breeding site in the area. The factors that appear to influence the decline of the colony in Clipon are:

- **the accumulation of sand and the natural vegetation process of the Clipon spit.** The Little Tern is a species particularly fond of pebbles and shelly sand where there is no or only scarce and short vegetation. On the historical islet, vegetation colonised the bay bar several years ago. It is similar to that of an incipient dune with tall grasses such as beach grass (*Ammophila arenaria*) and couch grass (*Elymus sp*.). This vegetation is not at all suited to the tern as it restricts its field of vision, rendering it more vulnerable to predators. This natural process will continue despite periodical rejuvenations due to the weather and/or tides. It would therefore appear unlikely that the colony return to settle on the historical islet in the years to come. In this respect, the Ruytingen bank offers an ideal habitat for the species, except the fact that it is greatly exposed to adverse weather conditions. It cannot therefore be suitable to the species in its current state. Reinforcement with materials taken from the sand mound further west of Ruytingen could reduce its vulnerability. It is not yet possible to give any firm opinion of the future of the colony that settled late in the storage area.

- **the change to environments around the spit.** Surrounding environments still change rapidly in just a matter of years. The work site alone represents quite a significant upheaval, particularly with the disappearance of an important resting beach for the species' uptake. To reproduce, a species needs a complex of habitats allowing it not only to install its nest but also to find food and raise its young.
- **disturbance of the species.** Natural or human-induced disturbance is also a factor that interferes with breeding success. Marine flooding caused by spring tides combined, or not, with northerly winds is a predominant factor in the species' breeding success or failure. In recent years, the equinoctial tides in mid-June and mid-July have caused major disturbance. Disturbance by gulls and magpies has also been seen in Clipon. However, natural predators are still present in the study area: the red fox, the stone marten and the peregrine falcon. It must nonetheless be said that predation is a natural interspecific relationship that is vital for the equilibrium of ecosystems. Human leisure activities such as hunting and horse-riding also cause disturbance even though, since the start of work on the methane tanker terminal, they have practically stopped on the site.

c) Actions taken

To mitigate this desertion by Little Terns and limit the breeding failure, GPMD made operational developments to the site in 2013, funded as part of the PANACHE programme (fig. below). They were made in partnership with experts and local associations:

⇒ Removal of former nesting islets on the shore at the end of March 2013 which were used as firing points by hunters at the site and have never been attractive for the colony of Terns;

⇒ Installation of pebble spots *in situ* (mid-March 2013) to recreate the habitat propitious to the reproduction of Little terns which tended to become sanded up and grown over with vegetation;

⇒ Installation of electric fencing in spring 2013, repeated in spring 2014 to limit predation (fox) and disturbance or even trampling by site users;

⇒ Planting of beach grass in the dune ridge on the backshore to limit sand lifts that are detrimental to the habitat and disturb the terns;

⇒ Installation of Notice boards to raise public awareness of the presence of little terns;

⇒ Performance of annual surveys and implementation of monitoring protocols on nesting individuals to improve knowledge of the species and its habits.

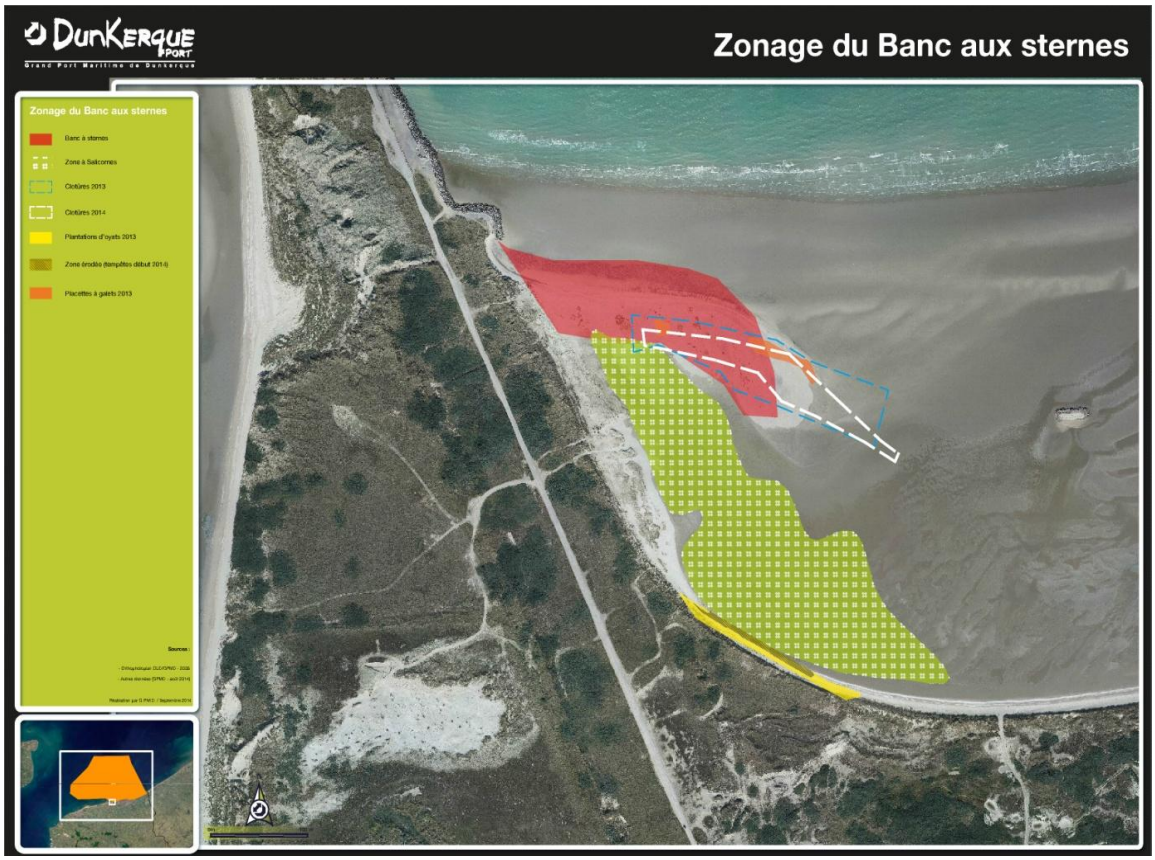


Figure 22: Developments made on the Tern bank in 2013 and 2014

d) Outcomes and Summary

The conclusions of the 2014 review for each site are given below (Rainette, 2014):

Clipon

The size of the colony has significantly decreased over the last few years: 10 pairs in 2014 versus about fifty in 2013, about forty in 2012, 130 in 2011 and 110 in 2010 (Rainette, 2014). Moreover, breeding has failed since 2010 in Clipon. Nesting terns have transferred to the Ruytingen site since 2013, which seems to provide better conditions, especially as regards breeding, due to its pioneer nature, despite not being protected from marine flooding. Similarly, a transfer to the Grand-Fort-Philippe colonies seems clear.

Grand-Fort-Philippe

Breeding numbers in Grand-Fort Philippe (24 pairs) are similar to the figures for 2012 (30 pairs). Nesting birds seem to be settling in earlier than in previous years. Following a partial failure in mid-June, the pairs transferred to Oye-plage, to a new colony. Contrary to 2012 and 2013, breeding totally failed in Grand-Fort Philippe.

Oye-Plage

For the second year running, a colony settled on the beach bank in Oye-plage. A first failed attempt had been noted in 2012. The size of this colony is increasing and it is larger than the Clipon and Grand-Fort Philippe colonies combined. A maximum of 71 pairs were seen this year as in 2013. We must however emphasize that this colony partly gained from the transfers from the other two colonies due to nesting failures.

Unfortunately, breeding was unsuccessful in this young colony, due to marine flooding, whereas in 2013, nine young were born.

Monitoring operations carried out between 2012 and 2014

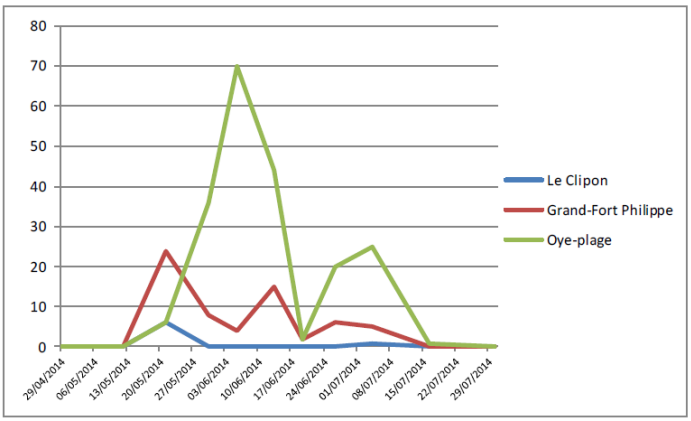


Figure 23: Numbers of Little Terns during the 2014 season in Clipon, Oye-Plage and GFP

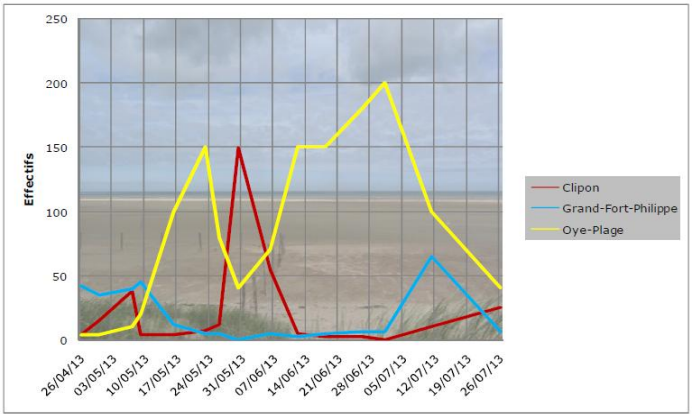


Figure 24: Numbers of Little Terns during the 2013 season in Clipon, Oye-Plage and GFP

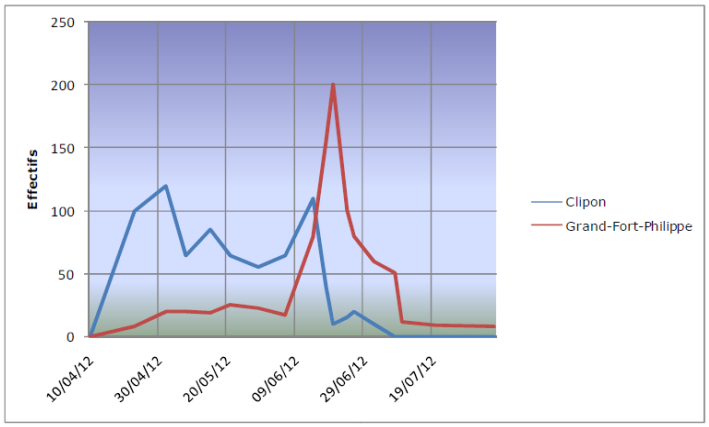


Figure 25: Numbers of Little Terns during the 2012 season in Clipon and GFP

Therefore, and despite the facilities installed by the GPMD under the PANACHE programme, the colonies did not settle again in the Clipon area. On the contrary, they have gone to the Oye-Plage and Grand-Fort-Philippe sites, and even to the Ruytingen breakwater where breeding success is not guaranteed, as the 2014 figures show. Experts give several causes resulting mainly from marine flooding, disturbance, habitat degradation and predation. However, there does not appear to be any direct link between the methane tanker terminal construction work and breeding success on the site. Continuous monitoring is therefore essential to understand the real mechanisms behind the desertion from the Clipon site and to identify suitable responses. In this context, safeguarding the Clipon site as a hotspot for Little tern reproduction does not appear to be an essential requirement since new neighbouring sites would appear better suited and able to meet the Little terns' needs. The Ruytingen site is a perfect example, even though it requires some development work to address the marine flooding issue, which is too significant to guarantee breeding success.

2.2 Kentish Plovers

2.2.1 Description of the species

Kentish Plovers, *Charadrius alexandrinus*, occur in temperate and tropical inshore areas as well as inner wetlands in Eurasia, America and North Africa. In Europe, they nest on the shores of the Western Baltic Sea, the North Sea, the Atlantic Ocean, the Mediterranean Sea and the Black Sea.
In France, the species nests on all flat sandy shores. The French counties (*départements*) of Aude, Bouches-du-Rhône and Manche accommodate approximately half of the national population.

Kentish Plovers are shorebirds of high heritage value in Normandy. The nesting population has increased consistently over the past decades (Debout 2009) whereas the species is declining at national and European level, to such an extent that it has recently been added to the list of species in Annex 1 of the EU Birds directive. The region hosts at least 20% of the French nesting population, and probably more, due to the various sources of information reporting confirmed declines outside our region.

Figure 26: Kentish Plover chicks (Aubry, D. & Debout, G. 2014)

2.2.2 Regional action plan for Kentish Plovers

a) Initial condition

In the Lower Normandy region, a first regional action plan in favour of this species (PRA GCI) was implemented between 2010 and 2012. Following this plan, a second action plan was launched by Groupe Ornithologique Normand (GONm), a group of Norman ornithologists, for the 2014-2016 period.

Surveys of this species in Normandy carried out by the GONm since the 1970s have shown a major fluctuation in breeding success rates with varied causes of failure.
Debout (op. cit.) recapitulated all the data acquired up to 2007: 83% of the causes of failure are identified and, among them, tidal or storm floods represent the main cause (72%). Flooding, of which the percentage compared to the total causes identified was less than 50% between 1971 and 2000, has increased significantly since 2001 to reach more than 85% of identified causes of failure between 2001 and 2007. Human-induced failures account for 12% to 18.5% of the causes identified. They include: hunters, deliberate destruction, nests ploughed in “mielles” (cultivated expanses of sand), vehicles used for fishing activity and driving on the beach, trampling (7%), and disturbance (4%).
The other cases recorded are predation, unfertilized eggs, and disturbance by dogs and cattle.

The first regional action plan also showed that the main cause of nest destruction identified was related to natural events (wind, tides, etc.). Human-induced destructions, either direct or indirect, also play a role. Indeed, human activities on the backshores (strolling, sports, heavy vehicles) destroy a significant number of nests and can wipe out reproduction of this species on certain beaches (Purenne 2013).

b) Protection systems

Based on these findings, the 2014-2016 PRA GCI included not only an improvement of knowledge of this species and its habitats, but also a measure to test the efficiency of the various protection systems that have been implemented since 2010 (Debout & Aubry 2014), establishing whether such measures actually alter the Plovers’ breeding success.
To optimally protect the Kentish Plovers’ nests, various types of enclosures have been put in place on the shores of Calvados and the Eastern and Western coasts of the Manche *département* (Figure 27).

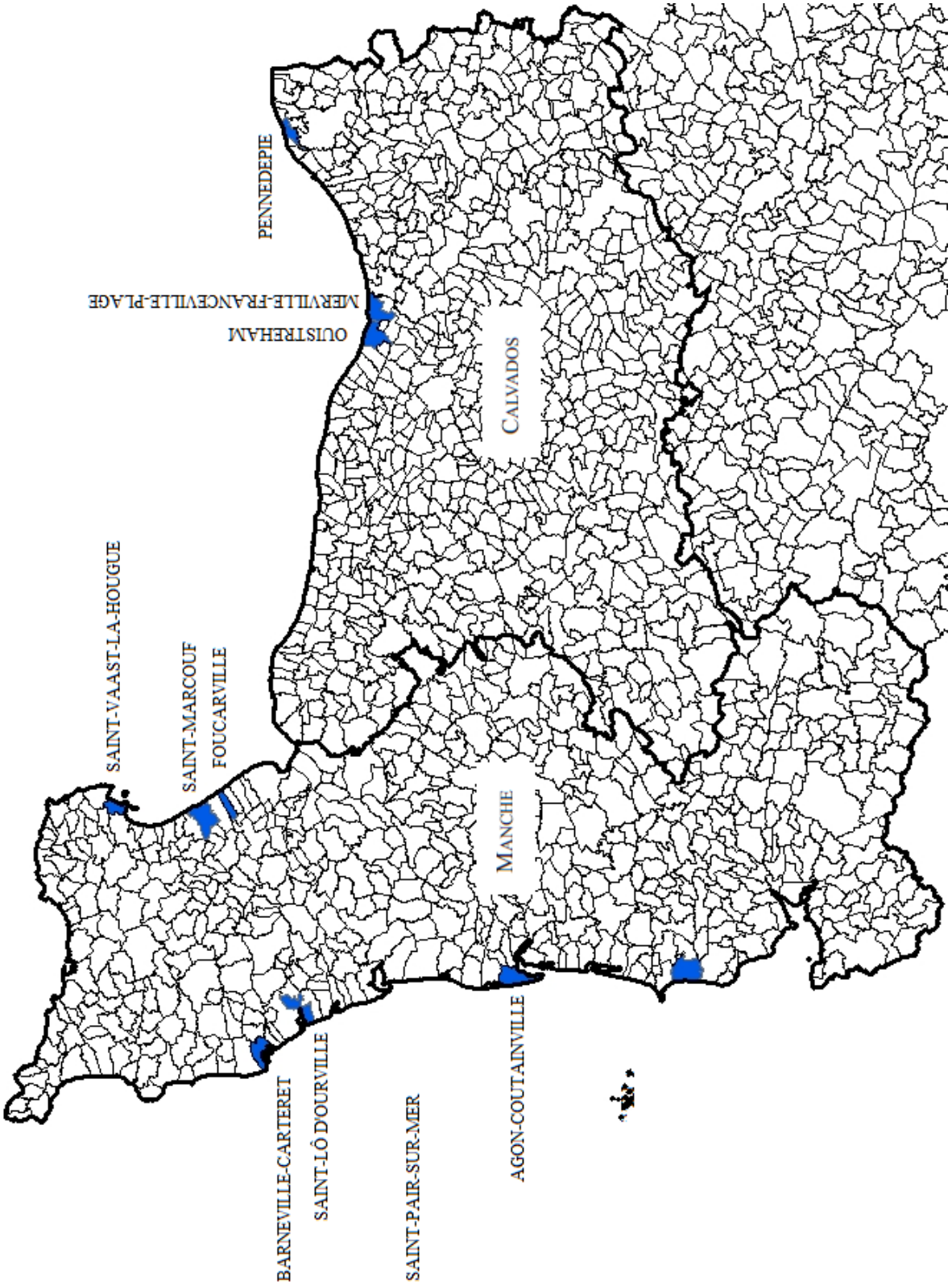


Figure 27: Maps of sites where protection systems have been put in place

Since 2010, “anticipatory” protection systems have been installed, before the laying of eggs, in areas spotted during previous years and where Plovers are likely to be nesting again. These enclosures consist of posts and lengths of vegetable fibre string or sheep fencing. At each end of the enclosures, notice boards are positioned. The aim is to avoid strollers and vehicles entering the

Kentish Plovers' colony. To install these protections, administrative steps must be taken by January, i.e. three or four months before the possible settling of nesting birds, to apply for the authorizations needed to temporarily occupy the Marine State Property. Refer to the appendix for the various sites and means used.

Figure 28. Enclosure put in place in Merville-Franceville

During the surveys of pairs and nest locations, observers also put in place so-called "reactive" protection systems. These can consist of several items:

- Driftwood
- Pebbles
- Wooden posts with a length of string
- Waste found on the beach
- etc.

These enclosures are designed to protect nests from trampling by strollers without making them more visible to the public and to predators.

Figure 29. Reactive enclosure made with a piece of rope found on the beach

c) Outcomes

The anticipatory enclosure systems put in place in Barneville-Carteret in 2011 and 2012, Merville-Franceville in 2010, Pennedepie in 2012 as well as Saint-Marcouf in 2012, did not accommodate any Kentish Plover nests.

Moreover, the nests monitored in Saint-Lô d'Ourville in 2010 and in 2014, Pennedepie in 2011, Saint-Pair-Sur-Mer in 2012, Foucarville and Merville-Franceville in 2012, showed no success, whether for nests protected in an enclosure or nests without protection (Table 6). Consequently, no analysis (N/A) could be carried out on such nests.

Years	Towns	Nests Tot	Nests w/ p.	Success w/ p.	Success w/o p.	% w/ p.	% w/o p.	Gain
2010	Saint-Pair-Sur-Mer	5	2	2	1	100%	33%	0.2
	Saint-Lô d'Ourville	5	1	0	0	0%	0%	N/A
	Pennedepie	9	6	3	1	50%	33%	0.60
2011	Saint-Pair-Sur-Mer	8	5	1	0	20%	0%	0.63
	Saint-Lô d'Ourville	7	4	2	2	50%	67%	0.63
	Agon-coutainville	18	4	2	9	50%	64%	0.52
	Merville-Franceville	12	3	3	1	100%	11%	0.02
	Pennedepie	5	2	0	0	0%	0%	N/A

2012	Saint-Pair-Sur-Mer	5	4	0	0	0%	0%	N/A
	Saint-Lô d'Ourville	16	6	0	4	0%	40%	0.12
	Foucarville	4	1	0	0	0%	0%	N/A
	Merville-Franceville	30	1	0	0	0%	0%	N/A
2014	Saint-Lô d'Ourville	2	1	0	0	0%	0%	N/A
	Saint-Marcouf	20	2	0	3	0%	20%	0.70
	Foucarville	7	3	1	0	33%	0%	0.43
	Merville-Franceville	52	25	0	1	0%	4%	1
	Ouistreham	2	1	1		100%		N/A

Table 6: Summary table of results obtained for all anticipatory protection systems
Nests Tot: Total number of nests monitored, Nests w/ p.: Number of nests with protection, Success w/ p.: Number of hatched nests with protection, Success w/o p.: Number of hatched nests without protection, % w/ p.: Success rate of nests with protection, % w/o p.: Success rate of nests without protection

As regards the other anticipatory protection systems, for half of them (5 out of 10, all years and towns taken into account), protected nests seem to have had a higher rate of successful hatching than nests without protection: this is the case for enclosures in Saint-Pair-Sur-Mer in 2010 and in 2011 (respectively 100% vs. 33% and 20% vs. to 0%), in Merville-Franceville in 2011 (100% vs. 11%), in Foucarville in 2014 (33% vs. 0%) and for the laid-out path in Pennedepie in 2010 (50% vs. 33%) (Table 6). However, such differences are not statistically significant… which does not mean that the hypothesis should be invalidated.
The only significant difference noted concerns the Merville-Franceville enclosure in 2011 (see table 6). Nests with protection show a higher success rate than nests without protection (100% vs. 11%).

As regards the reactive protection systems, the small enclosure placed around the five nests in Merville-Franceville in 2010 as well as the three types of reactive enclosure (driftwood, guard rail and post + wire) put in place in Merville-Franceville in 2011 show a significantly higher success rate compared to nests without protection, respectively 80% vs. 26%, 60% vs. 0%, 50% vs. 0% and 100% vs. 11%) (Table 7).

Years	**Towns**	**Type of Protection**	**Nests Tot**	**Nests w/ p.**	**Success w/ p.**	**Success w/o p.**	**% w/ p.**	**% w/o p.**	**Gain**
2010	Merville-Franceville	Wire	28	5	4	6	80%	26%	0.04
2011		Driftwood	38	15	9	0	60%	0%	0.06
		Wire		8	4	0	50%	0%	0.03

		Guard rail		3	3	1	100%	11%	0.01
2012		Driftwood	30	5	0	0	0	0	N/A
		Wire		13	0	0	0	0	N/A
		Guard rail		2	1	0	5%	0	0.17
2014		Anticipatory enclosure + Cage	52	6	0	1	0%	4%	0.81
	Ouistreham	Anticipatory enclosure + Barricade tape	1	1	1	0	100%	0%	1
	Foucarville	Wire	7	1	0	0	0%	0%	N/A
	Saint-Marcouf	Pebble circle	20	3	0	3	0%	18%	0.6

Table 7: Summary table of results obtained for all reactive protection systems
Nests Tot: Total number of nests monitored, Nests w/ p.: Number of nests with protection, Success w/ p.: Number of hatched nests with protection, Success w/o p.: Number of hatched nests without protection, % w/ p.: Success rate of nests with protection, % w/o p.: Success rate of nests without protection

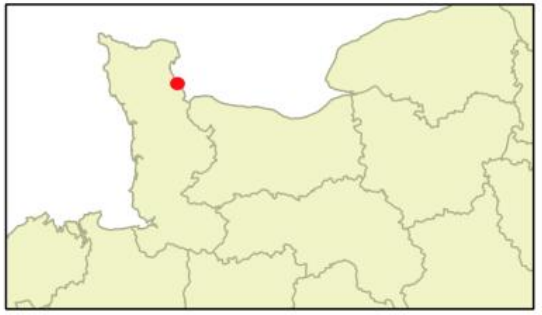
Anticipatory enclosures which hosted no Kentish Plover nest must therefore be considered ineffective.
Only the enclosure put in place in Merville-Franceville in 2010 as well as all the reactive protections installed in Merville-Franceville in 2011 foster successful hatching of Kentish Plover nests. However, when reused over the following years, these protections did not provide any significantly effective results.
There is therefore a limiting factor in year *n* when an action was possible. However, in year *n+1,* this factor may no longer be limiting. The protection system is then ineffective.
Moreover, in certain areas, all nests failed, both inside and outside the protective facilities. This proves that the factor leading to these massive failures was not one of the factors against which the enclosures were supposed to be effective: the limiting factor was not, that particular year and in that place, human disturbance.
The results may be explained by the fact that the breeding success of Kentish Plovers depends on several environmental factors, all of which should be measured to find out which one is limiting in a given year, at a given place, and even probably at a given time in the breeding season (disturbance, predation, wind, tides, rainfall, etc.).
As these various factors have not been measured, it is difficult to be categorical about the effectiveness of the various protection systems. Statistically effective protection systems may thus not directly favour the success of the nests, but may be related to one or more other factors which are more relevant to the species' breeding, and *vice versa* for protection systems considered ineffective.

On the other hand, in light of the small size of samples (a maximum of six nests in an enclosure, except the 25 nests in the Merville-Franceville enclosure in 2014), the risk of statistical error remains very high since it depends on two parameters: the significance of the result and the size of samples. In other words, certain protection systems may have an influence, but it is too low to be decisive with such small samples.

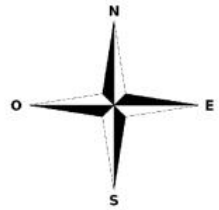
d) Study of refuge areas

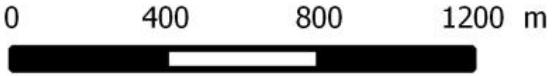
Debout (2009) briefly described the Kentish Plovers' habitat as follows:
"A beach with a clearly visible high water mark, hence the preferred presence of Plovers near ramps and on the tips of sandy spits. The horizon is clear as the incipient dune is almost flat and the rear part of the dune is not too high. This landscape can often be found in non-eroded areas, with the backshore featuring mainly fine sand, with a few pebbles."
Globally, Plover nests are located on stable areas, or with a slight seawards movement (+1m on average). Kentish Plovers do not therefore nest just anywhere on the shoreline and look for non-eroding areas or areas showing signs of growth: it is therefore threatened by marine erosion, as the sandy backshores are likely to diminish due to the rise in average sea level and to more frequent storms.

Localisation du nid de gravelot à collier interrompu sur Saint-Marie-du-Mont en 2011



Nid de gravelot à collier interrompu observé en 2011 sur le polder de Sainte-Marie-du-Mont





It has also been discovered that Kentish Plovers can breed outside the backshores and salt marshes: in polders or in the so-called "mielles"[2], grey levelled dunes that have long been cultivated. The ground in these mielles is unusual, as it consists of very fine, permeable sand with lower water retention power than the original grey dune (7% versus 8 to 11%, Chevin 1966). In the 1980s, nesting Kentish Plover pairs were spotted in carrot fields, in the mielles along the western Cotentin coast. Several sites were discovered: in Portbail, Surville where they were subsequently monitored; Bretteville-sur-Ay, Pirou, (Debout, pers. obs.) and Lessay (Gué de l'Orme) and Blainville-sur-Mer (obs. P. Sagot). For the first two sites, the number of pairs was precisely counted between 1979 and 1989, corresponding to the last sighting recorded. After the 1980s, no other pair was sighted.

Research done subsequently with specialists in carrot-growing in dune environments showed that changes in cultivation practices in these mielles probably caused this disappearance. A change had been made to irrigation practices. This method of watering carrots cultivated in mielles appeared after the 1976 drought. It became increasingly widespread between 1980 and 1990. Water-cannon irrigation is detrimental to Plovers' nests.

Another change concerned the ground surface: farmers used to spread calcareous mud (and lithic mulch, an oil by-product), to protect seedlings and foster good growth. But this practice was abandoned in the mid 1980s and replaced with farm manure spreading. After conclusive tests, this practice soon became widespread, approximately 25 years ago, and was even integrated into the specifications to obtain the French Label Rouge food label. Carrots are sown between late May and late June, manure mulching is carried out around mid-June and the manure stays in place for a long time. For Kentish Plovers, it becomes impossible to lay eggs in mielles for the following reasons:

- From mid-May onwards, the ground is finely worked: existing eggs would be destroyed or covered by the manure spread in June;
- Then, carrots grow while manure remains in place;
- In vegetable-growing mielles, no other area can be used as a refuge as no plot of land is free in April, May and through to early June.

However, these observations show that mielles (and polders) managed in a different way could allow Kentish Plovers to nest, without hindering carrot cultivation.

With a 2-metre rise in the sea level, which is a plausible hypothesis within one century, we can see that, from West to East:

- South of Granville, the backshores will disappear;
- Between Granville and Carteret, the backshores will diminish but, above all, most of the sand spits protecting havens will disappear;
- On the coast between La Hague and Réville, beaches will disappear;
- The same is true on the Western shore of Cotentin and the Bay of Veys;
- On the Calvados coastline, all sites currently occupied by Plovers will disappear.

[2] Refers to flat, dry and mobile shores or nearby dunes and sandy plains which are partly cultivated. Typical term used in the Manche area from the Old Norse word "melr" meaning "sandy hill/dune".

A rise in average sea level also brings an increase in the swell effect. The shallower the sea, the more noticeable this effect will be. The hypothesis of a movement of certain beaches towards the continent is sometimes put forward, but this could only occur where the dunes are wide enough. Anyway, the observations currently carried out in Baubigny and in Vauville (G. Debout, pers. obs.) show that pebble strips appearing where sandy backshores used to be are leading to the disappearance of the Kentish Plovers' breeding biotopes.
Consequently, with the backshores diminishing, or even disappearing, the mielles generally located above the +2m spot height could become refuges for Kentish Plovers, particularly as the rise in sea level will increase soil salinity and this would also be favourable for Plovers.

Within the framework of the PRA GCI, the GONm has drawn up a list of the mielles in the Manche *département*, based on plots of land thought to be favourable for Kentish Plovers as they correspond to the types of land where the species used to nest (i.e. large plots of land less than 1km/1.5km from the sea). It has then compared these plots of land with those belonging to Conservatoire du Littoral.

III. General recommendation and Outlook

Overall, the work done within the framework of the project has required a significant effort for quite variable results depending on the sites. The French sites will certainly require additional monitoring efforts to improve Kentish Plover success rates and define the causes of failure.

Additional studies must be carried out, especially in Normandy, to more specifically analyse the favourable and detrimental factors for the success of the nests, considering the environmental conditions of nesting over several years.

What is important, regardless of the species or the site, is to define what actually restricts this species' breeding success, not forgetting that it is more difficult to influence environmental factors. Moreover, we must bear in mind that this work involves a lot of uncertainty due to the very nature of what we want to protect. It is impossible to guarantee a totally safe egg-laying area for an animal whose survival strategy is based on a changing, adaptive behaviour. In the absolute, ensuring breeding success for these species means maintaining large areas in good environmental condition. It also demands in-depth work on “attractive” areas, like the work done in Langstone Harbour and Chesil Beach. However, some individuals may not adopt the particular features designed to protect an egg-laying site and attempt to lay their eggs elsewhere. The “reactive” enclosures studied in France seem to be the most effective, but are administratively limited by applications for authorization, whereas the English administration is more flexible.

It is also interesting to consider that these birds are capable of transferring their egg-laying site to fallback areas, depending on the conditions, and that these secondary sites must therefore be kept in good condition to accommodate them. In Normandy, the work done on mielles is one of those avenues explored, possibly via “natural improvement of the environment”, beginning with a return to ancestral farming practices.

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Appendix

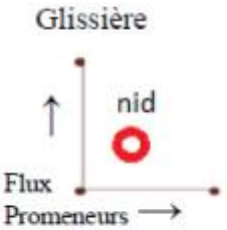
Appendix 1: Different types of enclosures put in place in Normandy for the protection of Kentish Plovers

Towns	Years	Systems	Photo	Comments
Saint-Pair-sur-Mer	2010-2012	Post and wire enclosure		Guiding of tractors and stroller at the mouth of the Thar
Agon-Coutainville	2011	Post and wire enclosure		Dimensions: 500m x 15m
Saint-Lô-d'Ourville	2010-2014	Two post and wire enclosures		Two enclosures with a passageway between the two. Overall dimension: 280m x 50m

Barneville-Carteret	2010-2011	Post and wire enclosure		200m in length, on the backshore salt marsh at the foot of the dune, harbour side
Pennedepie	2010-2012	Creation of a guided pathway in the shingle		Stroller guiding by clearing a pathway in the shingle
Merville-Franceville	2010-2012	Post and sheep fencing enclosure		3,000 m^2 enclosure, in place from mid-March to mid-July with information to kite-surfers and strollers
	2014	Barrier with posts and sheep fencing at the end of the sensitive area		Same principle as in previous years but not completely closed

Foucarville	2010-2014	Two small post and wire enclosures		Rectangular enclosure partly closed by the dike on the road side. Dimension: 60m x 12-15m. They are placed along the coastline.
Saint-Marcouf	2010-2014	Two post and wire enclosures		Two open enclosures are created with a path between them. The posts are only linked widthwise. Total dimension: 140m x 10m
Saint-Vaast-la-Hougue (Ile de Tatihou)	2010-2014	One small post and wire enclosure	Same principle as in Foucarville but completely closed	Dimensions: 60m x 5m

Site	Years	Systems	Photo	Comments
	2010	Small post and wire enclosure around 5 nests		Quick to install compared to large anticipatory

Merville-Franceville	2011-2012	Individual enclosures: - post + wire - guard rail - driftwood	Posts + wire Piquets + fil   Guard rail / nest Walkers Driftwood Bois flotté  Cage  Cage	enclosures. Warns strollers and allows observers to easily find the nest.
	2014	Individual enclosures around nests in the large enclosure: - driftwood - sheep fencing cage		

Saint-Marcouf	2014	Individual pebble circle around nests		Quick to install compared to large anticipatory enclosures. Warns strollers and allows observers to easily find the nest.
Foucarville	2014	Individual post and wire enclosure		
Ouistreham	2014	Individual enclosure with posts and barricade tape		

PANACHE

Protected Area Network Across the Channel Ecosystem

PANACHE is a project in collaboration between France and Britain. It aims at a **better protection** of the Channel marine environment through the **networking** of existing marine protected areas.

The project's five objectives:

- **Assess** the existing marine protected areas network for its ecological coherence.
- **Mutualise** knowledge on monitoring techniques, share positive experiences.
- **Build** greater coherence and foster dialogue for a better management of marine protected areas.
- **Increase** general awareness of marine protected areas: build common ownership and stewardship, through engagement in joint citizen science programmes.
- **Develop** a public GIS database.

France and Great Britain are facing similar challenges to protect the marine biodiversity in their shared marine territory: PANACHE aims at providing **a common, coherent and efficient reaction**.

PANACHE est un projet franco-britannique, visant à une **meilleure protection** de l'environnement marin de la Manche par la **mise en réseau** des aires marines protégées existantes.

Les cinq objectifs du projet :

- **Étudier** la cohérence écologique du réseau des aires marines protégées.
- **Mutualiser** les acquis en matière de suivi de ces espaces, partager les expériences positives.
- **Consolider** la cohérence et encourager la concertation pour une meilleure gestion des aires marines protégées.
- **Accroître** la sensibilisation générale aux aires marines protégées : instaurer un sentiment d'appartenance et des attentes communes en développant des programmes de sciences participatives.
- **Instaurer** une base de données SIG publique.

France et Royaume-Uni sont confrontés à des défis analogues pour protéger la biodiversité marine de l'espace marin qu'ils partagent : PANACHE vise à apporter **une réponse commune, cohérente et efficace**.

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