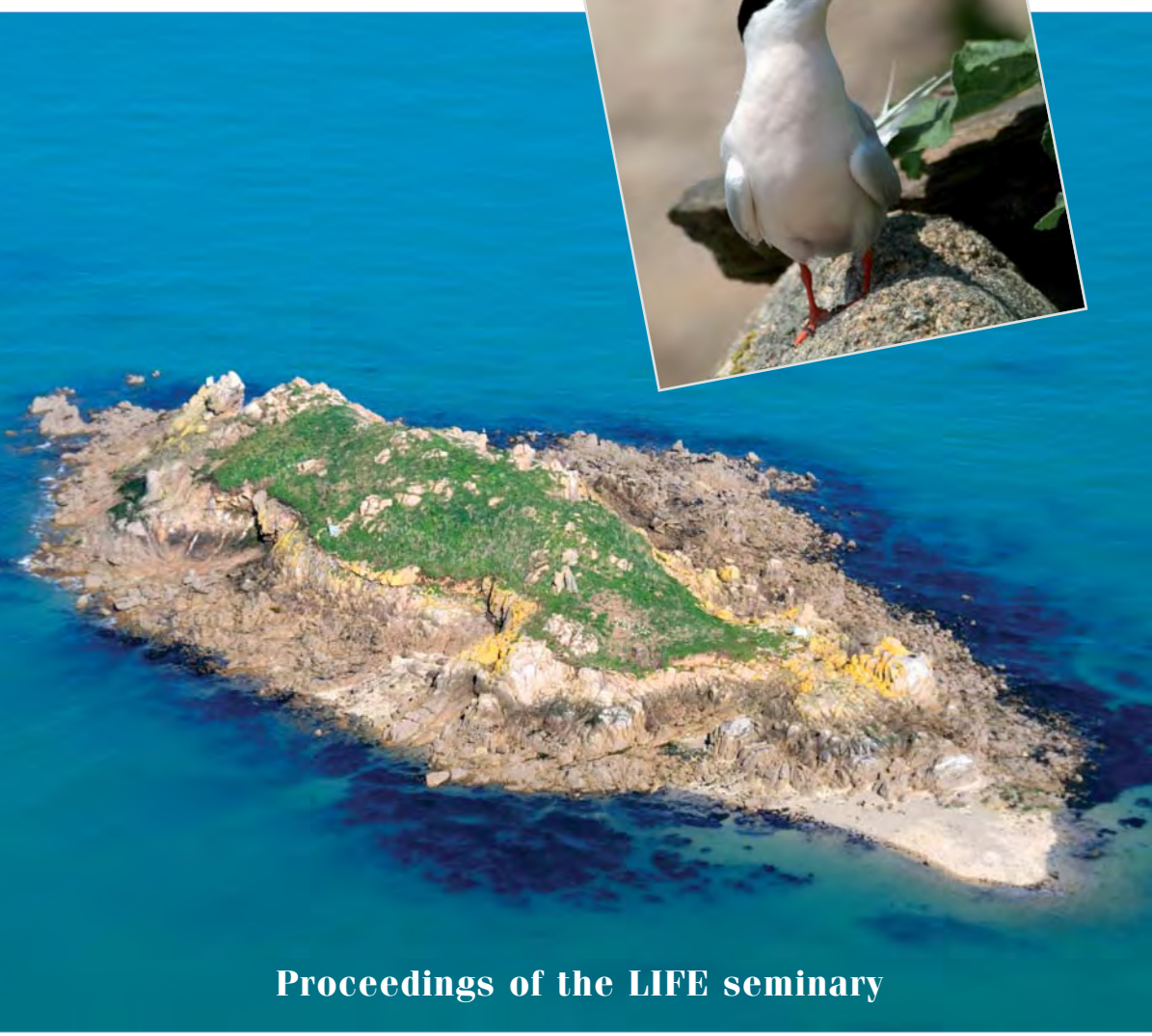
Roseate tern conservation



Proceedings of the LIFE seminary

Bretagne Vivante sepnb

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Roseate tern conservation in Brittany

European programme LIFE-Nature n° LIFE05NAT/F/000137 :

Partners:

Workshop:

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Picture of É. Drunat (B. Cadiou)

Summary

Roseate tern conservation

Proceedings for the LIFE seminar "Conservation of the roseate tern in Brittany",
November 2005 - October 2010, LIFE05NAT/F/000137,
coordinated by Marie CAPOULADE, Gaëlle QUEMMERAIS-AMICE & Bernard CADIOU

Recommended mention for these proceedings:

• for the whole *Penn ar Bed* publication:

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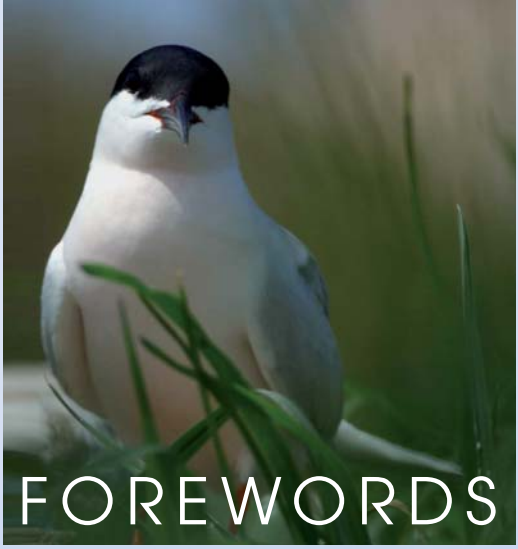
• for an article from *Penn ar Bed* publication:

MACLEOD I. 2010 - The mink threat in Scotland. In CAPOULADE M., QUEMMERAIS-AMICE G. & CADIOU B. (Éds), Roseate tern conservation. Proceedings of the LIFE seminar "Roseate tern conservation in Brittany". *Penn ar Bed*, n° 208, pp. 19-23.



FOREWORDS

February 2009, Isle aux Dames, in Morlaix bay. Gusts of wind, fresh weather, a team bustling about. The team includes Bretagne Vivante's volunteers and staff, and they are setting up a protective fence around the terns' nesting area. This proved to be effective, for several weeks later, the birds settled just as they had done in previous years. Even roseate terns nested, on whom mink had taken a heavy toll in 2008: in just two visits on the island, they destroyed one third of French breeders. However, the breeding success of roseate terns in 2009 was good, with around thirty young fledged. The fence thus achieved its goal; stopping the intrusion of this dreadful predator into the colony.

This protective measure, funded within the framework of the EU LIFE programme for the conservation of roseate terns in Brittany, was effectively conducted thanks to the help of volunteers who give their time, i.e. several thousands of hours over five years. This flawless mobilisation has been going on for over 50 years at Bretagne Vivante, as it has been present on all sites connected to the LIFE programme.

Laurent GAGER,
volunteer in charge of the LIFE roseate tern programme

First of all, I would like to sincerely thank the Brittany Regional Council for its support in organising this seminar, Océanopolis for hosting it and all the participants, some of whom have traveled long distances.

The organisation Bretagne Vivante celebrated its 50th anniversary in 2009, which was marked by the achievement of a 24-hours challenge for biodiversity that took place around the gulf of Morbihan in June 2009.

In the 1950s, the history of Bretagne Vivante began with the creation of the SEPNB (Société pour l'étude et la protection de la nature en Bretagne - Society for the Study and Protection of Nature in Brittany). At this time, this "scientifical society" worked to increased knowledge of protected areas. In the 1970s, a strong activist component was added to these actions and the educational component was developed in the 1980s-1990s. Bretagne Vivante now group these four features together following a participative approach: knowledge, protection, activism, education. Today, Bretagne Vivante is present within all Brittany's historical regional boundaries. The regional office is linked to the history of the organisation and remains anchored in Brest. Bretagne Vivante has 3,000 members distributed over 19 local sections and its action is represented among more than 200 institutional consultation authorities. It includes 49 employees and its overall annual budget is 2.5 million euros. Each year, 17,000 young people and school children raise their awareness of nature thanks to its educators, 34,000 visitors explore the reserves and 60 conservation projects and studies are carried out.

Historically focused on marine birds, Bretagne Vivante's network of reserves now includes 105 reserves representing diverse habitats and distributed throughout the region. Within this network, it is important to note the presence of five National Natural Reserves and one Regional Natural Reserve. The organisation is also in charge of managing other types of areas for their fragile biotopes. Part of its activities is also pointing out new areas needing protecting tools. Many areas managed by Bretagne Vivante are located in Natura 2000 sites, with a number of volunteers partaking in the steering committees. Moreover, a temporary occupational authorisation (AOT) covers around fifty marine islets within the reserve network. Finally, as the landowner of 300 ha (741 ac), Bretagne Vivante also closely collaborates with local Councils within the framework of their land acquisition policy.

Bretagne Vivante's values and missions are being redefined for its 50th anniversary project. Within this framework, the organisation wants to refocus its action on the protection of biodiversity. Yet, as expressed in the project's preface: "As man is part of biodiversity, its conservation is both an ethic and a vital necessity". The historical values of Bretagne Vivante (knowledge, protection, activism, education) are thereby clarified and will give a 2010-2012 action plan.

Bretagne Vivante also brings together men and women, nature lovers, diverse skills and know-how, activists, common actions and develops conviviality, thus creating an important social tie. The organisation has uncertainties too: is the naturalist an endangered species? What is the actual outreach of our action? How to renew activist actions? How to better meet the stakes, particularly of nature conservation?

In the future, data and their enhanced management will be at the heart of Bretagne Vivante's concerns: their improved gathering, their promotion, their development. The issue of training naturalists and volunteers, as well as the improvement of work with other organisations, scientists and local authorities will also be tackled.

Biodiversity must become a mainstay of land management policies and society, focused not only on the network of protected areas but also on so-called ordinary or nearby nature. It is however essential that know-how acquired in reserves is better promoted and becomes the basis of management for the entire territory in order for us to take up the challenge of protecting biodiversity together!

Speech by Jean-Luc TOULLEC,
President of Bretagne Vivante

The event of this 11th international seminar on roseate terns could find no better setting than Océanopolis in Brest – the location of Bretagne Vivante's head office – and at the crossroads of the two main tern colonies in Brittany: Isle aux Moutons and Isle aux Dames.

Though the Brittany Region is not a partner of this programme, we were however determined to support this seminar in order to contribute the conservation of the most threatened seabird in Europe, and also because the choice of this location is a manner to promote Brittany.

Since its creation, Bretagne Vivante has shown its commitment, its effectiveness in protecting the environment and in its educational action. These are our reasons for strengthening a joint partnership:

- multi-annual agreement on objectives,
- associational jobs of regional interest,
- Nature Contracts,
- implementation of the Marine Birds Regional Observatory (OROM) in Brittany (2009-2012),
- LIFE project on aquatic warbler.

Furthermore, Bretagne Vivante actively took part in developing the Regional Scheme for Natural Heritage. It also created, with the Finistère Council, the Cragou Moorland Regional Natural Reserve. Moreover, it recently signed the Brittany Coast Charter with the Regional Council, one of the targets being the conservation of biodiversity, coastal ecosystems and water quality.

As you know, Brittany holds many assets: a rich natural heritage, which is unique worldwide for some species, an outstanding coast yet coveted and fragile, remarkable inland areas such as heath, moor and peat land, authentic quality landscapes that build the regional identity on the same basis as cultural, maritime or architectural heritage. This heritage constitutes a key attractiveness factor in economic terms, particularly regarding tourism, and also contributes to the quality of life of Bretons.

A great number of emblematic areas were preserved thanks to regulatory and/or contractual protection tools implemented by the government, local authorities, environmental conservation organisations, including Bretagne Vivante, which started drawing public authorities' attention very early and played an essential part in citizens' awareness-raising of the overall environmental field.

However, maintaining this diversity is not automatic: land pressure, artificialising and trivialising of environments increase their fragile state of being. We must face the facts: the accelerated extinction of species will not slow down by 2010 despite reasserted targets. Hence the will to preserve, protect and promote.

This "will" gave rise to the development of a Regional Scheme for Natural Heritage and Biodiversity adopted in 2007: an educational, strategic, operational tool, a reference framework for the Regional Council's action, a consistency framework for public action strengthened by the creation – in partnership with the government – of a heritage and biodiversity regional observatory linked to PIG Bretagne Environnement (Public Interest Group).We aim to build, with our partners, a network of natural areas in Brittany made of Regional Nature Parks, Regional Nature Reserves designated as "outstanding areas of Brittany", great natural sites, Nature Contracts, ecological corridors…

Today, international summits and numerous European directives deal with environmental issues. Discussion about assessing the protection of the environment to the Constitution, "green" development, ecological prejudice are everywhere. Nonetheless, we are still far behind the wanted results.

There are still many people, including decision-makers, who need to be convinced that the environment is not a drawback or that sustainable development is not a fashionable phrase of a regression, but is, on the contrary, synonymous to progress and sharing. It is an investment for the future, a long-term overall view of society. The revival of general interest or solidarity expressed to all human beings, beyond borders or generations.

Opening speech by Gérard MÉVEL,
Vice-President of the Brittany Regional Council,
in charge of Quality of Life, Water, Natural Areas and Landscapes

Océanopolis is very pleased to host, in its premises, this conference on roseate terns conducted by Bretagne Vivante.

The ties that connect the facilities in Brest to the organisation are long-standing and strong.

I actually started working on marine mammals of Brittany with the SEPNB. The evolution of seal populations and the dolphin colonies of Brittany's headland result from actions conducted by the SEPNB. With the creation of Océanopolis in 1990, the facilities in Brest took over. Twenty years later, we now share these actions with the Iroise Nature Marine Park.

For Bretagne Vivante's 50th anniversary we were very pleased to contribute to the biodiversity challenge in the Natural Reserve of Séné.

I wish you all a most fruitful congress.

Welcome speech by Éric HUSSENOT,
Director of Océanopolis

Bretagne Vivante

Workshop participants at Océanopolis.

Roseate terns open new horizons

Alain THOMAS

Roseate terns are old acquaintances of Bretagne Vivante. Mobile and flitting, often unlucky, they have, nevertheless, been carefully tracked by ornithologists of the organisation, who have restlessly concocted the most varied protection methods for the colonies over the past fifty years. At the end of the conference dedicated to them in Brest in autumn 2009, they set new targets for us, provided that we would indeed be willing to secure their future in the westernmost part of Europe and, beyond the continent, on these overseas French territories, from the West Indies arc to New Caledonia. From regional-scale ties and marine boundaries, we have now moved to long-haul protection actions.

Before widening the sphere of action in favour of roseate terns, the conference for the pre-closing of the LIFE programme first put an end to an internal debate generated by the need for explanations and approval for choosing to rigid conservation management methods. The decision to build an anti-mink barrier gave way to many discussions. The plan was to pursue an extended annual restructuring of the breeding area of the last colony on Enez Wragez, i.e. the Isle aux Dames in the bay of Morlaix. Reports from our British and Irish colleagues showed the stage of habitat management or intervention we were all at to maintain this species in European natural heritage, with the prospect of future control of the deep-rooted causes for the species' decline.

Roseate terns will thus put us to the test in various ways at a time when broad awareness seems to be growing as regards the urgency to act and the implementation of new biodiversity conservation plans.

As the saying goes "*you only protect well what you know well*", we must now take into account an overall approach of the species' needs. For instance, this will involve a better definition of these terns' feeding behaviours by locating their foraging areas. The "Protected Marine Area" tool may prove to be very useful.

On land, the parameter to control disturbance by human activity must be further comprehended. As a chief species of the Morlaix bay's current richness, it could become the standard of a future Nature Reserve comprising islets and mudflats in this Tregor bay. It seems that such an idea is today making its way towards offering additional means of action and education.

Roseate terns also raise questions about our collective ability to repair thoughtless doings such as the introduction of exogenous species and primarily that of mink, an absolute plague documented by several speakers throughout this conference. The aim here is to bring new partners together in an attempt to control if not eradicate the species at the scale of the bay and of the various capture areas. Efforts and successful results recorded in Scotland imply that such an objective is neither presumptuous nor unattainable. A matter of political will in 2010, the year of Biodiversity.

Perhaps as a consequence of both their divided and cosmopolitan distribution, they suggest we contribute to sustaining a network for the exchange of information and know-how along their migratory route between West Africa and Europe via the Azores. As accomplished by the Anglophones with, for instance, the involvement of Ghana, it would be wise to have the Francophones cooperate, from Brittany to Senegal, in order for them to add to the increased knowledge and the preservation of roseate terns in their wintering areas. In short, the horizon and realm of the possible are broadening.

Moreover, the conference has highlighted France's responsibility for this tern with numbers scattered over three oceans. Indeed, the chart of French overseas territories and that of roseate tern colonies actually superimpose to a large extent! The prospect of a National Action Plan dedicated to them seems to bode well in this context. Bretagne Vivante is ready to take its part therein and pass on the fruits of its experience to potential partners on these territories slightly more distant than our "little" Irish or Iroise seas.

Before actually sailing out to these new horizons, we still have our internal strategy. Closely monitoring the only actual existing colony, running the regional tern observatory, extending the consistent management of a network of potential island sites by integrating what the LIFE contract will have helped to improve, etc., will lead to revealing the somewhat mysterious route of terns along our coasts.

Alain THOMAS is a volunteer of Bretagne Vivante

H. Ronné

Islets of the Morlaix bay.
Isle aux Dames in the foreground.

Status report of roseate tern populations in Europe

Bernard CADIOU

É. Drunat

The evolution of roseate tern populations in Ireland, the United Kingdom and France has been particularly well documented since the 1960s (Leroux & Thomas, 1989; Cabot, 1996; Cadiou & Thomas, 2004; Newton, 2004).

Sudden decline

Breeding numbers – all colonies together – recorded a very fast decline between the end of the 1960s and the mid-1970s, reducing from 3,900 pairs in 1967 to less than 700 pairs in 1977. The decline continued until the 1980s, yet at a slower rate, until an overall stabilisation was observed during the following decade. Numbers then ranged between 550 and 600 pairs.

The general decline is mainly related to various factors affecting the wintering areas of the African coasts on one hand and the Northeast Atlantic breeding colonies on the other hand. In Africa, trapped by man for food or recreational means, or even decrease in local food resources for terns, the birds seem to have generated a strong fall in their survival rates with repercussions on the species' demographic evolution (Cabot, 1996; Newton, 2004). In Europe, hosting conditions for the species in traditional colonies seem to have deteriorated, especially under the combined influence of the increase in gull populations – particularly herring gull – through spatial competition and predation, and human disturbance related to the development of recreational activities in the marine environment and the increased interest in island areas (Cabot, 1996; Newton, 2004).

Slow restoration

Conservation measures were implemented among colonies in the 1980s, particularly within the framework of a European action plan initiated in 1987 (Avery & del Nevo, 1991; Avery *et al.*, 1995; BirdLife International, 2002). These measures, which moreover are still relevant, aim to favour the species' breeding period, particularly by reducing predators, designating reserves, caretaking and keeping sea-users informed in order to avoid disturbance by human activity, and providing roseate terns with nest-boxes to enhance the hosting capacity of colonies and the productivity (Leroux & Thomas, 1989; Avery & del Nevo, 1991; Avery *et al.*, 1995; Jonin, 1990; BirdLife International, 2002; Ganne & Le Nevé, 2002). Campaigns to raise local awareness of the problems were also conducted in West Africa to reduce intended captures (Avery & del Nevo, 1991; Avery *et al.*, 1995). Thanks to these measures, the decline was finally stopped and recordings of the increase in numbers resumed from 1992 yet at a much slower rate than that of the decline phase.

Some thirty years were to go by before the threshold of 1,000 pairs, without Azores, was exceeded again in 2006.

Recent trend for the top five colonies

The detailed analysis of the numerical evolution of the five most important colonies since the 1980s – i.e. since conservation actions were implemented – brings a particularly interesting additional highlight to this recent increase [1] [2].

First of all on Rockabill, numbers show an almost continuous increase over the last three decades, from several dozen pairs in the early 1980s to record numbers reaching 1,052 pairs in 2009 (Cabot, 1996; Mavor *et al*, 2008; BirdWatch Ireland data). Very good productivity was recorded there, with outcomes generally ranging between 1.3 and 1.8 young fledged per nesting pair, considering that an average of 1.4 young per pair is required to keep a roseate tern population stable (Cabot, 1996; Hulsman et al., 2007).

The results obtained on Rockabill show a huge difference with what is happening elsewhere, whereas in the early 1980s nothing indicated that such a difference would occur. Indeed, in the other four colonies, numbers have only very seldom exceeded 100 pairs since the end of the 1980s.

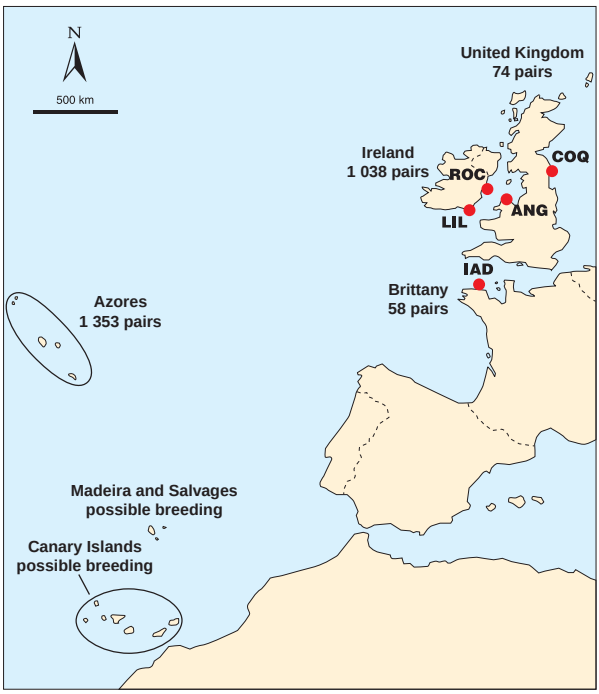
In Anglesey, Wales (with several distinct islets inhabited by terns), numbers quickly declined at the turning point of the 1980s and 1990s from around 200 pairs to just a few, and the species now only rarely breeds there (Cabot, 1996; Mavor *et al.*, 2008; RSPB data).

On Lady's Island, the fluctuation of numbers is more pronounced than for other colonies, mostly with 70 to 110 pairs in recent years and an average productivity of less than 1 young per pair (Cabot, 1996; Mavor *et al.*, 2008; BirdWatch Ireland data).

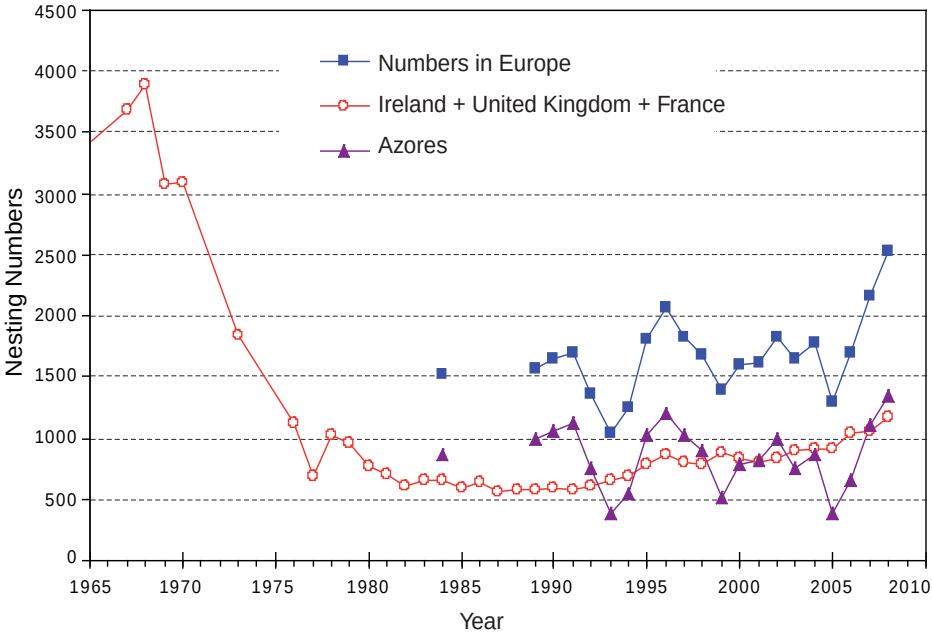
On Coquet Island, management measures have led to an increase in numbers, from 30-40 pairs in the 1992-2001 period to a maximum of 94 pairs in 2006, with a stabilisation in recent years (Cabot, 1996; Morrison & Gurney, 2007; RSPB data). The mean productivity there is most generally around 1 offspring taking flight per pair (Morrison & Gurney, 2007).

Finally, on the Isle aux Dames, while management measures have led to roseate terns returning in 1983 and to an increase in numbers (maximum of nearly 110 pairs in 1996), recordings since have shown slowly eroding figures (Le Nevé, 2005; Cadiou & Jacob in de Seynes *et al.* 2009; Bretagne Vivante data). Productivity is low and amounts to less than 1 young per pair, and actually less than 0.6 young per pair in recent years (Bretagne Vivante data). Besides these five colonies, a few breeding cases are recorded in other sites but usually only involve one to a few pairs.

Predation by mink and peregrine falcon is one of the main current causes of the colonies' destabilisation (Newton, 2004; Ratcliffe *et al*, 2004; Le Nevé, 2005). Information on the role of available food resources in the variation of productivity or in the numerical trend of colonies still has gaps and will have to be the subject of specific studies.



[1] *Location of roseate tern colonies in the northeast Atlantic (ANG = Anglesey, COQ = Coquet Island, IAD = Isle aux Dames, LIL = Lady's Island Lake, ROC = Rockabill).Trends of 2008.*



[2] ***Population trend of the roseate tern in Europe (from Avery et al., 1995; Cabot, 1996; Neves, 2005; BirdWatch Ireland, Bretagne Vivante, IMAR-Azores, Royal Society for the Protection of Birds and unpublished data).***

Different evolution in the Azores

There are no accurate early data for roseate tern numbers in the Azores, yet censuses have been completed there since the mid-1980s (del Nevo *et al.*, 1993; Avery *et al*, 1995; Neves, 2005). Very strong interannual fluctuations are recorded, with a cyclic evolution over a 5- to 6-year period, yet with no actual increase trend except in 2008. This cyclic feature in the Azores contrasts with the more linear evolution recorded over the same period in the three northeast Atlantic countries that host the species (Ireland, United Kingdom, France). The minimum number recorded in the Azores was approximately 390 pairs in 2005 and the maximum was around 1,350 pairs in 2008 (Neves, 2005; V. Neves pers. comm.). The species breeds annually in 20 to 30 different sites, out of around fifty sites known for having been occupied at least once. Conservation measures are also being implemented for terns (Neves, 2005; Bried *et al*, 2009).

World and European population

Elsewhere in Europe, roseate tern breeding has also been reported in the past, in the Canary Islands, Madeira or even the Salvage Islands. However, in the absence of recent observations, the species may well be considered as very rare or even extinct in these localities (Martín *et al.*, 1989; BirdLife International, 2004; Newton, 2004; Ratcliffe *et al.*, 2004). With approximately 2,500 pairs in 2008, the European proportion of numbers represents about 2% of the species' world population estimated at 130,000 pairs (Newton, 2004). Given the relative stabilisation of numbers in Europe during the 1990-2000 period, the conservation status of roseate tern evolved from "endangered" (Tucker & Heath, 1994) to "rare" (BirdLife International, 2004). In France, the species is still considered to be "critically endangered" (UICN France & MNHN).

Distinct metapopulations

Bird banding operations have not led to prove exchanges of breeders between the two groups of populations or metapopulations considered (northwest European colonies on the one hand, amongst which exchanges occur, and Azores colonies on the other hand; Ratcliffe & Merne, 2002; Neves, 2005; Ratcliffe *et al.*, 2008). Their numerical evolutions can thus be considered independent from each other, but they are both contingent upon environmental conditions in the main wintering areas of Africa where individuals of different geographical origins mix, and perhaps also along the South American coasts where some birds go to stay (Ratcliffe *et al.*, 2004).

Prospects

The future of roseate terns in northwest Europe currently clearly relies on that of the Rockabill colony ("Dougalland"). The productivity at the scale of each colony is a determining element ruling inter-colony exchanges. For seabirds generally, the higher the breeding success, the more a colony tends to keep its breeders and attract new local recruits, and also to attract young recruits from other colonies or even breeders deserting other colonies. If the input of new breeders does not compensate for the losses recorded in terms of annual mortality and emigration, a colony is doomed to decline.

Finally, the future of roseate tern cannot be considered irrespective of that of two other species with which it is always closely associated: sandwich tern and common tern. The persistence of these mixed colonies ensures possibilities towards the maintenance or resettlement of roseate tern.

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Bernard CADIOU is seabird biologist at Bretagne Vivante
bernard.cadiou@bretagne-vivante.org

Bretagne Vivante

WORKSHOP 1

Predations

- **Predation, spatial competition and interspecific disturbance in the bay of Morlaix**
  Yann JACOB & Marie CAPOULADE

- **The mink threat in Scotland**
  Iain MACLEOD

- **Assessment of gull management measures in tern sites**
  Bernard CADIOU & Matthieu FORTIN

Predation, spatial competition and interspecific disturbance in the bay of Morlaix

Yann JACOB & Marie CAPOULADE

J.-P. Rivière

Bretagne Vivante

With varying degrees of intensity depending on the year, interspecific disturbance, spatial competition and predation affect the last sustainable colony of roseate tern in metropolitan France, located on the Isle aux Dames in the bay of Morlaix.

The Isle aux Dames is part of the ornithological reserve of the islets of the bay of Morlaix, founded by the SEPNB in 1962. This reserve comprises seven islets included in maritime public domain that belongs to the "Conservatoire du Littoral". Two decrees insure the protection of the biotopes on three islets: Isle aux Dames, Beclem and Rikard – since 1991[1]. Fourteen bird species breed on the islets of the reserve every year, including nine seabird species. The islets of the bay of Morlaix are the third site of heritage importance for the conservation of seabirds in Brittany, following the National Nature Reserve of "Sept-Iles" archipelago and Iroise (Cadiou, 2002). Every year, the Isle aux Dames hosts 13 of the 14 nesting bird species of the reserve: great cormorant, European shag, herring gull, lesser black-backed gull, great black-backed gull, sandwich, common and roseate terns, common shelduck, mallard and rock pipit. Only the Atlantic puffin, still nesting on Rikard Island, is no longer found on the Isle aux Dames. More or less, all these species live together in harmony. Being monitored on a regular basis since the 1950s, the tern colony went through a desertion stage between 1974 and 1981 (de Kergariou, 1984). Afterwards management actions were carried out by the SEPNB and led by Even de Kergariou. They have contributed to restore favourable conditions for the settlement of a sustainable tern colony since 1981. However, this colony is still vulnerable and depends on regular protection actions.

The Isle aux Dames' geographical location accounts for this vulnerability. The island is about 1.3 km from the coast, right in the middle of a deeply indented bay with a ragged coastline, thereby making it accessible to land predators such as brown Norway rat (*Rattus norvegicus*) and the mink (*Mustela vison*) [2]. This accessibility is increased by the presence of islets and rocky reefs located between the coast and the Isle aux Dames. In the east, the Islets of Stérec, Karo, Blanche, Le Drezenn and Sable, and in the west, Louët Island and the Taureau Castle are ever so many intermediate stages that help land predators to gradually reach the Isle aux Dames. The widest channels are indeed reduced to a few hundred metres at low spring tides, whilst mink is renowned for being able to reach the islets located up to 2 km from the coast (Ratcliffe *et al.*, 2008). The lower bay hosts many wintering and migratory birds on its mudflats. The islets are used as resting places at high tide, whilst the bay's eastern coast consists of cliffs. This site is thus favourable to the wintering and nesting of peregrine falcon, which is coping increasingly better in Brittany after several decades of absence (Cozic, 2009).

These elements help to easily understand the precarious situation of the tern colony of the Isle aux Dames. Besides the site's accessibility to land predators, other threats identified are the population's concentration in one single site (Le Nevé, 2005; see article by B. Cadiou, this

1 & 2 : see notes at the end of article.

	2006	2007	2008	2009
Herring gull	0	0	0	0
Lesser black-backed gull	4	0	3	> 3
Great black-backed gull	0	0	> 6	> 7

[1] *Number of tern (3 species collectively) captures by gulls at the Isle aux Dames from 2006 to 2009.*
Comment: captures by gulls all involve tern chicks except for 1 adult sandwich tern captured by a great black-backed gull in July 2009.

issue), the erosion of nesting numbers (see article by B. Cadiou, this issue), human activity (Cadiou & Thomas, 2004; see article by B. Carnot & P. Le Dœuff, this issue), spatial competition and predation by gulls (see article by B. Cadiou & M. Fortin, this issue), disturbance and predation by peregrine falcon.

All these threats do not affect the conservation of terns in the bay of Morlaix in the same way. Spatial competition with gulls can today be considered under control by the annual reduction campaigns carried out on the island since 1979 with a yearly prefectoral authorisation to destroy clutches and breeding adults by poisoning with alpha-chloralose. This reduction maintains a low density of gulls, particularly on the southern side of the island used by terns, and cuts predation numbers. Since the beginning of the LIFE programme, cases of predation by gulls were systematically recorded during the daily wardening sessions. It appears that there was no case of predation by herring gull on terns reported over the 2006-2009 period. Predation is mostly due to lesser black-backed and great black-backed gulls that mainly capture chicks of all ages. It often seems to be achieved by specialised individuals. This predation takes the heaviest toll on common terns. On the other hand, the direct impact on roseate terns appears to be very low and, in four seasons, one single capture of a twenty day old roseate tern chick by a lesser black-backed gull was recorded. This predation pressure by gulls can nowadays be considered as acceptable by the reserve manager [1].

For several years, predation and disturbance caused by peregrine falcon have been recurrent threats to the Isle aux Dames colony. Yet, there again, predation on roseate tern is insignificant since a single capture of one adult was recorded since the beginning of the LIFE programme. Conversely, the disturbance it creates has various consequences on the colony depending on the date of presence [2], which can lead to the terns deserting the site. Thus in 2006, 800 pairs of sandwich terns laid eggs and about a fortnight later deserted the colony due to predation by a peregrine falcon, combined with predation by a mink and poor weather conditions. As for roseate terns, they left the bay of Morlaix before even laying eggs, in search for substitute sites (archipelago of Bréhat, La Colombière in Saint-Jacut-de-la-Mer). 25 to 40 pairs bred more or less successfully in these sites in 2006 whereas 76 pairs had nested in Brittany in 2005 (Drunat *et al.*, 2006; Drunat & Cadiou, 2006). In 2008 and 2009, one or two peregrine falcons were present later in the season and did not cause the desertion of the colony. Conversely, the estimated consequences on roseate tern (though not accurately assessed) include delays in laying dates, abandoning of clutches – recorded every year –, early moving of chicks of the three tern species resulting in frequent interspecific aggressions by adults against chicks and mainly in an increase in predation by lesser black-backed and great black-backed gulls, as this was also recorded in the case of black-legged kittiwake colonies (Thomas 2007a, 2007b).

Due to the precariousness of the French roseate tern population and the lack of a truly functional substitute site, the reserve's team wondered whether or not to take action to try to reduce the impact of peregrine falcon. This issue was the subject of an passioned and sometimes stormy discussion within Bretagne Vivante itself (Thomas, 2007b). Information and contacts

	2006	2007	2008	2009
Date of presence at the Isle aux Dames	early May	no	from 18 to 25 May 23 June from 16 to 23 July	from 3 to 29 July
Impact	desertion	none	predation and disturbance	predation and disturbance

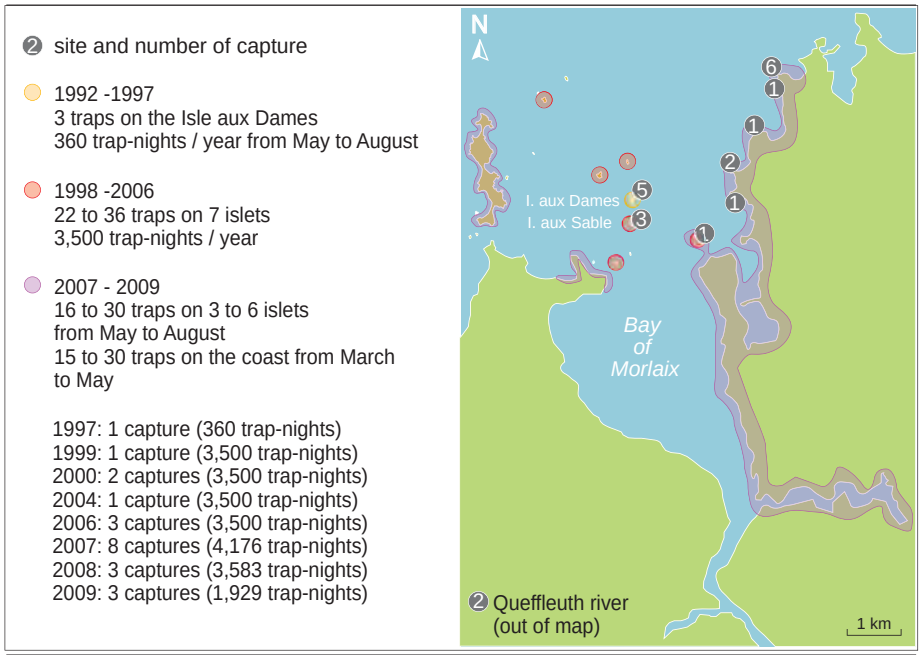
[2] *Impact of peregrine falcon according to the date of presence in the tern colony of the Isle aux Dames.*

from organisations in charge of the monitoring and conservation of tern colonies worldwide helped to determine practices against super-predators such as peregrine falcons or nocturnal birds of prey that come to tern colonies and particularly roseate tern colonies. In Canada, a great horned owl (*Bubo virginianus*) was captured in the roseate tern colony of North Brothers in Nova Scotia (D'Eon, 2008) and a peregrine falcon was captured in the common and roseate tern colony of Bird Island, Massachusetts, USA in 1991 (Nisbet, 1992). These predators were released several dozen kilometres from the colonies and therefore solved the problem. In the bay of Morlaix, we decided to increase monitoring in order to better determine the reaction of terns when attacked by peregrine falcon. We also chase away gently the falcon by approaching the island by boat, which is usually enough to cause its flight, thereby letting the terns come back more rapidly to incubate or brood their eggs or chicks. We only step in if the falcon stays on the island for an extended period of time (more than 30 minutes) and after it has ingested its prey, in order to avoid its returning to hunt, thereby causing further disturbance (A. Hauselmann, pers. obs.). Stepping on the island may occasionally be required when it cannot be approached closely enough to cause the falcon's flight, due to the tide. In order to be effective, this increased monitoring requires 16 hours of presence at sea per day, from sunrise to nightfall continuously. Weather conditions and human resources available for several days are thus the limitations of this monitoring which was conceivable and actually took place in 2008 and 2009 thanks to the involvement of volunteers and to the resources available within the framework of the LIFE programme.

While predation by peregrine falcon has spectacular impacts, the major threat affecting terns since the early 1990s is predation by mink. This species was introduced in France in 1926 for the fur industry (Pascal *et al.*, 2006). In Brittany, mink farms developed thanks to food resources easily available from fishing and slaughterhouse subproducts. Inevitably, more or less unintentional repeated introductions into the natural environment occurred (Léger & Ruette, 2005; Pascal *et al.*, 2006). Mink was observed in the wild in the 1970s (Phélipot, 1975; Pascal, 2006) and for the first time on the Trégor coast, east of the bay of Morlaix, in 1987 (Lafontaine, 1988). It currently has all the features of an invasive species (Bifolchi, 2007) and is regarded as a game and "pest" species in the French departments of Finistère, Morbihan and Côtes d'Armor. The first case of predation by mink on terns on the Isle aux Dames was recorded in 1991. Since then, mink attacks have taken a heavy toll on the French roseate tern population, with each new predation event destroying 25 to more than 30% of the nesting population [3]. In 2006, the colony was deserted under the combined effect of predation by peregrine falcon and mink. Following the first attack in 1991, Bretagne Vivante developed trapping campaigns with cage traps. From 1992 to 1997, trapping was conducted on the Isle aux Dames using 3 traps, i.e. the annual equivalent of 360 trap-nights (total trap-nights = number of traps opened per night multiplied by number of trapping nights). From 1998 to 2006, trapping was extended to the other islets of the reserve and especially to intermediate islets between the coast and the Isle aux Dames, always during the nesting period (E. de Kergariou, pers. comm.), i.e. 3,500 trap-nights. In Scotland, where the fight against this invasive species is organised on a large-scale, the success rate of mink captures depends on the season, with two peaks tallying with the mating season in late winter / early spring and with the dispersal of the young in late summer (Moore *et al.*, 2003). The LIFE programme enabled to extend trapping to the coast of the bay of Morlaix between the harbour of Dibenn / Plougasnou and Callot Island / Carantec, and to the mating season of mink, i.e. more than 4,000 trap-nights [4].

Year	Nesting numbers (pairs)	% of the french pop.	Predation date	No. of roseate terns killed	% of the French pop. destroyed
1991	90	97%	early June	54 adultes	25%
1997	100	99%	early June	49 adultes	30%
2006	2	5% - 8%	late May	0	indirect impact
2008	57	100%	8/9 June 15/16 July	37 adults 7 chicks	32%

[3] ***Predation of roseate tern by mink on the Isle aux Dames.***



[4] ***Evolution of mink-trapping efforts in the bay of Morlaix from 1991 to 2009.***

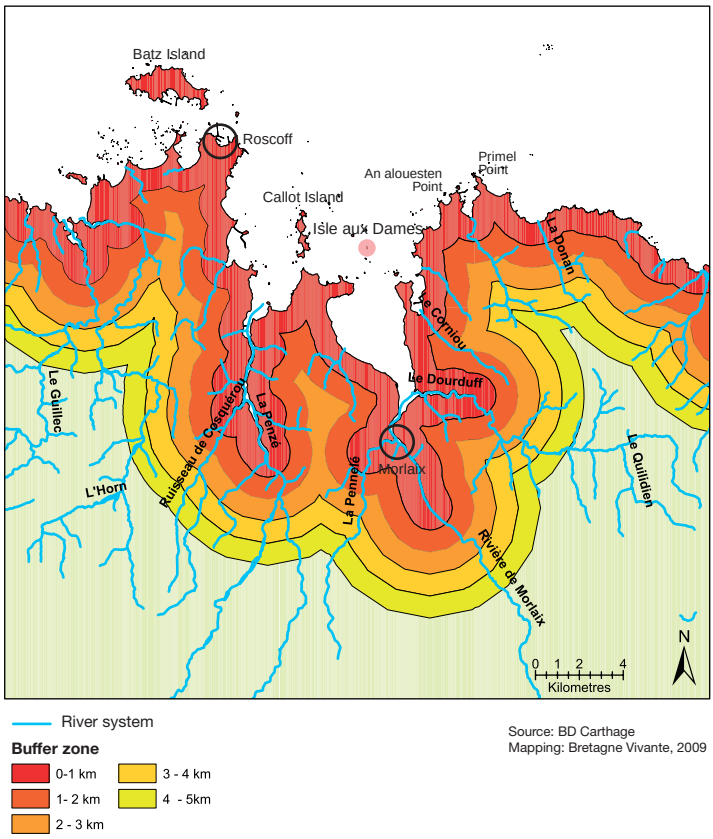
Despite this increased effort, both predation cases that occurred in the spring and summer of 2008 show that our available means for trapping is insufficient to eradicate the problem. Moreover, some individuals are never caught in the cage-traps (Zuberogoitia *et al.*, 2006). Given this observation, the goal was no longer to reduce the impact of mink on tern but to actually put an end to it, which required reviewing the strategy adopted so far.

As the eradication of mink in Brittany currently seemed impossible in the absence of a substantial programme (Bifolchi, 2007), we first considered creating a mink-free buffer zone around the Isle aux Dames. This type of buffer zone would involve setting 2 to 3 traps per km² for 7 months a year in order to cover both the mating season in the late winter and spring and the dispersal and emancipation period of the young in the summer and autumn (Harris, 2005; Bonesi *et al.*, 2007). Provided that a trapper can collect 25 to 55 traps a day depending on his experience and the layout of the area and that traps cover 60 to 130 km of coastal land, this amounts to a significant number of trappers for daily collection **[5] [6]**. Furthermore, these means do not guarantee the complete absence of mink and the operation would necessarily have to be renewed every year. This solution rapidly seemed out of reach of the means available in the short term within the framework of the LIFE programme and with no guarantee of completing the goal.

To meet this “zero predation” target, the protection of the tern colony by developing a mink-proof fence was considered (see article by Y. Jacob on managements, this issue). This “last chance solution” was the only one that could meet the target in the short term, and was justified by the great precariousness of the roseate tern colony still present in France and by the lack of a functional substitute breeding site in Brittany.

Terns came back to nest in 2009 and seemed to have adapted to the change to their breeding site related to the new fence, which was a first positive result. 50 to 54 pairs of roseate terns bred on the Isle aux Dames in 2009. This number is greater than the number of pairs that survived both cases of predation by mink during the previous season. It conveys the lack of massive emigration of experienced nesting pairs and the recruitment of new breeding pairs.

No mink seemed to have come to the island in 2009 and the fence will thus have to prove its effectiveness in the years to come. This “unnatural” solution arouses



[5] ***Exclusion area of 1- to 5-km mink-free buffer zone around the Isle aux Dames.***

everyone's concern and is not unanimously approved due to the site's artificialising and to the costs of developments which were mainly supported by the LIFE roseate tern programme. From our standpoint, it must remain an exceptional solution and not divert the necessity to continue, in parallel, the restoration of a network of functional islets liable to let the terns change breeding sites on a regular basis, as they have always done. ■

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Width of the buffer zone	From Callot Island to An Alouesten Point (60 km)	From Roscoff to Primel Point (130 km)
1 km	135	293
2 km	270	586
3 km	405	879
4 km	540	1,172
5 km	675	1,465

[6] ***Number of traps required according to the width of the buffer zone and the length of coast considered.***

Notes

1 - The prefectoral decree n° 91.1957 of 23 October 1991 establishes the prohibition on disembarking on the Isle aux Dames, Beclem and

Rikard Islands from 1 March to 31 August and the interdepartmental decree of 23 January 1991 establishes a protected area of the maritime public domain on the emerged section of Isle aux Dames, Beclem and Rikard Islands and in an 80 m area starting from the deep-sea tidemark with a 120 tide coefficient. In this area, it is forbidden to land on the islets, boat, wander or dock, from 1 March to 31 August.

2 - American mink classification has change recently. "The Handbook of Mammals of the World" of 2009 named it *Neovison vison*. After consultation, we decided to stick to *Mustela vison* in this book.

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Yann JACOB is a warden-educator at Bretagne Vivante, in the Ornithological Reserve of the Islets of the bay of Morlaix
yann.jacob@bretagne-vivante.org
Marie CAPOULADE is project manager at Bretagne Vivante
marie.capoulade@bretagne-vivante.org

The mink threat in Scotland

Iain MACLEOD

Bretagne Vivante

The American mink (Mustela vison) has been introduced to many areas worldwide due to commercial fur farming (Dunstone, 1993) and their impact on indigenous wildlife can be devastating. Sterna species are particularly vulnerable to these voracious predators due to the nature of their colonial behavior and their relatively small size compared to other gull species (Craik, 1997).

I. Macleod

In Scotland, mink have been an unintended non-native introduction to our countryside since the early 1950s, due to their escape or intentional releases from the fur farming industry (Bonesi & Palazon, 2007). Feral populations exist throughout most of Scotland but in some areas their distribution and the density of these populations is still poorly understood.

The management of the mink threat in Scotland has been ongoing for many years but of late, it has become more organized and coordinated. All the projects currently underway have at least some element of volunteer effort involved and the largest, most effective project to date is the Cairngorm and North East Scotland Water Vole Conservation Project. This project uses rafts first designed by the Game and Wildlife Conservation Trust to monitor for the presence of mink, on clay footprint traps, using a volunteer workforce, once detected a trap is set on the raft and the animal caught quite quickly. More details can be found at:
www.watervolescotland.org.

J. MacAvoy

American mink.

Other projects within Scotland also exist including the Northwest Scotland Mink Project and various local volunteer based control schemes for example in Lochaber, Mull and Skye. The largest project however, and one which relies on a professional team of trappers, is the Hebridean Mink Project which operates in the Outer Hebrides of the west coast of Scotland.

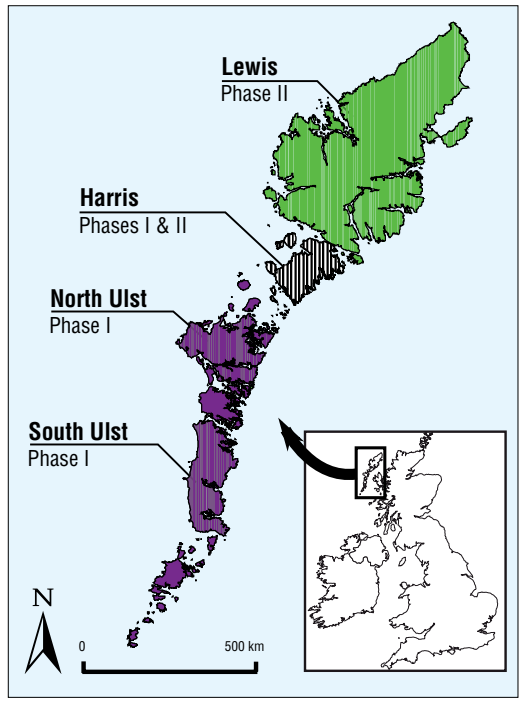
The Outer Hebrides are situated to the far north-west of Scotland, comprising an archipelago of several large islands many connected by causeways or bridges. There are numerous offshore islands creating a highly complex landscape, which includes dune, rocky shore, pebble and boulder bays, cliffs, beaches, estuaries and saltmarsh along the coast, with small to medium sized riparian habitats joining one of the most complex freshwater systems in the UK (Helyar, 2005).

The American mink was introduced to the Outer Hebrides in the 1950s as a fur animal and by the end of the decade, it had escaped and spread throughout Lewis and Harris, causing considerable damage to breeding birds, poultry, aquaculture and fisheries (Angus, 1993). By the late 1990s they had spread from these islands further south to North Uist (Harrington *et al.*, 1999), Benbecula and most recently, South Uist [1].

The fact that the archipelago is isolated and therefore not susceptible to recurring immigration pressure from mainland mink make it an ideal location to trial large-scale control. In addition, internationally important assemblages of ground nesting bird species require protection in one of the most designated areas of Scotland. In 2001, an EU LIFE project, the Hebridean Mink Project (HMP), was set up with the objectives of eradicating mink from North Uist and Benbecula (South Uist added subsequently) and reducing the population in South Harris.

The first phase of the HMP was viewed as a trial of eradication techniques but was ultimately successful and finished in 2006, a second phase started in 2007 with the objective of extending the eradication programme to Lewis and Harris [1]. Phase II of the project was not funded by LIFE III but by a partnership of various Scottish Agencies and UK Trusts. The total area of the Western Isles extends to 305,000 ha. In worldwide terms, this is the largest island eradication ever attempted for any species.

The Outer Hebrides complex coastal and freshwater habitats gave the project considerable difficulties in planning and executing a coherent approach to trapping [2]. There are 3,297 km of coastli-



[1] *Outer Hebrides situation and details of the island archipelago. This map shows the area of Phase I of the Hebridean Mink Project in Purple, Phase II of the Project, shown in green with South Harris, which was trapped during both Phases, acting as a significant buffer zone to re-invasion between phases.*

ne approximately 20% of the coastline of Scotland, 4,721 km of loch edge approximately 25% of loch edge in Scotland and 1,831 km of riparian habitat 3% of Scotland's river. In addition, much of this is situated within some of the remotest wilderness anywhere in Europe.

Results

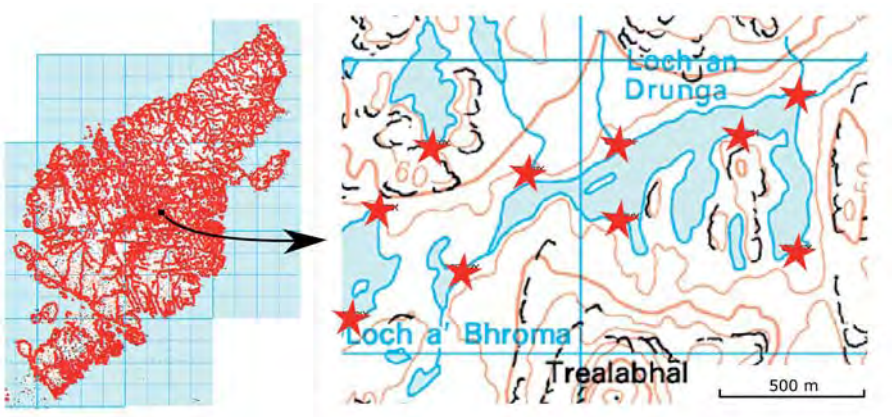
Several tern species have been shown to increase in number after the removal of mink. Even for a short time during the breeding season, common tern (*Sterna hirundo*) have shown improvements in productivity (Craik, 1997) as well as arctic tern (*Sterna paradisaea*) (Nordström *et al.*, 2003). This was bourn out in the later stages of Phase I when hatching success of all tern species present in the Outer Hebrides, *Sterna hirundo, Sterna paradisaea* and *Sterna albifrons* increased significantly within the control area when compared to those colonies out with the HMP control area (Scottish Natural Heritage, 2006) [3].

By 2005 the arctic tern in Lewis and Harris grouped into one very large colony in excess of 800 individual birds, at Aird, Point Isle of Lewis. This proved to be a very unsuccessful survival strategy with at least 200 birds predated by mink. Thereafter the colony moved to a new location in 2006 and 2007 [4]. The fact that the densities of mink within the entire control area have been significantly reduced appears to have been recognized remarkably quickly by the tern species but the mechanism behind this is not understood. In the forthcoming breeding season with even lower mink densities, across a larger area, this behavior should be consolidated, and given equally abundant sandeel numbers, as 2009, breeding success will continue to be high.

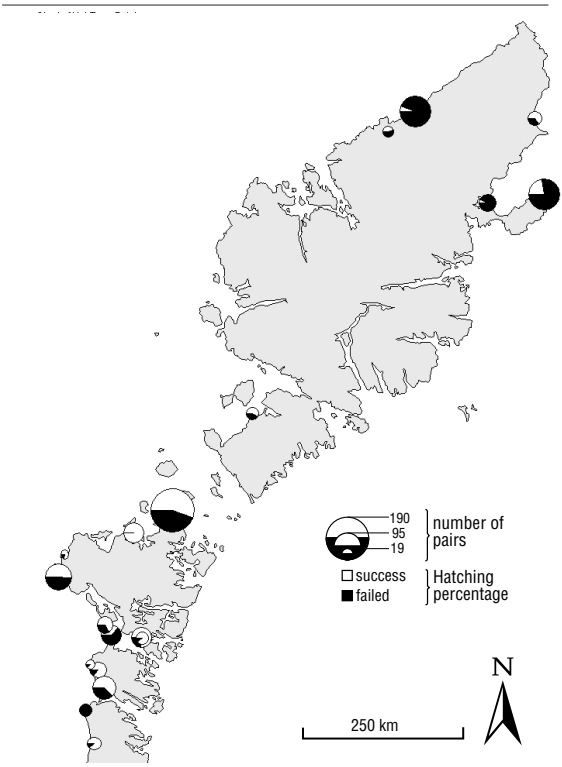
Some of the key lessons learned during the project can and should be applied to other control attempts:
- **planning**: methods, strategy and trap structure need to be established prior to the start of the project;
- **scale**: target smaller areas until logistics have been tested;
- **immigration**: control of immigrating animals needs to be incorporated at the planning stages;
- **personnel**: highly experienced, motivated field staff are the best way of improving the chances of success;
- **innovate**: test new ideas. The Hebridean Mink Project now uses mink gland lure as the main attractant in the cages, which has improved catch efficiency greatly (Roy *et al.*, 2006) [5];
- **monitoring, indicators of success**: the use of as many different techniques as possible. Make use of trained dogs whenever possible.

Conclusions

It has been shown during the project that the removal of 532 mink during Phase I and currently 1,143 mink during Phase



[2] ***Trap distribution on Lewis during Phase II of the HMP. In total 7,500 traps were pre-positioned on GIS software and trappers were then allowed a degree of flexibility (50 m) when positioning the traps in the field. Traps are distributed on junctions or prominent features every 400-500 m linearly throughout the coastal and riparian habitats that mink tend to follow.***



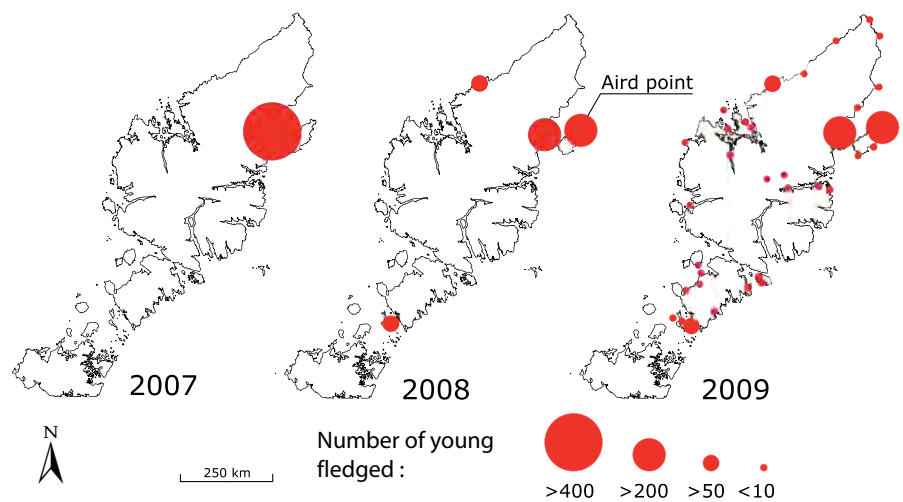
[3] ***Higher levels of hatching success for tern species in HMP areas (59%) compared to areas outside (18%). The relationship is highly significant (P < 0.0001).***

II, can have a significant effect on the breeding success of all tern species, as might be expected (Moore *et al.*, 2003), but the speed of the behavioural responses to mink removal is somewhat surprising. It should be noted that whilst it is obvious that in year productivity is also largely dictated by available food resource the longer-term survival of local populations of different species of terns could be severely impacted by the predation of adult birds (Craik, 1997). Terns can be relatively long-lived individuals meaning that the breeding success in any single year is not as significant as survival year to year; therefore, the predation of a large proportion of adult birds by mink can have an even greater significance when breeding success is low due to inadequate food resources.

The Hebridean Mink Project has shown that the control of mink over a large area is feasible and the long-term success of the project will be dependant on the final stages and the elimination of the last individual mink in remote or hard to access areas.

Acknowledgements

Phase I: EU "LIFE" Fund, Scottish Natural Heritage (SNH), Central Science Laboratory (CSL), Highlands and Islands Enterprise (HIE Innse Gall), Western Isles Council (CNES), and the Royal Society for the Protection of Birds (RSPB), All trapping staff, and in particular Dr S. Roy and Dr. A. Helyar for establishing the methodologies used.
Phase II: Scottish Natural Heritage (SNH), Esmée



[4] ***Initial results show an increase of total fledged young from 20-54 for the last 3 years to well over 250 for 2009, within the control area. In addition as can be seen in the distribution of colonies for 2009 all tern species have changed their behavior and are making use of previously abandoned colonies, some for the first time in a decade or more.***

[5] ***The use of lure as an attractant within the traps has become a vital component of the projects success. It has been shown that the use of lure can greatly increase the rate of mink capture (Roy* et al.*, 2006). The gland lure was originally extracted from the carcasses of captured animals but is now purchased from a trapping supplies company in the United States. Details can be found at: www.kishelscents.com.***

Fairbairn Foundation (EFF), Highlands and Islands Enterprise (HIE Innse Gall), Western Isles Council (CNES), Outer Hebrides Fisheries Trust (OHFT), Royal Society for the Protection of Birds (RSPB), Newcastle University (Modeling contract), Central Science Laboratory (Post mortem contract), Project foreman and all trapping staff whose efforts make this possible.

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Iain MACLEOD is the manager of the Hebridean Mink Project for the Scottish Natural Heritage
iain.macleod@snh.gov.uk

I. Macleod

Assessment of gull management measures in tern sites

Bernard CADIOU & Matthieu FORTIN

É. Drunat

Bretagne Vivante

The tern populations' history in Brittany is fairly well known since the 1950s thanks to the development of field ornithology and to the particular interest in seabirds shown by naturalists of that time (Henry & Monnat, 1981). The three most represented tern species are sandwich, common and roseate terns. The end of the 1960s and 1970s, particularly 1973 and 1974, marked a turning point in the records of Brittany's terns, with the dispersal of the large mixed colonies and a significant drop in breeding numbers for all species (Henry & Monnat, 1981; Cadiou, 1998; Le Nevé, 2005).

The increasingly intense gull-tern competition on the islets due to the great increase in gull numbers – mainly herring gull – was highlighted as one of the key factors of this evolution. Yet, other factors, such as the development of boating along Brittany's coast and the increasing pressure due to human activity near breeding sites, most certainly contributed to the rapid decline of terns.

Interaction between gulls and terns

Gull-tern competition can result in both spatial competition and predation pressure. First of all, gulls settle in the colonies before terns return and therefore – due to such massive space occupation and given their greater size – can impede the later establishment of terns (Crowell & Crowell, 1946; Kress *et al.*, 1983; Sadoul *et al.*, 1996; Blokpoel *et al.*, 1997). Secondly, gulls are predators which attack eggs and chicks of other species. The great black-backed gull can also potentially attack adults. Predation is a natural phenomenon, which does not necessarily constitute a major threat to the affected species. However, repeated predation, which is most often perpetrated by "specialist" gulls, can lead to a marked decrease in tern-breeding success, or even to the colony's desertion in extreme cases (Whittam & Leonard, 1999; Guillemette & Brousseau, 2001; Oro & Martínez-Abraín, 2007). This predation pressure must nevertheless be put into perspective as there are cases of tern colonies coexisting with sizeable gull colonies (Béniguet Island for instance: Yésou *et al.*, 2007; see also Crowell & Crowell, 1946), and this is very seldomly assessed (Whittam & Leonard, 1999; Guillemette & Brousseau, 2001; Donehower *et al.*, 2007; Oro & Martínez-Abraín, 2007). It is important to stress the fact that external factors can favour predation, e.g. disturbance by human activity, weather conditions or the level of abundance of food resources (Yésou *et al.*, 2005; Oro & Martínez-Abraín, 2007).

These factors can indeed generate an increased exposure of clutches or chicks as the parents take flight, thereby possibly resulting in or facilitating the action of predators.

First reduction campaign in Brittany in 1978

From the 1970s, being the manager of protected natural areas created for the conservation of seabirds and terns in particular, Bretagne Vivante-SEPNB thus had to deal with issues related to the development of an increased interspecific competition between gulls and terns (Jonin, 1989). In 1978, a large-scale egg-sterilisation campaign was conducted on the Breton coast, using a method formerly implemented in the United States between 1940 and 1950. In total, a little more than 19,000 clutches were sterilised, i.e. over a third of Brittany's numbers for herring gull at that time (Camberlein & Floté, 1979). However, since such large-scale operations were challenging and costly, and results were not always those expected, a change in strategy was then required in order to seek specific solutions adapted to isolated issues arising (Kadlec & Drury, 1968; Thomas, 1972; Duncan, 1978; Camberlein & Floté, 1979; Jonin, 1989).

Gull control operations to protect terns

From 1979, Bretagne Vivante-SEPNB thus settled on operations to eliminate breeding adults. Such operations had been previously implemented in the Camargue or abroad to reduce the negative impacts of gulls on other bird species (Blondel, 1963; Thomas, 1972; Camberlein & Floté, 1979). Regulation campaigns require an official authorisation issued by the government services. Herring gull is a protected species in France. Yet, this protection status enables the legal services to deliver destruction authorisations under certain conditions.

Campaigns are carried out according to a standardised protocol by setting out poisoned baits in gull nests. The product used for this purpose is alpha-chloralose (or chloralose-alpha) [1]. The reserve staff then leave the site and give the gulls time to get back to their nests and ingest the baits, i.e. about 1 to 2 hours' wait. It is important to be very careful not to disturb the gulls following the treatment to stop them from flying away after they swallowed the baits and going to die away from the site. Dead birds are then collected, examined and eliminated.Non-ingested baits are also collected and

M. Fortin

Herring gull is a protected species whose numbers can however be controlled under certain conditions and with an official authorisation.

Y. Jacob

[1] ***Poisoned bait set out in a herring gull nest.***

counted to reduce the dissemination of poison in the natural environment. The dead birds are carefully examined as other species than herring gull may accidentally be affected. The non-selective nature of this control method by poisoning most generally makes the impact unavoidable on both non-targeted gull species (lesser black-backed gull and great black-backed gull), which are fully protected species. The presence of potential ringed birds is also tracked. A number of successive operations are usually required in the spring in order to ensure some degree of effectiveness. At some sites, adults are also eliminated by shooting and nests and clutches are destroyed. Shooting can especially help to eliminate specialist gulls, regular predators, which may – though not always – be settled in the immediate neighbourhood of terns. Monitoring the colony subsequently provides information on breeding progress among surviving gulls. Each operation is subjected to an annual report submitted to the official authorities involved (Prefecture, DDAF, DIREN / DREAL, etc.).

Egg sterilisation is a method unsuited to this context as its only expected immediate outcome is the total or partial reduction in the number of young fledged, and several successive years of intervention are required before a decrease in gull numbers is observed. Only the eradication of gulls or their exclusion due to developments impeding their landing (see Blokpoel *et al.*, 1997) suggests the immediate result of freeing space for the year in progress, a space the terns are likely to recolonise. The situation will have to be put into perspective if there is a significant group of non-breeding gulls prepared to rapidly occupy free places. Subsequently, the control operation will inevitably have to be renewed on an annual basis to avoid the resettling of gulls, at least to the extent that the numbers in the gull population are considered too high and incompatible with adequate tranquillity for terns. As for controlling specialist gulls, this process is trickier to carry out. After the eradication of a dominant specialist gull, it may indeed be replaced by another individual (Guillemette & Brousseau, 2001; Donehower *et al.*, 2007).

Assessment of control operations

In 1979, nearly 3,500 gulls were eradicated on Brittany's coasts. These operations have since been continued, yet only with certain tern colonies. Overall, nearly 18,000 gulls were eradicated with

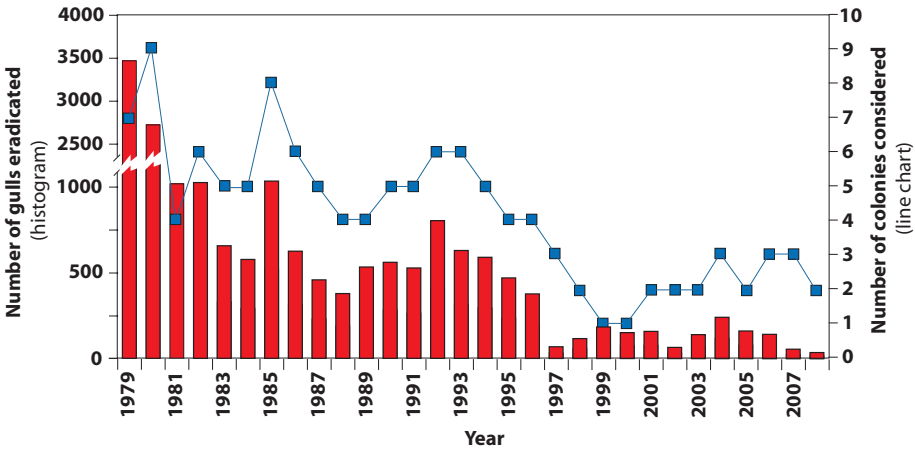
an average of 1,395 individuals eradicated per year from 1979 to 1986, 536 per year from 1987 to 1996 and 128 per year from 1997 to 2008. Over this same period, some 4,900 nests and clutches were also destroyed, including nearly 1,600 for the year 1983 alone. In recent years, the control pressure was distinctly reduced [2], among others reasons, due to gull density being much lower on many islets, as herring gull populations are now clearly decreasing on Brittany's coasts. Moreover, several historical colonies that were formerly aimed at in gull-control operations no longer host terns.

This drop in competition by restricting gull numbers has led to positive results in some of the treated sites, with terns returning or being maintained, yet not in all sites (in Kergariou, 1984; Jonin, 1989; Cadiou & Jonin, 1997; Cadiou, 1998; Le Nevé, 2005). The most outstanding example is that of the Isle aux Dames' tern colony in Finistère, a colony that has been hosting the majority of the roseate tern nesting population in France for several years. After terns disappeared in 1975, gull-control operations were developed in 1979 and renewed on an annual basis since. Common terns resettled from 1981, followed by sandwich and roseate terns in 1983.

The concurrence of these operations to reduce gull numbers and the return of terns is close enough to conclude that, without this gull-control pressure in sites that are historically or potentially attractive to terns – a control moreover combined with other colony management measures –, the demographic situation of the latter would nowadays be very precarious. As regards colonies formerly inhabited by hundreds or even several thousands of pairs of terns, which they did not return to (Trevoc'h, Meaban, Er Lannic), it is possible that gull-control pressure may not have been high enough or that other factors may have had a predominant role, such as disturbance by human activity or the level of abundance of food resources – the influential factor(s) however not being clearly isolated.

Conclusion

In the natural environment, large-scale operations to reduce gull populations are difficult to carry out, generally not very effective, and can have uncontrollable consequences related in particular to phenomena of dispersal of individuals (Camberlein & Floté, 1979; Coulson, 1991; Oro & Martínez-Abraín, 2007). In the particular case of tern colonies' conservation, it is thus advisable to search for specific solutions most adapted to the local context and to issues identified, whether they are a result of spatial competition or a result of predation (Ickes *et al.*, 1998; Guillemette & Brousseau, 2001; Morrison & Allcorn, 2006; Donehower *et al.*, 2007). Furthermore,



[2] ***Assessment of gull-control operations in Brittany: number of gulls annually eradicated from 1979 to 2008 and number of colonies involved in this type of management action.***

herring gull is recognised as a declining species since the 1980s, therefore requiring a rigorous approach to management actions involving this species (Finney *et al.*, 2001).

The conclusions of a study conducted in a tern colony in the United States show that the targeted management of the gull population by systematically destroying nests and eggs close to the colony during the management or monitoring operations aimed at the tern colony, as well as the supervised human presence directly generated by these actions, is probably the best way to increase productivity of terns and to favour the colony's maintenance (Donehower *et al.*, 2007). The terns' ability to adapt to this presence is higher than that of gulls. This is obviously no longer valid when uncontrolled disturbance caused by uninformed individuals (landing of sailors, shellfish gatherers, etc.) is involved. It seems difficult to transpose this type of action to the majority of tern colonies in Brittany located on islets with an often reduced surface area.

For 30 years, gull-control operations in Brittany have greatly evolved in terms of their implementation. Initially planned on a large scale, the reduction in gull numbers was subsequently narrowed down to the "tern colony" target. In recent years, the action has actually been further targeted as the eradication of gulls – when it is still being implemented – is only being considered at the scale of the area usually inhabited by terns and its immediate periphery, rather than the entire islet. This action seems to have a positive impact on tern breeding, in terms of the settling phase as well as productivity and the colony's sustainable on-site maintenance. However, it is important to bear in mind that gull-control measures are, in the vast majority of cases, combined with other management actions, and it is thus advisable to assess the respective significance of each type of action implemented in favour of terns. ■

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Bernard CADIOU is a seabird biologist at Bretagne Vivante
bernard.cadiou@bretagne-vivante.org
Matthieu FORTIN is a project manager at Bretagne Vivante
matthieu.fortin@bretagne-vivante.org

WORKSHOP 2

Occupancy

- **Human pressure on tern colonies and given answers to the problem**
  Brigitte CARNOT & Paskall Le DŒUFF

- **Issues regarding the conservation of roseate tern in the French West Indies**
  Lionel DUBIEF & Gilles LEBLOND

Human pressure on tern colonies and given answers to the problem

Brigitte CARNOT & Paskall LE DŒUFF



Bretagne Vivante

Observations

Development of boating

While forerunners of boating appeared around 1950, this activity really started to thrive since the 1970s. The islands, which, until then, were mainly resting places for birds, were increasingly being invaded by human activity. As early as the 1960s, J. Baudouin-Bodin was writing about common eider on the islets of the bay of La Baule in the French department of Loire-Atlantique: "*as there are now sailboats often going to these islets, there are less and less opportunities to observe nesting there*" (Baudouin-Bodin, 1964).

In the past thirty years, motorboats, launches, rubber dinghies and semi-rigid boats have appeared and activity around the islands has increased more than ever (Fortin, 2005). Nowadays, the use of GPS facilitates navigation and the access to islands no longer holds many secrets for sailors. For instance, in 2000, the Brittany Region comprised 164 facilities to a total hosting capacity of 33,212 sailboats, i.e. approximately 20% of the capacity of metropolitan France (INSEE, 2008). By 31 August 2006, around 198,000 boats (sailboats and motor vessels, all sizes collectively) had been registered in Brittany, i.e. more than 20% of registrations in metropolitan France (INSEE, 2008). Thus, to illustrate these data, on a Sunday in June 2006, around the Isle aux Moutons, between 12 pm and 2 pm, 180 moored boats were counted (G. Quemmerais-Amice, pers. comm.).

The Isle aux Moutons is eight nautical miles away from the nearest coast. It is part of the Glénan archipelago, although it is located half-way between the coast and the main islands of the archipelago. It is one of the first sites of Brittany, in terms of tern breeding numbers. People can easily go on the island with their boat arriving alongside the slipway of the island [1]. The public that disembarks on the island partly includes regular visitors who know the reserve and enjoy observing the tern breeding season. The other visitors comprise sailors who do not know that the island is inhabited by birds and


Bretagne Vivante

[1] ***Intense tourism activity on the Isle aux Moutons in the middle of the summer.***

Bretagne Vivante

[2] *Isle de la Colombière at low tide.*

H. Ronné

[3] *Kayaking near the Isle aux Dames.*

have no knowledge of the stakes of tern conservation. For instance, during the 2008 season, swimmers were observed near young terns; they were trying to push them towards a small boat nearby in order to take their picture!

Shellfish gathering
During spring tides, the islands close to the coast are very crowded. The Isle de la Colombière, which is accessible on foot at low tide during high-coefficient periods, is one of the most vulnerable sites of the LIFE programme [2].

Other water-sports
Kayaking, which combines sport, excursion and nature, is becoming more accessible. Kayakers think that they do not disturb the birds, or much less than motorboats do. However it is not noise or speed that most disturbs the birds but the element of surprise, which is the actual danger. A silent approach low on water, like a predator, causes panic flights, leaving eggs or chicks exposed to the sun or to real predators, such as gulls (Le Nevé, 2005). Nevertheless, noisy high-speed water scooters can also generate surprise and trigger flight. Due to their light draught, these machines can easily land on the islands [3].

Over-flights
Some airplanes or helicopters that fly at low altitude above nesting areas inevitably trigger flights. Terns are more or less sensitive to over-flight distance, and their tolerance threshold can vary according to the breeding stage and weather conditions. In early May 2007, during the terns' settling period, a drill was carried out on Penneg Ern (islet located close to the Isle aux Moutons) by the emergency services helicopter, which flew over the nesting areas several times thereby triggering multiple flights. The prefecture, contacted by Bretagne Vivante, assured that it would require notification prior to the next drill.

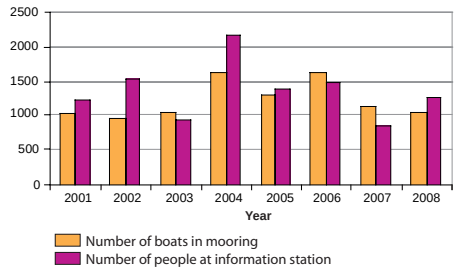
Measuring the pressure

Sailing activity around the Isle aux Moutons
From 2001 to 2008, 1,000 to 1,600 boats called in at the Isle aux Moutons during the terns' nesting season, from 1 May to 15 August. On average, 1,350 individuals per year have been to the information station or have been approached by the warden, and received information about the LIFE roseate tern programme and the protection of terns [4].

The warden fills in a form on a daily basis, in order to evaluate human activity and disturbance on the colony. These forms, developed in 1995, were revised in 2005 and are now more detailed. However, these observations are not made within the framework of a precise protocol: there is no established typology to describe the various phenomena observed, and no determined objectives to guide questioning (Fortin, 2005).

Isle aux Dames and la Colombière
To both of these islands public access is prohibited and the means of surveillance thus differ from those of the Isle aux Moutons. An 80-metre and 100-metre forbidden perimeters for the Isle aux Dames and for the Isle de la Colombière are marked out with yellow buoys [5].

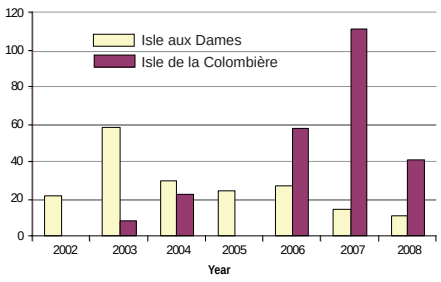
The wardens monitor the colony from a boat or positioned on a rock close to the reserve and can intervene if sea-users are in breach of the law. Intervention takes place if the warden considers there



[4] *Activity around the Isle aux Moutons (sources: Tern Observatory, 2001-2008).*

is a risk of disturbance. As there are no standardised means of recording, the warden is the only one judging the risk of disturbance and calls out to the sailors more or less distant from the boundary marked by the buoys. In 2002 and 2005, no interventions were recorded around La Colombière [6]. In 2008, wardening stopped in June due to the fact that terns, disturbed by fox and peregrine falcon, deserted the site. From 2003 to 2007, were noted between 10 in 2003 to 111 interventions in 2007. On the Isle aux Dames, the number of interventions during the same period varied from less than 50 to around 10, with a steady decline. Does this reflect the outcome of wardening and prevention perseverance on this site?

It seems necessary today to standardise the collection of data referring to visits to these sites, as this was previously implemented in order to monitor breeding progress. This involves providing new field forms that are more specific, with precise, select questioning supplied with an explanatory leaflet. This would level out the heterogeneous data that could be integrated into the "terns" database and used for statistical purposes (Fortin, 2007).



[6] *Number of interventions on the Isle aux Dames and de la Colombière (sources: Tern Observatory, 2002-2008).*

H. Ronné

[5] *Buoy signalling the prohibition on approaching the Isle aux Dames.*

Measures to reduce the impact

Measures to reduce the impact can be classified into two categories according to the nature of the message and the target public. We can thus distinguish between the means developed which require the presence of a mediator and those which do not.

Measures requiring the presence of a mediator or an educator

On-site wardens

The aim here is to make direct contact with users of the coastal area close to the programme's sites. These measures require daily wardening during the entire period of the terns' presence.

In the Azores, disturbance by human activity led to the desertion of several colonies in the 1990s. Today, only a few colonies on Graciosa Island are continually protected by the presence of wardens (Monteiro *et al.*, 1996). In the Republic of Ireland and the United Kingdom, the constant presence of wardens and information notices control disturbance by human activity (Avery *et al.*, 1995; Casey *et al.*, 1995).

The Isle aux Moutons has a distinctive feature related to its significant surface area – approximately 3 ha – and its accessibility for sailors. The presence of a warden from early May to 15 August facilitates public information on the actions that are carried out towards protecting tern colonies in Brittany. This presence is very important as, in addition to guaranteeing the actual peacefulness of terns, it provides a direct relationship with sailors and the communication of clear and precise information to ensure birds remain undisturbed during the nesting season. It also allows them to observe the birds from a reasonable distance using the telescopes available. This mediation is crucial towards providing the public with simple facts to better comprehend prohibitions and thereby defuse potential conflicts.

On the Isle de la Colombière and the Isle aux Dames, as surveillance is carried out from a boat or from a rock, the approach is slightly different. Wardens systematically take action when sailors get too close to the prohibited area. When approaching them, the warden usually starts the conversation like this: "*Hello, we are the wardens of the ornithological reserve – have you heard of it?*" Depending on the reaction of the people and the type of craft they have (kayak, sailing or rubber dinghy…), the warden comes alongside and stops the engine in order to talk to them. Visitors who are prepared to learn more are invited to observe the species; they are provided with further information about terns and the measures implemented for their protection.

Shellfish gatherers who come to these islands during spring tides are systematically approached to be reminded of the reserve and the prohibited perimeter. These contacts are the most delicate, all the more since these are regular visitors to the site who consider they are not disturbing the birds because they have been coming there "*for a long time*", "*before you were born*", "*I used to come with my grandfather*"… The wardens then need to strive in explaining that the status of conservation of terns has strongly evolved since then and that it is important today to change our behaviour around the colonies for terns to be able to carry on nesting on the site [7] [8].

Live interventions
Around the Isle aux Dames, a 15 minute speech is delivered on board leisure tourim boats to inform passengers on bird life and the reserve. Near the reserve, the Taureau Castle can be visited. An information point was developed there, equipped with a telescope to observe the tern colony [9].

A camera was set up on the Isle aux Dames making it easy to monitor with live images the life of roseate terns from the Carantec museum and the LIFE website. The increasing numbers of visitors to the museum shows their interest (Jacob, 2008).

In the gulf of Morbihan, the activity was aimed at local primary and secondary schoolchildren in order to reach future users of the gulf. Ten classes discovered the birds and especially the terns. These activities gave rise to an exhibition displayed at the Séné Nature Centre.

Conferences
The film "La sterne de Dougall" directed by Allain Bougrain-Dubourg (Nature Production) in partnership with Yannick Chérel (freelance film-maker) was presented in 2008 and 2009 in the towns close to the five LIFE sites. In 2008, 864 people attended the show and the debate that followed [10].

The film was promoted through press ads in local newspapers and municipal reports. Posters and brochures were also available in neighbouring towns one week to ten days prior to each viewing. The website also enabled to give appropriate information on these public conferences. This tool met the public's expectation, given the various questions and feedback we received.

Awareness-raising tools in absence of wardens

Information signs
On the Isle aux Moutons, information signs on protection and regulations are found in various places, including at the top of the slipway, it being the main access point to the island. In addition to this sign, there is an information point above the colony. Besides the privileged observation of terns, this place provides information on five noticeboards about the different nesting tern species as well as other species present and of European interest [11].

Sailors who go ashore on the island thus have ample time to observe and learn about the life of terns, the designation of a reserve for the colony, protection mea-

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[7] Top: raising awareness of a kayaker near the Isle aux Dames.

[8] Middle left: surveillance of the Isle de la Colombière by boat.

[9] Middle right: information station at the Taureau Castle.

[10] Opposite: general public conference and viewing of the film on roseate tern

sures, the various actions developed within the framework of the LIFE roseate tern programme, conducted by Bretagne Vivante.

For other sites, information and regulations notices are displayed in the main ports of embarkation close to the islands where terns are found [12] [13].

Brochures

Public awareness-raising also involves the distribution of information brochures about the LIFE programme. These brochures describe the various species and the conservation measures that are implemented. They include a specific sheet for each site. These documents are distributed in the port authority offices, yacht clubs and tourist offices. A plastic coated brochure is also available for sea-users. It helps to identify sea birds. This tool is much appreciated by those who sail alongside tern sites [14].

Website

The LIFE programme has had its own website since spring 2007: www.life-sterne-dougall.org. It is useful for promoting our actions, seeing live terns, viewing recent information and recruiting eco-volunteers to monitor and protect the colonies.

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[11] ***Information station on the Isle aux Moutons.***

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[12] ***Sign on port of Stellac'h.***

Conclusion

All of these tools obtain good feedback from a majority of people provided that wardens take time to explain the stakes related to the protection of the sites and terns. Communication is an important factor towards successfull integration of protective measures among local or visiting population. It also enables to avoid local conflicts between those who share the same territory but not the same use of it.

If these measures apply well to a non-professional public, it is not so true for sea-linked professionnals. Approaching this public is more difficult and induces specific and better targeted actions.

It is also important to note the public's very high interest in the conferences. They provide an opportunity for people to meet passionate and fascinating specialists, and to ask countless questions that sometimes stray from the "tern" subject but are often very relevant.

The presence of a warden in the colonies appears to be a strong element in favour of the preservation of terns. Their triple role as the person in charge of monitoring, surveillance and public awareness-raising ensures the actual mediation between protection requirements and a sometimes inquiring public.

Yet it is important to bear in mind that the absence of effective assessment tools does not provide an objective and quantifiable view of the impact of all the actions implemented in the LIFE programme.

Bretagne Vivante

[13] ***Sign on the Isle du Petit Veizit.***

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Brigitte CARNOT is warden-educator on the Isle aux Moutons
brigitte.carnot@bretagne-vivante.org
Paskall LE DŒUFF is educational coordinator for Bretagne Vivante
paskall.ledoeuff@bretagne-vivante.org

Issues regarding the conservation of roseate tern in the French West Indies

Lionel DUBIEF & Gilles LEBLOND

L. Dubief

J.-P. Rivière

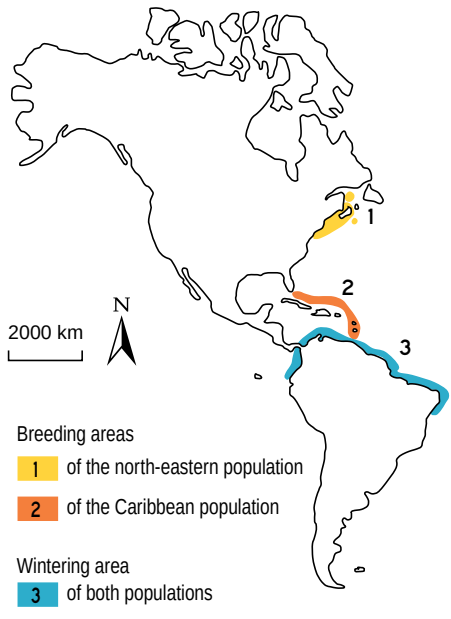
Roseate terns of Martinique and the Guadeloupe archipelago belong to the subspecies *Sterna d. dougallii*, which is found across the entire Atlantic Ocean. This subspecies includes two population groups along the American coasts:

- one part of the population is located in the United States (New York State) and in Canada (province of Nova Scotia) and comprises 3,000 to 4,000 pairs (Gochfeld *et al.*, 1998; Delany & Scott, 2002). The U.S. Fish and Wildlife Service consider it an "Endangered" population;
- the second population is located in the Caribbean Sea and comprises 3,500 to 7,100 pairs (Bradley & Norton, 2009). The U.S. Fish and Wildlife Service consider it a "Threatened" population and it is the subject of a restoration plan since 1993 – the "Caribbean roseate tern recovery plan" (Saliva, 1993) [1] [2].

In the Caribbean, the last census of seabirds lists 18 colonies comprising 2 pairs to 2,300 pairs (Bradley & Norton, 2009). Five colonies reach or exceed 400 pairs: in the Bahamas (800 to 900 pairs), in Puerto Rico (935 to 1,000 pairs), in the British Virgin Islands (500 to 2,300 pairs), in the U.S. Virgin Islands (600 to 2,000 pairs) and in Martinique (400 pairs; Dubief, 2007) [3]. It can be noted that the breeding season is identical to that of Europe, from May to August, with a hatching peak in June-July.

Roseate terns of the French West Indies

The French West Indies are located in the Lesser Antilles archipelago between the 14th and 18th parallel north. They



[1] *Distribution of roseate tern populations of the Western Atlantic (from Calkins & Amirault, 1999).*

V. Lemoine

[2] ***Roseate tern.***

include the northern islands (Saint-Martin and Saint-Barthélemy), the Guadeloupe archipelago (Grande-Terre, Basse-Terre, Marie-Galante, la Désirade and les Saintes) and the Island of Martinique.

Martinique colonies

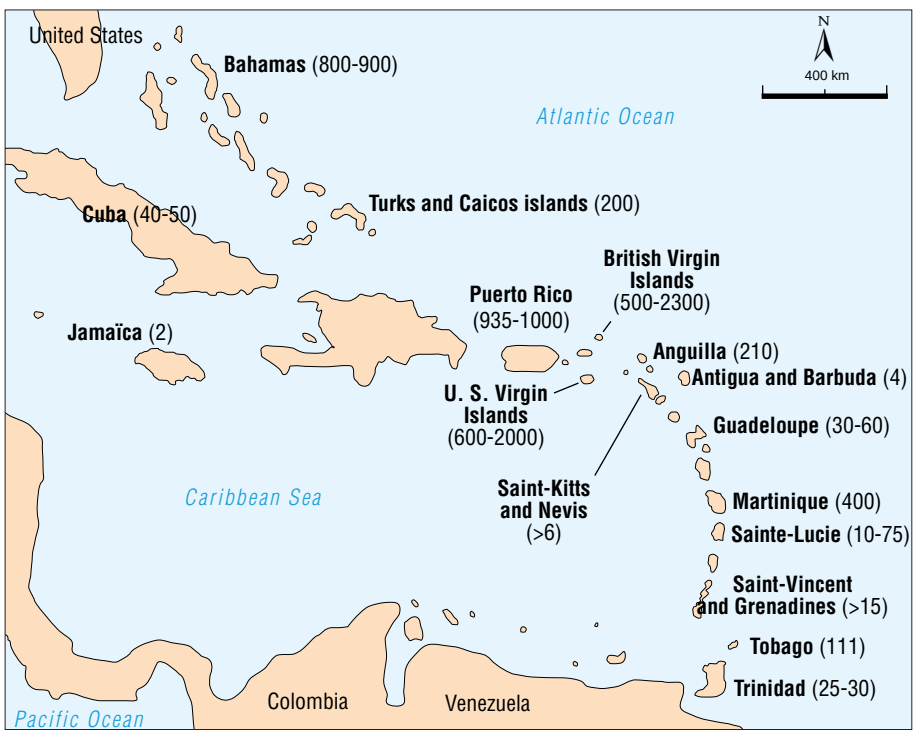
On the Atlantic seafront, four sites are used by two colonies, depending on the year. The two most occupied sites are Boisseau Islet in the bay of the locality of Robert and the Pain de Sucre peninsula in the locality of Lorrain.

Two other sites are apparently used as alternative sites, i.e. Petit Piton Islet (next to Boisseau Islet) and Sainte-Marie Islet in the locality of Sainte-Marie **[4]**.

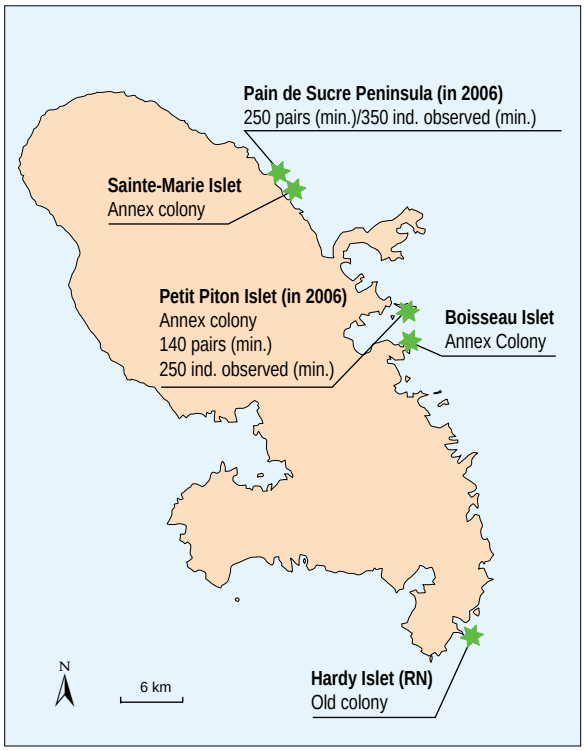
The only census currently published refers to 2006 (Dubief, 2007). Despite its non-exhaustive nature, it can help to estimate the population of Martinique at 400 pairs at least, 250 on the Pain de Sucre peninsula and 150 on the Petit Piton Islet (in 2006, year of the census, the colony did not settle on Boisseau Islet but on Petit Piton Islet, a substitute site for Boisseau).

No annual monitoring is carried out besides the location of colonies and there are thus no data regarding breeding success or population dynamics.

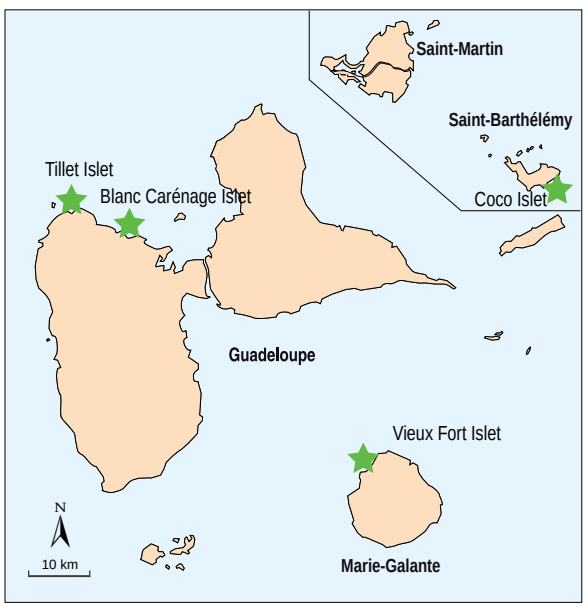
Petit Piton Islet, Sainte-Marie Islet and the Pain de Sucre peninsula are managed by the National Forests Office (ONF) within the framework of the "50 geometric steps" law (the first 80 metres of coast are integrated into the State Private Domain for 50% of Martinique's coastline). Boisseau Islet is managed by the Conservatoire du Littoral. A prefectoral decree for biotope protection (APPB) applies to Boisseau and the Pain de Sucre.



[3] ***Distribution of the roseate tern population in the Caribbean Sea, in terms of pair numbers (from Bradley & Norton, 2009).***



[4] ***Location of roseate tern colonies in Martinique. In 2006, at least 250 pairs bred on the Pain de Sucre peninsula and 140 on Petit Piton Islet.***



[5] ***Roseate tern colonies location map for Guadeloupe.***

Although these measures facilitate the sustainable protection of the sites against all forms of urbanisation, they are however inadequate to reduce threats related to predation or disturbance by human activity.

Guadeloupe archipelago colonies

In Guadeloupe, two sites are occupied by one same roseate tern population on a regular basis: Blanc Carénage Islet (0.5-ha sand islet) and Tillet Islet (1.5-ha volcanic islet, still called Tête-à-l'Anglais Islet) [5].

On Blanc Carénage Islet, the anthropogenic tree vegetation developed significantly, making the site less attractive to roseate tern and favouring the presence of predators. The vegetation cover of Tillet Islet mainly comprises herbaceous and cactaceous plants. Around forty pairs evolve on both sites (Mege, 1998; Leblond, 2000, 2009a). Historically, roseate tern was recorded in Marie-Galante on Vieux Fort Islet (Bénito-Espinal, 2003) and on Saint-Barthélemy (Bénito-Espinal, 2003; Leblond, 2003). Associated nesting species are least tern (*Sternula antillarum*) for Blanc Carénage Islet and sooty tern (*Onychoprion fuscata*), bridled tern (*Onychoprion anaethetus*) and brown noddy (*Anous stolidus*) for Tillet Islet. The Guadeloupe National Park will designate the Grand Cul-de-Sac Marin Nature Reserve – including the aforementioned Islets – as "core area", which should favour the improved monitoring of the colony [6] [7].

Predation-related issue

Martinique colonies

The disastrous effects of predation by black rat (*Rattus rattus*) on seabirds are known in Martinique due to the various rat-extermination operations carried out in the Nature Reserve of Sainte-Anne Islets (Brithmer, 2002; Pascal *et al.*, 2004; Raigne, 2006). Black rat and mongoose (*Musculus musculus*) probably have the same impact on roseate tern colonies even though no actual proof was sought in the past ten years (such as the decline in breeding success). Nonetheless, many failures in breeding have previously been recorded such as:
- in 1998 or 1999, desertion of the Pain de Sucre colony in favour of Sainte-Marie Islet (C. Moyon, pers. comm.);
- in 1998 or 1999, neglect of eggs on Boisseau Islet and Petit Piton and

G. Leblond

G. Leblond

[6] ***Blanc Carénage Islet ;*** **[7]** ***Tillet Islet.***

observation of predated eggs (C. Moyon, pers. comm.);
- in 2005, desertion of the colony on Boisseau Islet in early May, observation of predated eggs and transfer to Petit Piton (L. Dubief, G. Montdésire, J.-F. Maillard, pers. obs.);
- in 2009, desertion of the colony on Boisseau Islet in early July and observation of predated eggs (L. Dubief, W. Belhumeur, pers. obs.).
Rat or mongoose droppings were thus searched for and found on each of these 4 sites.

As regards rat extermination actions, only one 5-day trapping operation could be conducted by SEPANMAR on Boisseau Islet in 2006, though unsuccessfully.

Complete rat extermination should be operated on Boisseau and the neighbouring Madame Islet in 2010, as ordered by the Conservatoire du Littoral.

Finally, another aspect of this issue is the sites' potential or definite re-infestation by predators following their era-

L. Dubief

[8] ***Petit Piton Islet, breeding site for roseate tern.***

dication, due to their direct connection to the coast (Pain de Sucre, Sainte-Marie Islet) or their nearness to Islets visited year round and hosting major rat populations (Boisseau, Petit Piton).

Guadeloupe and Saint-Barthélemy colonies

On breeding sites of Guadeloupe, two types of predators can be distinguished: natural predators and invasive predators, such as black rat. Natural predators are mainly birds: yellow-crowned night heron (*Nycticorax violacea*) can prey on adults and chicks, laughing gull (*Larus atricilla*) on chicks, ruddy turnstone (*Arenaria interpres*) on eggs and peregrine falcon (*Falco peregrinus*) – observed on Coco Islet in Saint-Barthélemy – on adults. Theoretically, black rat is only found on Blanc Carénage Islet since 2008. Its presence is related to the high activity of summer visitors around the Islet and to the important development of vegetation. Proliferation of crab (*Gecarcinus* sp.) can also lead to the disturbance of brooding birds, as well as spatial competition with sooty tern. The latter factor may account for the lack of nesting for roseate tern on Vieux Fort Islet. In Saint-Barthélemy, on Coco Islet, potential predators are yellow-crowned night heron, peregrine falcon and perhaps rat.

In order to reduce predation and favour the development of the roseate tern colony, several solutions are under consideration by the Guadeloupe National Park: deforestation and clearing of part of the vegetation on Blanc Carénage Islet, implementation (on this same Islet) of developments that would favour nesting and creation of a nesting platform and/or Islet.

Human activity-related issue

After predation by invasive species, human activity is probably the most important source of disturbance to colonies with the development of water activity (boat, scooter, etc.) and of green tourism (kayak, pedal boat, etc.), which make nesting sites more accessible.

Martinique colonies

The actual impact of disturbance by human activity remains unknown because of lack of monitoring, yet the nume-

rous failures in breeding mentioned in the previous chapter may likewise be related thereto. This issue must however be urgently dealt with due to the extreme vulnerability of tern colonies to disturbance by human activity and to the general lack of surveillance of Martinique colonies (except on Boisseau).

Status report on Boisseau Islet:
- access is usually forbidden by an APPB from April to September;
- surveillance by coast wardens based on Madame Islet, 300 m away;
- traces of fishermen's visits, yet few of them;
- sailors' mooring close to the Islet. Boisseau Islet is close to Madame Islet (300 m), which has much tourist appeal and is located in the bay of Robert visited by countless sailboats.

Status report on Petit Piton Islet [8]:
- no surveillance;
- 150 m away from La Grotte Islet, inhabited year round;
- possible connection between Petit Piton and La Grotte on a narrow reef at low tide;
- probably visited by a few fishermen though apparently fairly rarely.

Status report on the Pain de Sucre peninsula [9] [10]:
- access is usually forbidden by an APPB from April to September;
- no surveillance;
- regular activity of fishermen and other regular visitors to the site.

Status report on Sainte-Marie Islet:
- accessible via a sand tombolo part of the year (approximately April to August);
- no surveillance;
- regularly visited by locals (landscape and historic appeal of the site) and fishermen;
- development project of the ONF and the locality to open and protect public access and promote its historic and landscape interest. The fact that the colony must be taken into account was integrated into the project, yet the colony is exposed to risks in terms of its sustainable maintenance in this site due to visits to this Islet without surveillance.

Only active surveillance throughout the breeding season and an effective awareness-raising campaign will help reduce the impacts of human activity on roseate terns of Martinique.

Guadeloupe and Saint-Barthélemy colonies

Only one site is exposed to intensive activity, Blanc Carénage Islet, due to its easy access: it is located in a lagoon close to the coast. Despite the prohibition on disembarking on the Islet from 1 May to 31 August, the birds are disturbed due to discontinuous surveillance during this period. On other sites, with no control and no prohibition, activity seems more occasional, especially during Easter and All Saints' holidays. Egg-poaching operations are not excluded on Tillet Islet and Coco Islet. There is another source of disturbance to the colonies: craft generally power-driven going past or moored close to the colonies, which can frighten the birds and prompt them to desert the site.

In order to reduce this disturbance, several decisions must be made:
- prohibition on disembarking on Islets all year round or according to the season, depending on the context;
- development of a marine protected area (100 m) around the Islets to reduce water traffic;
- continuous surveillance of occupied sites to avoid shoring and poaching during the breeding season;

D. Belfant

D. Belfant

[9] [10] ***Proof of activity in the midst of the Pain de Sucre peninsula colony in September 2009: fishing rod pole and clothes drying in the sun.***

- information to users, prior to and during the breeding season, on the reasons for protecting this species and its habitat.

Further conservation issues
In Martinique and Guadeloupe, all sites hosting seabirds belong to the State and are thus no longer threatened by new housing projects. In Saint-Barthélemy, some Islets are still private and there is no coastal law. Food resources for terns depend on the types of craft and on fishing pressure around the colonies, as well as on the impact of the various types of marine pollutions. Regarding this last point, food selectivity of roseate tern (Shealer, 1998) can be a disadvantage. Egg poaching still seems to occur and climatic hazards (very high rainfall, cyclones) also have a definite impact.

Gaps and prospects
Due to the lack of monitoring, threats and means to reduce them are poorly known. In 10 years, only two APPBs were implemented and a single census carried out in Martinique. There are no effective dynamic of nature conservation in Martinique and ornithologists are inadequately trained. Moreover, there is an important turnover of ornithologists from Metropolitan France who only conduct isolated actions before returning to metropolitan France with no medium- or long-term monitoring. The few data collected are thus scantily or not disseminated.

The recent creation of a “seabirds” working group and of a regional action plan on seabirds by the DIREN / DREAL (Leblond, 2009b, 2009c) should facilitate the launching of the conservation dynamic. Furthermore, the management plan for the Sainte-Anne Islets Nature Reserve (2007-2012) dedicates part of its actions to reducing disturbance to seabirds in order to favour their peacefulness during the breeding season, and mentions roseate tern in particular as an example.

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Lionel DUBIEF is freelance ornithologist
dubief.lionel@wanadoo.fr
Gilles LEBLOND is project manager for BIOS Environnement
gileblond@wanadoo.fr

WORKSHOP 3

Migrations and wintering

- **Roseate tern in Ghana**
  Erasmus OWUSU

- **Migratory behaviour of roseate tern in Brittany and in the gulf of Morbihan**
  Matthieu FORTIN & Hélène MAHÉO

- **Movements, migrations and the metapopulations of terns using the western Irish Sea in late summer**
  Stephen F. NEWTON

- **Larid project and monitoring of roseate tern: new wintering sites in Senegal**
  Idrissa NDIAYE

- **Report on roseate terns' ring reading and ring recoveries in the bay of Morlaix**
  Bernard CADIOU & Yann JACOB

Roseate tern in Ghana

Erasmus OWUSU

Bretagne Vivante

The "Ghana Wildlife Society" is a non-profit, non-governmental organisation which seeks to conserve wildlife in all its forms and to integrate this conservation to ensure a better environment and improved quality of life for all people. The organisation currently develops and supports actions in the field of environmental education, communication, conservation, management and research, and advocates the sustainable use of natural resources and the environment.

Background

The observations made by British ornithologists of the Royal Society for the Protection of Birds (RSPB) highlighted the importance of migratory stopovers of roseate tern (*Sterna dougallii*) in Ghana and the need to take action towards its conservation. The "Save the Seashore Birds Project - Ghana" (SSBP-G) was then established by the signature of an agreement between the Ghana government and the International Council for Bird Preservation (ICBP) in June 1985 (Avery *et al.*, 1995). This project including four components – education, awareness-raising, conservation and development – prefigured the creation of the current "Ghana Wildlife Society".

Awareness-raising and education

This project led to the establishment, in 1987, of multiple "Wildlife Clubs of Ghana", nature conservation clubs for young people [1]. These clubs which are junior wing of the Ghana Wildlife Society use a variety of activities (excursions, camping, tree planting, music, drama, junior parliament, competition, etc.), to help increase knowledge and to raise awareness of the stakes related to the conservation of wildlife in schools and universities [2]. On this occasion, the

Ghana Wildlife Society

[1] ***Opening of a "Wildlife Club of Ghana", an essential awareness-raising and educational tool.***

Ghana Wildlife Society

[2] ***Junior environmental parliament established by the "Wildlife Clubs of Ghana".***

Ghana Wildlife Society

[3] ***Roseate tern being captured by a child. This picture illustrates the origin of organisations' motives for getting involved in the "Save the Seashore Birds Project - Ghana" (SSBP-G).***

awareness of the local communities that practice trapping and killing of seabirds, including roseate tern, is raised **[3]**. Such platforms are also used to communicate the need to save such important species of global conservation concern.

Seabirds in Ghana

Research and monitoring actions are also developed in order to seek resting and feeding areas for terns in Ghana, and the coastal environment is kept clean to improve habitat quality for roseate tern.

The monitoring of seabirds conducted by the "Ghana Wildlife Society" team, with support from British ornithologists in November and January 1986, has facilitated the identification of 13 sites of importance to coastal birds. Six of them – Keta lagoon, Songaw lagoons group, Sakumo lagoon, Densu delta and Panbros salt marshes, Muni lagoon and Esiama beach – are known to shelter significant seashore bird populations and are currently assigned the Ramsar convention status for sites of international importance **[4]**.

Eleven tern species can be observed along the coasts of Ghana. Four species – common tern (*S. hirundo*), sandwich tern (*S. sandvicensis*), black tern (*Chlidonias niger*), royal tern (*S. maxima*) – represent 80% of the numbers observed, which can amount to 50,000 individuals. Roseate tern is much rarer, with a share of only 2% of these observations. Moreover, 42 species of waders, including 34 migrators and 11 with numbers of international importance, consider the Ghanaian coasts a key site. For 20 years, counts were successively carried out, showing monthly variations in terms of roseate terns' visits along the coasts of Ghana with maximum rates in the months of September, October, November and also January. In parallel, records of Wetlands International in Ghana mention the presence of 5 roseate terns in 1998, 274 in January 1999 including 242 in the Densu delta area, 656 in January 2000 including 625 in the actual delta, which was a near-exclusive area for this species' presence that year (Dodman & Diagana, 2003). 20 individuals were recorded in 2001 (Dodman & Diagana, 2003) and 483 in January 2002 for the entire country (Diagana & Dodman, 2006).

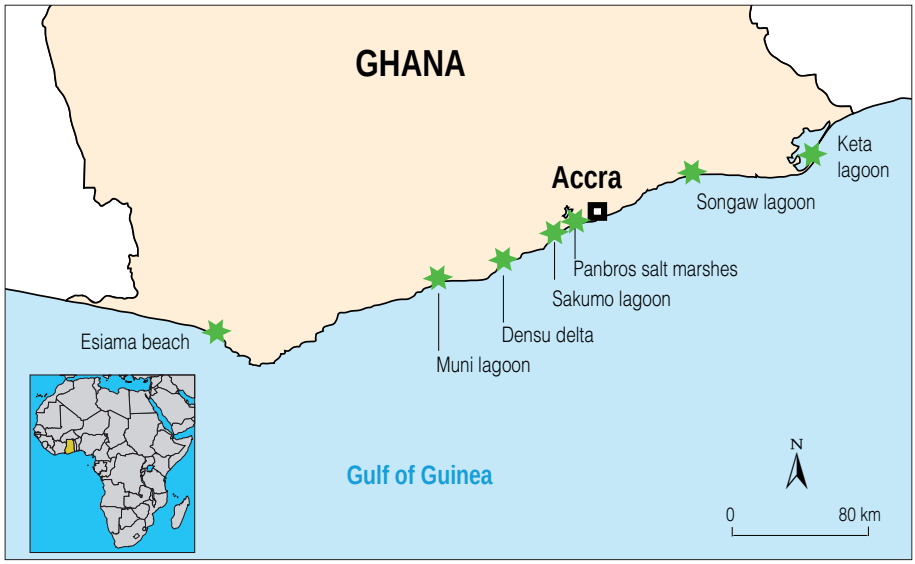
Benefits

The project, which initially focused on roseate tern, proved to have an outreach far wider than expected and largely contributed to general awareness-raising of the stakes related to the conservation of wildlife in Ghana. It provided major new information regarding the ornithological richness of the coast and wetlands of Ghana.

Furthermore, the project helped to develop skills in the fields of identification, monitoring and management of seabirds, as well as education and awareness-raising, in Ghana. Other countries of West Africa were thus able to take part in the training programme within the framework of the SSBP-G project and subsequent projects facilitated by the Centre for African Wildlife in collaboration with the Ghana Wildlife Society. The countries include: Nigeria, Togo, Sierra Leone, Liberia and Gambia.

Prospects

A new project is currently under consideration to establish a regional scheme for western Africa and the other countries within the sub-region are invited to get involved. However, the issue of fun-



[4] ***Location of the six sites of international importance listed in the Ramsar convention.***

ding conservation projects remains one of the main difficulties in such countries where stakes are nonetheless significant, in terms of wildlife as well as in terms of education and local development.

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Erasmus OWUSU is executive director for the Ghana Wildlife Society
erasmus67@yahoo.com

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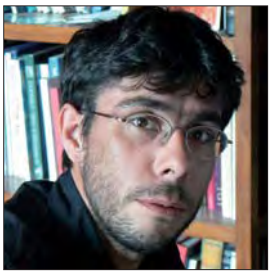
Migratory behaviour of roseate tern in Brittany and in the gulf of Morbihan

Matthieu FORTIN & Hélène MAHÉO



Bretagne Vivante

É. Drunat

Taking into account the entire biological cycle of a species is essential in drawing up a conservation scheme. This particularly applies to migratory birds. The quality of habitats visited on migratory routes or in wintering areas, in terms of peacefulness or food supply, can indeed be a stake as important as the maintenance of good breeding conditions for a threatened species.

Roseate tern is considered “rare” in Europe (Birdlife, 2004) and “critically endangered” at the scale of its nesting population in France (IUCN France & MNHN, 2008). Two population pockets are currently identified on the East-Atlantic scale: the Azores archipelago and Western Europe (Delany *et al.*, 2006). For this latter geographic area, most numbers (around one thousand pairs) are distributed between the Republic of Ireland and the United Kingdom. The French population, confined to northern Brittany, seems relatively marginal with around fifty pairs, i.e. 2% of European nesting numbers. Wintering sites known to date for this population are located in Africa, around the gulf of Guinea and particularly along the coasts of Ghana (Olsen & Larsson, 1995; Ratcliffe & Merne, 2002).

Brittany, and more generally the French Atlantic coast, plays a key part in the migration of many species of the European avifauna, especially waterfowl and seabirds (Bargain *et al.*, 2007; Delany *et al.*, 2009). For roseate tern, a number of sites have previously been identified in terms of their attractiveness quality during migratory seasons. The gulf of Morbihan is one of those sites (Gélinaud *et al.*, 2002).

The data sets available facilitate the descriptive synthesising of roseate tern’s migration in Brittany. We will thereafter consider the particular case of the gulf of Morbihan where more in-depth investigation was carried out in recent years.

Material and methods

Three main information sources facilitated the gathering of a considerable amount of data:
- ornithology journals of Brittany, especially *Le Fou* published by GEOCA

(Côtes d'Armor Ornithological Study Group) and *Ar Vran* published by GOB (Brittany Ornithology Group) (see enclosed list);
- reference to databases of various organisations such as Bretagne Vivante - SEPNB or the Morbihan GOB delegation, aimed at centralising field observations collected by part of the naturalist and bird-watching community of Brittany;
- recent monitoring implemented at the scale of the gulf of Morbihan within the framework of the LIFE programme "Conservation of the roseate tern in Brittany".

Several targeted observers were moreover approached in order to access yet unpublished data.

It is however necessary to put into perspective the data set used. The analyses carried out are based on available and easily accessible data. Complements will probably be required to refine the image of the species' migratory passage in Brittany for the period studied.

In order to eliminate the "noise" that could be generated by observations referring to the species' breeding colonies located in Brittany, data collected from mid-April to mid-July directly next to the colonies (such as in the bay of Morlaix) or in associated feeding sites were kept separate.

Description of migratory behaviours in Brittany

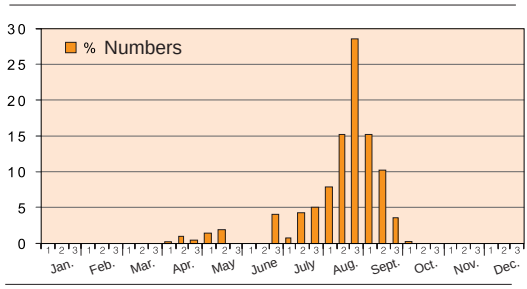
The analysis of the set of available data leads to the description of three features of roseate tern migration in Brittany:

1- The main part of the migratory passage occurs during post-breeding flights [1].

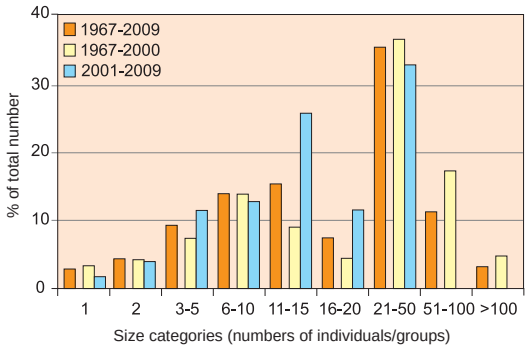
The vast majority of data are indeed associated with autumn migration (mid-July / late September); it is also during this period that the highest numbers are observed.

The passage peak is during the 3rd 10-day period of August, with more than 25% of the total number observed, and the 3 10-day periods between 10 August and 10 September add up to more than 58% of this number.

Pre-breeding migration remains very much unnoticed in Brittany (a few observations in April and May), and the



[1] *Chronology of the migratory passage of roseate terns in Brittany. The chart shows the distribution of numbers' abundance (percentage) from 1967 to 2009 by 10-day period. The data used were collected from 1967 to 2009. n=440 (n=181 for the 2000-2009 period).*

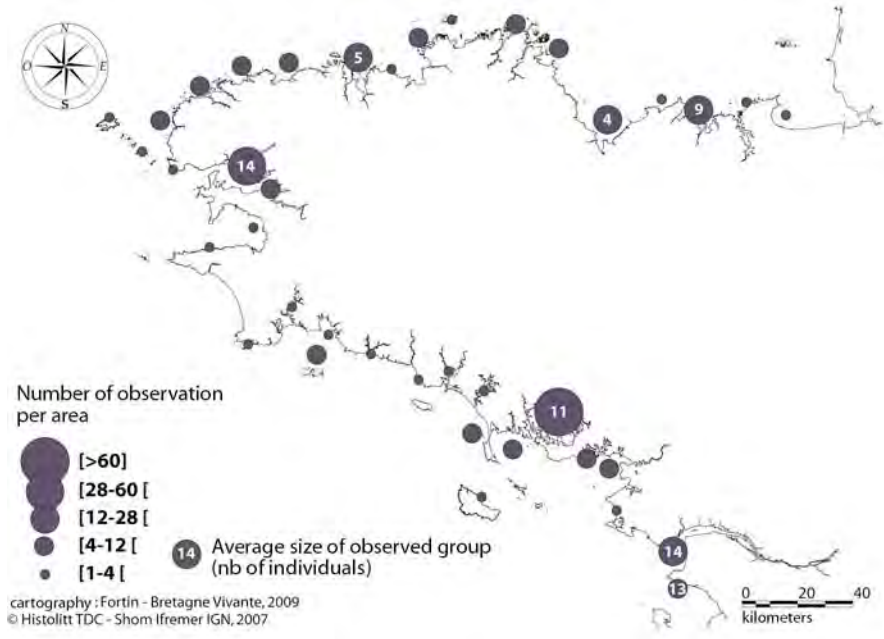


[2] *Size of migratory groups observed grouped into size categories and evolution between the 1967-2000 and 2001-2009 periods. The chart is stated in percentage of group categories in relation to total number observed. The data used were collected from 1967 to 2009, n=440 (n=169 for the 2001-2009 period).*

data available are mostly old and referring to Brest harbour. As regards these observations, it is difficult to distinguish migratory passage from local flights of the population nesting on Trevoc'h Island (north-western coast of Finistère) during this same period, which disappeared at the end of the 1980s (Coulomb *et al.*, 2008) and could go to Brest harbour to search for food. Though roseate terns visit Brittany's coasts in the spring, no noticeable bird passage or stay is reported.

2- The analysis of the size of groups observed shows some evolution over time [2].

Throughout the entire period (1967-2009), the number observed is half contingent on groups comprising more



[3] ***Geographic distribution of roseate tern observations from 1967 to 2009 according to number of observations made. Average size of groups is stated for important groupings.***

than 20 individuals. During the recent period (2001-2009), strong erosion in the frequency of large groups was observed. Though the [21-50] category is still prevailing, small or medium groups (3 to 20 individuals) now represent more than 75% of observations. The two largest categories (groups including over 51 individuals) have completely disappeared.

3- The geographic distribution of birds during post-breeding migration is fairly localised and a decrease in the number of sites visited over time at the scale of Brittany was recorded **[3]**.

The geographic distribution of data collected was recorded according to the division used within the framework of the OROM (Seabirds Regional Observatory) for the allocation and grouping of "seabirds" data.

The frequency of observations is not homogeneous throughout Brittany. In total, 41 zones are relevant to observations during the migratory season. Only 7 of them were subjected to more than 15 observations for the studied period. It is important to note that the monitoring of migrating roseate terns was never subjected to a dedicated regional survey. The data collected thus mainly tally with isolated observations made by field ornithologists, leading to strong variability in terms of geographic coverage or observation pressure.

The average size of groups observed per zone also varies and the observation of large groups can only be achieved in a few sites. For the most visited zones, the average number of individuals observed ranges from 3 to 14. Brest harbour is once again a particular case as it only refers to former data (previous to the early 1990s). The gulf of Morbihan alone represents 195 data with an average group size of 11 individuals, yet the intensification of monitoring since the early 2000s then within the framework of the LIFE programme "Conservation of the roseate tern in Brittany" accounts for this imbalance.

This combined information leads to the identification of 3 zones in Brittany likely to constitute migratory stopover areas: the bay of Lancieux, the gulf of Morbihan and the Loire estuary. It is moreover possible to identify other areas where observation efforts would need to be strengthened.

M. Fortin

Some supports, as these oyster-bed low wall are used by birds as resting places in the Kerdelan cove or at Pointe du Berchis.

Description of migratory behaviours in the gulf of Morbihan

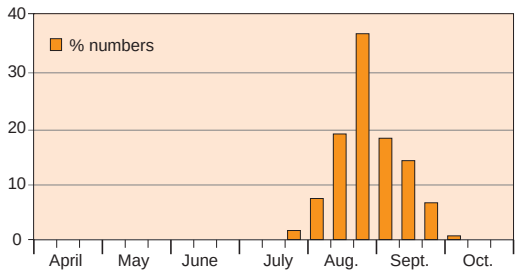
The first observations of roseate tern in the gulf date from 1969, however large groups were observed from the late 1980s. Since, the continuous – or at least regular – presence of large groups during the post-breeding migration period and the stay of birds for several days (as confirmed in the monitoring of ringed individuals) provide evidence to claim the role of the gulf of Morbihan as a migratory stopover. Roseate tern's affinity for the gulf was thus perpetuated over time, thereby maintaining this site's ornithological reputation.

The distinctive structural and ecological features of the gulf of Morbihan account for its attractiveness for migratory birds, and particularly roseate tern.

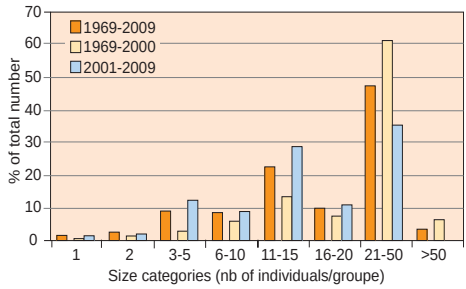
This enclosed sea, covering a total area of 11,500 ha, is connected to the ocean by tight narrows and its freshwater supply originates in three main rivers. The gulf is divided by several dozen isles and Islets. This layout produces an original hydrodynamism: channels, with rocky features characterised by strong tidal currents, follow shallow bays more conducive to sand or silt sedimentation. This results in a large mosaic of habitats. Though it is fairly enclosed (water mass flow at each tide, freshwater and nutrient salt inputs), it is a productive environment, known for instance as an important nursery and fattening area for fish. The strong presence of sand smelt (atherine family, *Atherina presbyter*), a potential prey for roseate tern, is particularly noted.

The chronology of roseate terns' passage in the gulf [4] is close to the regional pattern. A vast majority of observations and numbers refer to post-breeding migration. The period of presence however seems more restricted and observations are mainly made from late July to late September, with a peak of presence around the 3rd 10-day period of August. Observations related to pre-breeding migration are near-insignificant, and no recording were made since the 1970s.

The majority of birds observed are part of large groups [5]. For the entire period, groups larger than 10 individuals represent more than 75% of the total number observed. The [21-50] category alone adds up to 45% of the total number. The recent evolution illustrated by comparing observations between the [1969-2000] and [2001-2009] periods shows strong erosion of the large cate-



[4] ***Chronology of migratory passage of roseate terns in the gulf of Morbihan. The chart shows the distribution of numbers' abundance (percentage) from 1969 to 2009 by 10-day period. The data used were collected from 1969 to 2009, n=190 (n=128 for the 2000-2009 period).***



[5] ***Size of migratory groups observed in the gulf of Morbihan grouped into size categories and evolution between the 1969-2000 and 2001-2009 periods. The chart is stated in percentage of group categories in relation to total number observed. The data used were collected from 1969 to 2009, n=190.***

gories benefiting medium and small groups, just as on a regional scale. Although the [21-50] category is the largest, the 3- to 20-indvidual categories are significantly increasing and represent approximately 60% of numbers observed for the recent period. The strongest category (> 50 individuals) has completely disappeared.

Since the beginning of the LIFE programme "Conservation of the roseate tern in Brittany", observations have intensified in the gulf and a more elaborate monitoring protocol was developed from 2007. Global counts are thus carried out every 5 to 10 days throughout the migration season (early August / late September), providing an estimate of the number of birds present in the entire gulf. This census is completed with intermediate monitoring conducted on a more restricted geographic scale (most visited areas), which particularly facilitates the rapid identification of arrivals or departures of new birds. Moreover, a number of complementary data are recorded: precise locality of observation (associated with the site's morphology), age or activity of bird(s) present(s) – fishing, resting, flying.

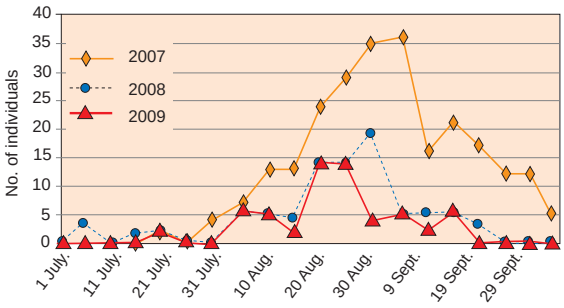
The aim of this monitoring is to describe the migratory passage and characterise the species' use of the environment during the migratory stopover. This study requires in-depth data analysis; however the first results obtained are available for presentation.

The migratory passage chronology is virtually identical for the years 2007, 2008 and 2009 [6]. The peak of presence ranges between 20 August and 10 September. In 2007, the period of presence of the species was however longer and included a larger number of individuals, with a maximum of 36 individuals recorded in early September. It is nonetheless currently impossible to explain the differences observed between the year 2007 and the years 2008 and 2009 (local causes depending on broader phenomena).

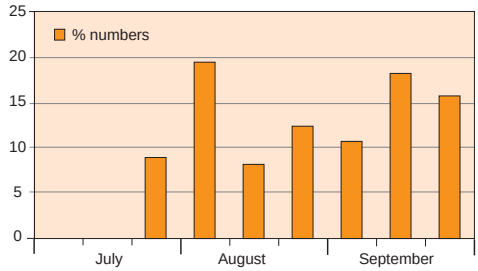
The age ratio calculated over the full three years shows that the groups comprise 12% young on average. The age ratio of the bird groups does not significantly vary during the season [7]. It thus seems likely there are no passages staggered per age category. Many young were moreover observed begging for food from adult individuals, thereby demonstrating that the learning phase still continues, at least partly, during migration.

From 2006 to 2009, most observations were carried out in the west of the gulf and 6 adjacent areas were mainly exploited by terns [8]. The geographic division used is that relevant to various avifauna monitoring operations in the gulf.

As regards bird activity, resting is largely in the majority and adds up to 63% of observations, as opposed to 32% for fishing and 5% for flying. We focused the activity analysis on the 7 areas most



[6] ***Migratory passage observed in the gulf of Morbihan in 2007, 2008 and 2009 on the basis of estimates of roseate tern individuals per day. n=133 (group size=1 to 36 individuals).***



[7] ***Age-ratio: evolution of percentage of young observed in groups during post-breeding migration in the gulf of Morbihan from 2007 to 2009 by 10-day periods. n=264 (group size=1 to 19 individuals).***

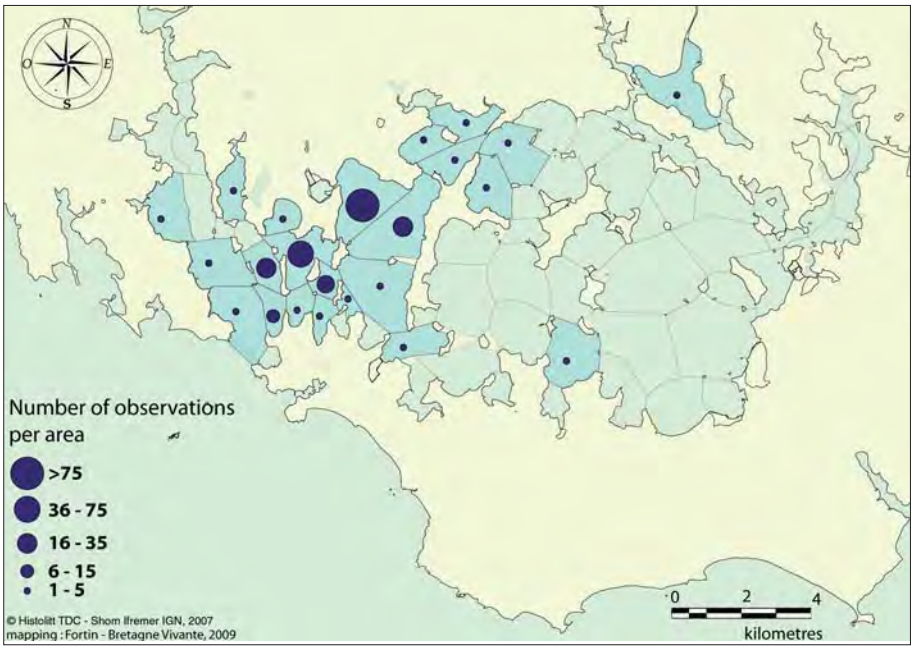
visited by the species. A high disparity is noted according to areas [9]. For instance, some sites are near-exclusively dedicated to a single activity (fishing or resting), which means the birds successively use several sites to meet their daily physiological needs.

It seems interesting to evaluate the number annually transiting through the gulf during post-breeding migration. There are several constraints that nonetheless emerge. Field observation pressure is important but not constant, and it is possible that bird groups in transit over short periods of time go unnoticed. It is also difficult to comprehend the average time of presence of birds during the migratory stopover, as the number of ringed birds observed is very low and poorly represents the groups monitored. It seems however problematic to individualise birds by other means in order to assess renewal among groups observed.

The set of available data for the 2006-2009 period can nevertheless be used to make a first estimate of the number of combined days of presence of the species. On the basis of the size of the population present for each full census,

M. Fortin

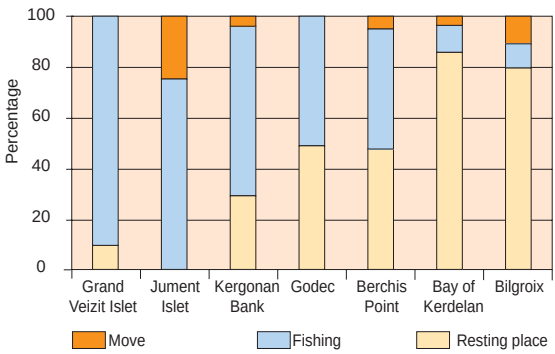
Another resting place: marking buoy.



[8] ***Geographic distribution of roseate tern observations in the gulf of Morbihan. The data used were collected from 2006 to 2009. n=389 (group size=1 to 56 individuals, total number of individuals=2,090).***

the number of "roseate days" can be approximately evaluated at 607 individual days per year.

It would be necessary to complete this approach, particularly as regards the birds' average time of stay, in order to estimate the total number of the population transiting through the gulf during migration. Currently, the time of presence recorded for ringed birds ranges from 1 to 21 days but does not exceed 6 days in most cases.



[9] ***Discrimination of activities observed in roseate terns according to geographic areas of observations in the gulf of Morbihan.***

Discussion / conclusion

These first analyses have highlighted the role of Brittany and the very particular importance of the gulf of Morbihan in the migration of roseate tern. It is however important to stress the fact that some reduction in numbers of birds and visited sites has been observed for several years during post-breeding migration in both Brittany and the gulf of Morbihan. Monitoring operations started in the gulf of Morbihan already provide an improved characterisation of the species' migratory passage, yet many questions remain, which will require further research.

According to the pace of activity (search for food…), it is first essential to identify the ecological requirements of terns during these migratory stopovers and to understand in what ways exploited sites meet these requirements. Are these sites exposed to threat or degradation and what are the possible impacts on roseate tern? Is it possible to take action for the conservation status of these sites with regard to roseate terns' requirements?

M. Fortin

The strong current area at the gulf entrance is one of the main areas where fishing activities were recorded.

Finally, the origin of birds observed during migration yet remains unknown. It seems that the numbers observed are higher than nesting numbers of the species in France. The rate of ringed birds observed is very low, which effectively excludes an origin of populations strictly restricted to Irish and British colonies, where the rate of ringed birds exceeds 90% of the population (S. Newton, pers. comm.).

Particular migratory behaviours were moreover recently described, including loop patterns, in the Irish Sea for roseate tern or in the North Sea for common tern, before a permanent departure to Africa, i.e. deviated courses in relation to general north / south migration routes (see article by S. Newton on migratory stopovers, this issue). Hence, what is the situation with the nesting population of Brittany? Where do birds observed in Brittany during migration come from? Is it possible that nesting populations of the Azores archipelago display such behaviours in the bay of Biscay, thus transiting through Western Europe before going back down to Africa?

In this regard, it is important to note that information on the presence of the species at sea in the bay of Biscay is particularly incomplete as, for the 1976-2002 period, there are but 10 observation data collected for roseate tern within the framework of standardised monitoring of birds at sea (Castège & Hémery, 2009). Further investigation hence proves to be essential. ■

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M. Fortin

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Matthieu FORTIN is a project manager at Bretagne Vivante
matthieu.fortin@bretagne-vivante.org
Hélène MAHÉO is curator of the Natural Reserve of Iroire
helene.maheo@bretagne-vivante.org

Movements, migrations and the metapopulations of terns using the western Irish Sea in late summer

Stephen F. NEWTON

Bretagne Vivante

This paper is an attempt to pull together and synthesise a series of miscellaneous observations of terns in the western Irish Sea, which, at first glance do not appear to be connected. The observations arose for a variety of reasons; some are given below:
- the general activity of birdwatchers and "twitchers" in the greater Dublin Bay;
- tern conservation action and monitoring at the small Dalkey Island colony;
- long-term ringing and re-sighting of roseate (and common) terns across northwest Europe;
- BirdWatch Ireland's concern over the impact of rapid development of offshore windfarms on the Irish east coast shallow water banks which are likely to be Important Bird Areas for foraging seabirds, including terns.

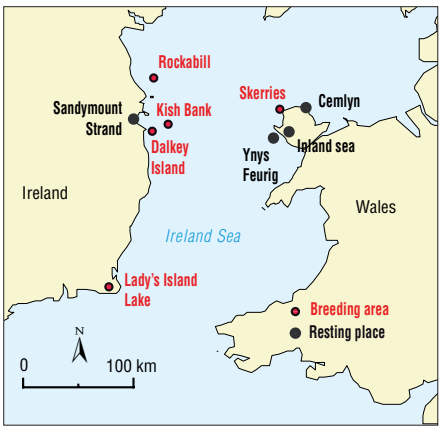
The east coast of Ireland supports relatively few, though often large, breeding colonies of terns – here I focus on those supporting roseate (*Sterna dougallii*), common (*S. hirundo*) and arctic (*S. paradisaea*) terns [1]. This is likely due to the rarity of islands off a largely "soft" shoreline and contrasts with the abundance of islands and smaller tern colonies in the west. In fact in the Republic, there are only four colonies, three in Dublin and one in Wexford. There are other large colonies of these species in Northern Ireland and on the Island of Anglesey in North Wales. Most specific locations mentioned in this paper are given [2].

Roosting observations at Sandymount Strand, Dublin City

Since the 1960s it has been known that terns fly into Dublin Bay to night roost in considerable numbers on the exposed sandflats at Sandymount Strand (Pettit, 1973; Newton & Crowe, 1999; Merne *et al.*, 2008). The phenomenon starts in late July and peak numbers are present between 20 August and 20 September; it is clearly a post-breeding congregation involving all three local breeding medium-sized tern species and often flocks include a high proportion of juveniles. Light conditions at dusk are rarely good enough to indentify species and age composition in all but a few birds at the edge of the flock nearest the observer. However, the regular presence of small numbers of black terns (*Chlidonias niger*) indicates that not all birds are of local origin and that terns are attracted to Dublin Bay from a large area of, presumably, northern Europe. On the basis of recent systematic counts (Merne *et al.*, 2008), peak numbers are about 10-12,000 though in 1996 20-30,000 were estimated. It is highly likely that there is a continual turnover of birds within the flock so overall numbers of terns using Dublin Bay

	Breeding pairs		Post-breeding population
Years	1999	2009	2009
Rockabill	1,300	3,200	11,200
Dublin Port	220	400	1,400
Dalkey	30	20 *	50
Lady's Island	850	1,000	3,500
TOTAL	**2,400**	**4,620**	**16,150**

[1] ***Breeding and post-breeding population sizes of three medium-sized tern species (all species taken together, roseate, common, and arctic terns) in southeast Ireland. Post-breeding population estimated as approximately 2 x number of pairs + 1.5 fledglings per pair. *colony failed in 2009.***



[2] ***Roseate tern colonies and post-breeding areas in Ireland Sea.***

as a post-breeding pre-migration staging area could be in the order of 30-50,000 individuals.

Dalkey Island

The Dalkey Islands lie at the southeast entrance to Dublin Bay. The number of breeding terns is rarely more than 50 pairs but late summer day-loafing numbers are often well in excess of this and include large numbers of roseate terns (before they were "encouraged" to nest at the colony). Cabot (1996) indicates that "upwards of a 1,000" can be present though more recently I have not seen more than 200 (Newton & Crowe, 1999). Observations of colour rings and field-readable metal rings indicate that roseate terns from Rockabill, Lady's Island Lake, Northern Ireland and Wales use/have used the site.

Kish Bank

This is a long thin sandbank that runs parallel to the coast about 10 km off the south side of Dublin Bay. A lighthouse at the north end has a helideck (landing pad for helicopters) and since 1996, roseate terns (and common) have been recorded resting there (MacLochlainn, 1996; Newton & Crowe, 1999). Foraging terns (all three medium-sized plus black tern) are present over the bank in August and September (Newton & Crowe, 1999).

Lady's Island Lake

Roseate, common and arctic terns usually arrive at this colony earlier in the spring than at Rockabill (150 km to the north). First eggs appear here about a week to 10 days before Rockabill. Most breeding terns and their fledged offspring (virtually all are ringed) depart from the colony by the end of July and a temporary aggregation of post-breeders and fledged young occurs at Nethertown Beach approximately 3 km to the east, very close to Carnsore Point, the very southeastern "tip" of Ireland.

Rockabill

All roseate tern pulli are ringed at this colony and since the early 1990s a

From left to right: Maiden Rock and Dalkey Island, Lady's Island lake and Rockabill Island.

second field-readable metal ("special") ring has been applied. Reading these special rings has provided considerable information on survival rates (Ratcliffe *et al.*, 2008), natal site fidelity and movements between colonies and has supported the contention that northwest European roseate terns comprise a metapopulation. In most years fledged young and their parents from Lady's Island Lake appear on Rockabill in late July and early August. At this time there is usually a sudden rise in the number of new ring read roseate terns, perhaps from an average of two per day to 20. These could be birds from "hard" to monitor areas of the colony, or due to increased ring reading efforts, but equally, and more likely, represent an influx of "new" birds. Common terns bearing single national rings are also read on the island and though the majority are of local origin, occasionally some birds with colour ring combinations or non-BTO rings appear. These are virtually always seen in late July and early August and have, for example, included birds ringed in Norway, Finland and Teesmouth in eastern England; the latter site is also known as a post-breeding staging area (Ward, 2000; Ward *et al.*, 2004). In some cases, some "phenotypically different" common terns appear with darker red bills and legs compared to local birds (L. Glenister, pers. comm.); some of these carried SAFRING rings (South African Bird Ringing Unit). Such individuals could have bred and eluded detection on the island but often their appearance coincided with an apparent influx of birds from elsewhere. Some Rockabill raised (and ringed) birds have been caught in Namibia and we have ring read others from there too.

Synthesis

Four species of tern appear to make regular post-breeding migrations to the Dublin Bay area. In the case of roseate terns some, including those from Lady's Island Lake, are making a significant northward movement diametrically opposed to their eventual autumn migration direction (south). For common terns there appears to be a significant influx from breeding areas substantial distances to the east (North Sea and Baltic Sea) and some of these birds may also use a staging area at Teesmouth. The nearest breeding area for black terns would appear to be The Netherlands and thus those that appear in Dublin Bay could have moved in a northwesterly direction. The origins of arctic terns using Dublin Bay are not known. These are the least numerous of the three local breeding species in southeast Ireland but they are more numerous in Anglesey (Wales) colonies such as The Skerries and Ynys Feurig. However, in 1996 when there were possibly 30,000 terns of which the majority were arctic, then the source areas perhaps included northern and western Scotland and maybe further afield (Iceland?). A non-breeding concentration of arctic terns has been described in the central North Sea (Camphuysen & Winter, 1996). The presumed attraction of Dublin Bay must be related to an abundance of small prey fish – sandeels (*Ammodytes* spp.) and/or sprat (*Sprattus sprattus*) – though there are no fisheries data to test this assumption. The birds presumably forage over the Kish and nearby Burford Banks and possibly the Bennet Bank off the northern

entrance to Dublin Bay. Information on seabird distribution over the Kish Bank has been collected by the offshore wind energy industry as part of Environmental Impact Assessments and the release of these data into the public domain will further the understanding of post-breeding movements into the Dublin Bay area. The application of geolocator tags to breeding terns in northern Europe will also increase our understanding of post-breeding and pre-migratory movements.

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Stephen F. NEWTON is senior conservation officer with BirdWatch Ireland
snewton@birdwatchireland.ie

Larid project and monitoring of roseate tern: new wintering sites in Senegal

Idrissa NDIAYE

Larids (gulls, terns, skimmers, etc.) are mainly piscivorous seabirds very much present on the West-African coasts where they feed, winter or nest. The West-African coasts are full of fish, which accounts for the presence of large larid colonies during breeding season in the so-called upwelling area located on the Atlantic coast of north-western Africa ("Sahelian upwelling marine ecoregion" - SUME).

These birds generally breed on remote islands or peninsulas to avoid land predators. Available information regarding the numbers and distribution of the various larid species on the West-African coasts are still limited. This particularly applies to roseate tern, a species very seldom observed on the West-African coasts where it mainly feeds on sardinellas. European birds spend the winter in the gulf of Guinea, mainly in Ghana. In Senegal, the recovery of two British subjects was achieved in Dakar in October and June 1966 (Morel & Roux, 1966; Ratcliffe & Merne, 2002).

Status report

Visited sites are located from northern Senegal to the south of the country. The methodology used to monitor roseate tern in parks and reserves is ground count. Censuses were carried out on an annual basis in January with count activities commonly called "International Waterfowl Census in Africa" (Dodman & Diagana, 2003; Diagana & Dodman, 2006) by counting teams. Over the 1999-2004 period, no observation of roseate tern is reported for Senegal in these assessments. In the recent period, isolated observations provided records of the species in different areas (I. Ndiaye, pers. obs.): 1 individual in Djoudj park in January 2003, 1 individual in Ngor (Dakar) in December 2006, 1 individual in Cap Skirring in January 2007, 2 individuals in the Saloum Delta in January 2007 and 1 individual in the Rufisque area in February 2008 [1].

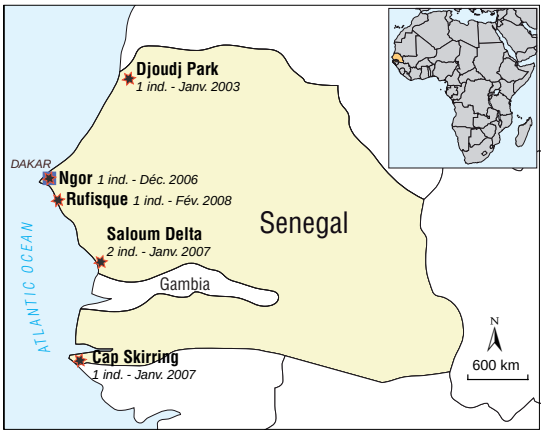
Further data were collected in seawatching sessions carried out in Dakar in October since the 1990s (Dubois *et al.*, 2009). Numbers observed range from 0 to 29 individuals, with a record number of 49 individuals in 2008 (Dubois *et al.*, 2009).

Threats in wintering areas

Mortality in young after egg-laying is the main threat affecting the species in the Caribbean and East Africa. In the northeast of South America and in West Africa, adults in their wintering sites are captured by man with nets and hooks for food. This alarming practice is the cause of decline in numbers in these areas (Del Hoyo *et al.*, 1996).

Conclusion and recommendations

It is important to note that there are no annual and regular censuses of roseate



[1] ***Location map of roseate tern observation points (I. Ndiaye, pers. obs.).***

tern in its wintering sites as it is very poorly known in Senegal and other West-African countries. Counts of larids and other waterfowl are organised annually most often in protected areas and on a voluntary basis. The irregularity of censuses is also due to the lack of financial means and to political instability, which are major obstacles to increasing knowledge of these wintering sites and of actual numbers. All projects will thus need to be actively supported and managed by the authorities of each country (Ministries of Environment, Departments of Water Affairs and Forestry, Administrations of National Parks and Reserves, etc.) for the monitoring and protection of the species.

In order to increase knowledge of wintering areas, census activities at the scale of the entire West-African coast must be broadly conducted. The creation of a network for the monitoring and systematic census of roseate tern in all countries of West Africa and the gulf of Guinea would facilitate field surveys (training of the various network members in monitoring) and ringing campaigns. Moreover, the identification and protection of wintering and breeding sites of other larids with which roseate tern shares the same habitat would also be a means of protecting the species. In parallel, awareness-raising activities for school children and populations living close to coastal sea-areas would contribute to increasing knowledge of the species and of its ecology towards enhancing its protection. Finally, exchange visits between the Senegal larid network members and European nature conservation organisations would facilitate the exchange of essential information for the conservation of roseate tern.

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Seydina Issa Sylla, former director of Wetlands International; Eddy Wymenga and Altenburg Ecologisch Onderzoek; Bretagne Vivante and more specifically Gaëlle Quemmerais-Amice and Yann Jacob; Jean-Jacques Guitare, LPO; Administration of National Parks; Patrick Triplet and Vincent Schricke from the ONCFS; Nik Borrow.

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Idrissa NDIAYE is freelance ornithologist
idrissawestafricaspoonbills@yahoo.fr

Report on roseate tern's ring reading and ring recoveries in the bay of Morlaix

Bernard CADIOU & Yann JACOB

É. Drunat

J.-P. Rivière

Whatever the species considered, bird banding facilitates the collection of information on migrations and wintering areas, on fidelity to natal site or breeding place, and on many other aspects of their biology. The acquisition of this knowledge by banding usefully contributes to the conservation of studied species (Anderson & Green, 2009).

As regards roseate tern in Europe, given that there are few colonies with low numbers, bird marking is important for collecting data on the recruitment of young individuals and identifying exchanges between colonies, and also for getting feedback from wintering areas (Avery *et al.*, 1995; Stienen et al., 1998; Ratcliffe & Merne, 2002; Ratcliffe *et al.*, 2008).

Marking method

In addition to the metal ring traditionally affixed to birds (bearing a number and details of the Museum for the country it is related to), a second metal ring has been used in Europe (Ireland, Great Britain, Azores and France) since 1992, as well as elsewhere in the world. This special roseate tern ring comprises a 4-character alphanumeric code displayed twice and legible from a distance (up to 25 m in good light). It is equivalent to the engraved plastic rings used for many bird species. Rings are provided by CRBPO (French ringing scheme) and BTO (roseate special rings). In the vast majority of cases, the chicks are ringed before fledging, yet in some colonies, adults are also captured to be ringed (Casey *et al.*, 1995; Hays *et al.*, 2002; Ratcliffe *et al.*, 2008).

In Brittany, the first ringing operation took place on the Isle aux Dames in 1993 (19 chicks ringed), however there was no follow-up as the Bretagne Vivante team in charge of the management of the reserve at the time considered this activity caused too much disturbance to birds. Ringing was then planned again within the framework of the LIFE programme "Conservation of the roseate tern in Brittany". However, since the programme was launched, the operation was impeded in 2006 due to the absence of roseate tern in the bay of Morlaix and in 2008 due to predation by mink. Only 7 chicks were successfully ringed in 2007 and 28 more in 2009. An important point regarding the Isle aux Dames colony: visits must be

H. Ronné

Ringing of roseate tern chicks on the Isle aux Dames in June 2009.

planned during the best period in order to capture the greatest number of chicks in the least amount of time while minimising disturbance to roseate terns and other species, particularly sandwich terns that are earlier in their breeding. Observations of the first food provisioning by adults to chicks are thus especially significant. The ringing operation requires the presence of at least four people: a pilot who drops off the team on the island and remains on board the boat, one person to locate the chicks, one person to ring and measure them and one person to take notes. The time of presence within the colony is restricted to about 20-30 min to reduce disturbance, hence the importance of preliminary observations to locate the areas where chicks are actually present.

Ring reading and recoveries

Reading rings from a distance can be done directly in the colony by taking cover in a hiding place or on the shore at low tide while birds gather there in clubs (areas where displays and social interactions between young individuals take place) or for roosting and preening.

Though the camera set up on the Isle aux Dames within the framework of the LIFE programme facilitates the location of ringed birds, the image quality in zoom shots is however insufficient to read the ring numbers. It is possible to use the hide underneath the camera. A blind screen can also be temporarily attached to the solar panels in the east, with the observer concealed beneath the panels. However, the issue of a more complicated access has arisen since the fence was erected around the colony.

On the shore, the access is easier. In order to approach the birds close enough while not making them fly off, three techniques were used: approach in the open without the boat, approach under cover using a mobile blind and approach in the open with the boat. With the first technique, inspections cannot be carried out without disturbing the birds. The latter can be approached at a short distance for a few minutes, from which the rings can possibly be read but, due to the birds' level of stress, the slightest warning caused by a gull flying by or any other event results in the terns flying away then landing out of the observer's reading range. The birds can be approached very closely with the mobile blind, and they may even land on it! The observer, wearing waders, is dropped off on the shore at falling tide with the blind, a pair of binoculars, a telescope, a camera and a notebook. He/she follows the ebb tide then the flood tide, approaching the terns that land on the shore. Visibility, mobility and comfort in observation during the 3 to 4 hours spent this way are not as great as in the approach next to the boat. With this third technique, birds can be approached fairly close without them flying off and rapid moves are possible in case the terns change position due to water-level variations or to any kind of alarm. In the event of the terns flying away, they will come back and land next

Y. Jacob

Roseate tern 87R6 ringed in Rockabill in 2005 and observed on the shingle bank of the Isle aux Dames in 2008.

to the boat, apparently unconcerned about the observer's presence, this being unpredictable with the mobile blind and never occurring if the observer is isolated. The approach by staying next to the boat was thus used for most ring-reading sessions. The observer, wearing waders, kneels in several dozen centimetres of water with the boat nearby. He/she still has a complete visual field of observation and can move according to the terns' position on the shore.

While inspections carried out in the colony generally provide information on the birds' status, whether breeders or not, inspections done on the foreshore do not reveal whether the birds observed are local breeders, prospectors seeking a future breeding site or birds merely passing through.

The main problem remaining is that of partial readings of the 4 characters on the special roseate tern ring, as the birds are most generally only seen once (Newton & Crowe, 2000).

Besides these visual inspections on the foreshore or in the colony, the recovery of rings obtained during the examination of dead birds following cases of predation by mink provides another source of data.

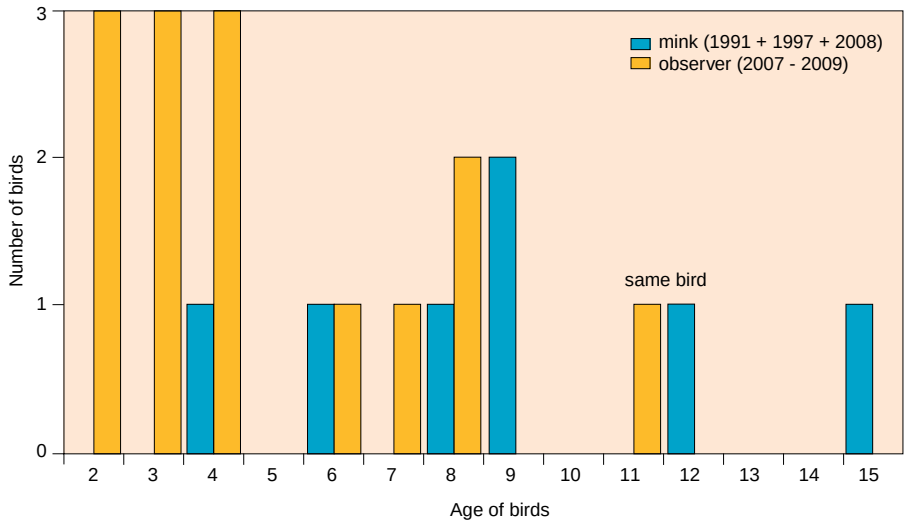
Report of data collected in the bay of Morlaix

In 1991, 4 ringed birds were found among the 54 adults killed by mink (i.e. 7%), all ringed as a chick in Wales (Anglesey) – 2 in 1982, 1 in 1983 and 1 in 1985.

É. Drunat

É. Drunat

Roseate tern chick ringed on the Isle aux Dames in July 2007.



[1] ***Ring recoveries and controls on the Isle aux Dames (birds killed by mink and birds observed through telescope).***

In 1997, 1 ringed bird was found among the 49 adults killed by mink (i.e. 2%), ringed as a chick in Wales (Anglesey) in 1993.

In 2008, 2 ringed birds were found among the 37 adults killed by mink (i.e. 5%), both ringed as a chick – one on the Isle aux Dames in 1993 and the other on Lady's Island in 1996.

As a comparison, the percentage of ringed terns (with 1 single ring or 2 rings – Museum and special roseate-tern ring) among the birds observed in the Rockabill colony – where chick ringing is completed annually, and intensively since 1986 – increased from about two thirds in the late 1990s to about three quarters nowadays (Newton & Crowe, 2000; Hulsman *et al.*, 2007).

The other data were provided by ring readings accomplished on the shore and in the colony from 2007 to 2009. At least 13 ringed birds were observed and identified with certainty, all ringed as a chick on Rockabill (2 in 2000, 1 in 2001, 3 in 2003, 1 in 2004, 3 in 2005, 2 in 2006), except for one bird ringed as a chick on Coquet Island in 2007. There is uncertainty about two other birds, one potentially originated from the USA and the other from the Azores or the USA, given the partial reading obtained during the unique observation of these birds. Proven or strongly suspected exchanges between the colonies located on either side of the North Atlantic have previously been reported (Nisbet & Cabot, 1995; Newton & Crowe, 2000).

The age of birds controlled using a telescope thus ranges from 2 to 11 years whereas the age of birds killed by mink ranges from 4 to 15 years [1]. This difference is accounted for by the fact that the various categories of individuals coming to the colony and its surroundings do not stay in the same places depending on whether they are breeders, prospectors or mere visitors.

One case of natal dispersal exists for birds hatched on the Isle aux Dames. One of the 19 birds ringed as a chick in 1993 was controlled on Rockabill from 1995 and bred there at least in 1998 (Newton & Crowe, 2000). Another individual – one of the 7 birds ringed as a chick in 2007 – was controlled on Rockabill in July 2009, but as a mere prospector for the time being.

Prospects

The roseate tern colony on the Isle aux Dames thus is not an isolated colony. It attracts and recruits birds from other European colonies (Great Britain and Ireland) and also exports young recruits to these same colonies.

The aim is now to continue chick ringing on an annual basis and to seek the opti-

misation of options for ring-reading directly in the colony, while maintaining the search for ringed birds on the shore in order to increase the chances of controlling the different categories of individuals that come to the colony and its surroundings.

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Bernard CADIOU is seabird biologist at Bretagne Vivante
bernard.cadiou@bretagne-vivante.org
Yann JACOB is a warden-educator at Bretagne Vivante, in the Ornithological Reserve of the Islets of the bay of Morlaix
yann.jacob@bretagne-vivante.org

WORKSHOP 4

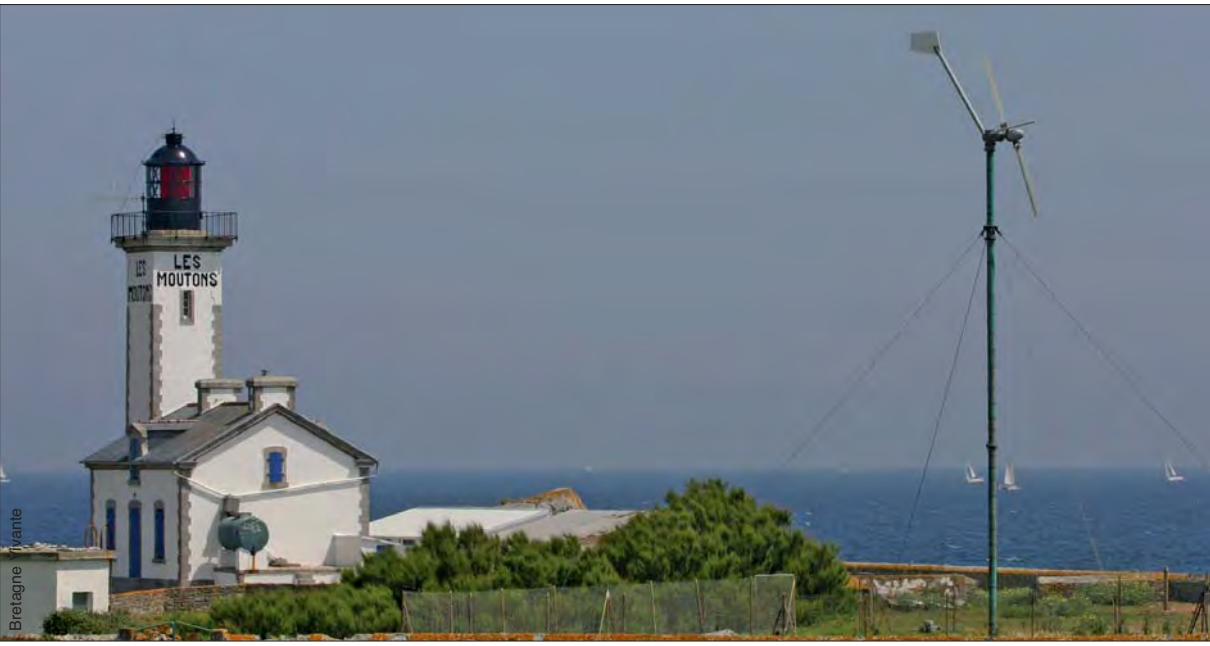
Managements measures

Substitution of a wind turbine by a solar powered station

Philippe GENTY

Bretagne Vivante

The Isle aux Moutons – Enez Moelez in Breton – is located in the north of the Glénan archipelago, off the town of Fouesnant in the French department of Finistère. It is one of the most important tern colonies in Brittany. The island hosts a mixed colony of common and sandwich terns. In 2009, over 1,000 pairs of terns bred on the island (140 pairs of common terns and 900 pairs of sandwich terns). Roseate tern bred on the Isle aux Moutons until the early 1970s. Since, it has only been seen occasionally. The last nesting pair was observed in 1996.



Bretagne Vivante

The wind turbine that supplied the Isle aux Moutons' lighthouse caused the accidental death of several terns every year and complicated the work of ornithologists, who could only count birds on the rare windless days. The impact on the colony's demography was substantial and did not favour the return of roseate tern. Thanks to the LIFE roseate tern programme, the wind turbine was replaced by solar panels during the breeding season. With the double aim to reduce disturbance caused to birds and to substitute an ageing wind turbine, the Local Authority for Public Works of Finistère (DDE) completed this operation successfully.

P. Genty

P. Genty

The headlight garden before (top) and after (down) work.

Solar park development project

In 2002, the DDE – by means of the Finistère Lighthouse & Beacon Subdivision – started considering an alternative to wind power to supply the electrical system on the lighthouse of the Isle aux Moutons. Indeed, Bretagne Vivante was showing concern about terns' high mortality rate due to the blades of the aerogenerator.

A preliminary study to reduce the power-consumption of the lighthouse was thus carried out.

This project then became the basis for the development of actions within the framework of the LIFE roseate tern programme managed by Bretagne Vivante, aiming at replacing the aerogenerator of the lighthouse with solar panels from March to September.

The project was formalised on 21 December 2006 with the signing of an agreement according to which the DDE of Finistère became Bretagne Vivante's partner within the framework of LIFE roseate tern.

Funding

The estimate for this action was 130,000 €, with up to 70% co-funded by the European Union – i.e. 91,000 € – and the remaining 30% provided by the French government – i.e. 39,000 €. Climatic hazards however increased this amount and the excess was paid by the government.

Technical aspects of the project

The installation includes 60 solar panels, with a unit power of 50 Wp (peak Watts), fastened to "marine"-quality aluminium mountings. The anchorages of these structures are formed by buried concrete blocks and a 1.80 m-high fence securely encloses the site.

Electric power is conveyed to the lighthouse through cables buried up to the power-management box and the storage batteries installed on the ground floor.

Implementation

The installation has been in operation since 15 March 2008. After a few days of trial, the wind turbine was lowered and set to the summer position.
Work achieved under DDE supervision were the following:
- general studies, administrative issues, coordination and monitoring of works (Lighthouse & Beacon);
- logistics, sea transport (Lighthouse & Beacon);
- construction work for concrete anchorages on the island (company);
- study of mounting structures for solar panels (company);
- manufacturing of structures (company);
- setting-up of structures (Lighthouse & Beacon);
- construction and installation of power boxes (Lighthouse & Beacon);
- installation of cables and junctions (Lighthouse & Beacon);
- positioning of batteries (Lighthouse & Beacon);
- installation of protective fencing (company).

P. Genty

P. Genty

P. Genty

P. Genty

From top to down : electric storage batteries, electrical equipment box, installing solar cable and fence work.

Problems encountered

The remoteness of the Isle aux Moutons and the lack of maritime infrastructures for docking did not facilitate the work: delivering 22 tons of aggregate (sand, cement) and machinery was not an easy task due to the lack of a dock. Only one company answered the two consultations carried out for on-site works. Moreover, as the working period was between September and April, due to nesting , the weather in late autumn proved unfavourable to complete the work in 2007 and the project was put in operation one year behind schedule.

It is also important to mention the financial aspect. An inadequate breakdown in the line of expenditures appears in the preparation phase, in examining the line of expenditures. It is therefore important to define expenditure items appropriately: purchases, company work, work achieved by the partner, transport by the partner, travel expenses… in order to integrate them in the total amount of the operation and to facilitate payments.

Assessment of the operation

The assessment is very satisfying in terms of lack of disturbance for terns and the energy balance of the lighthouse, despite weather hazards and other unexpected incidents during the work. Besides substituting wind production in the summer, these panels also significantly reduced the use of the generator in windless periods. This action is thus fully in line with the sustainable development approach of Europe and the French government.

Note

Alternative Environment was subcontractor in charge of the work for concrete anchorages on the island and for protective fencing.

Philippe GENTY is in charge of Concarneau branch at the Lighthouse & Beacon Subdivision of the Infrastructure and Agriculture Department of Finistère
philippe.genty@developpement-durable.gouv.fr

Management measures and video surveillance in tern colonies

Yann JACOB

Bretagne Vivante

The management of sites hosting tern colonies is a widespread practice (see for instance Avery & Del Nevo, 1991; Avery et al., 1995; Nisbet & Spendelow, 1999; Newton & Crowe, 2000; Le Nevé, 2005; Morrison & Gurney, 2007; D'Eon, 2009). Developments in LIFE roseate tern sites meet three objectives.

The reduction of anthropogenic disturbance is the first of these objectives. This mainly involves land and sea signage around the sites (see article by B. Carnot & P. Le Dœuff, this issue) and the replacement of the wind turbine with photovoltaic panels to solarise the Isle aux Mouton's lighthouse (see article by P. Genty, this issue). The second objective is to restore or increase the sites' hosting capacities. The provision of nest-boxes proved to be effective in roseate tern colonies of the British Isles and North America before being also developed in Brittany. Finally, the third objective is to reduce biological disturbance, in this case repeated predation by mink, which justified setting up a fence on the Isle aux Dames.

Roseate tern nest-boxes

From 1987 to 2003, Even de Kergariou – who had previously drawn his inspiration from Anglo-Saxon experience – gradually developed nearly 80 dry-stone nest-boxes on the Isle aux Dames. These nest-boxes were immediately adopted by the roseate terns and almost all inhabited some years (E. de Kergariou, pers. comm.; SEPNB, 1987, 1994). Nest-boxes are successfully used by roseate terns in Irish, Scottish and North American colonies. The average clutch volume and the breeding success are higher for nest-boxes compared to open nests (Avery *et al.*, 1995; S. Newton & P. Morrison, pers. comm.). With this wealth of experience, dry-stone or wooden nest-boxes were developed on the five sites of the LIFE programme [1]. On the Isle aux Dames, the goal is to favour the growth of the colony and, secondarily, to enhance the effectiveness of ringing operations. On other sites, the establishment of roseate tern is aimed at by increasing the number of sites favouring this species. The number of pairs that use nest-boxes, the rate of occupancy and the percentage of the colony using nest-boxes are monitored on a yearly basis [2]. Terns are more attracted by nest-boxes when they are grouped together rather than scattered around the island (S. Newton, pers. comm.). This would perhaps partly account for the fact that no nest-box, to date, was used on the Isle de la Colombière [3] [4].

	Dry stone	Wood	Total
La Colombière	12	0	12
Isle aux Dames	83	20	103
Trevoc'h	11	0	11
Isle aux Moutons	33	17	50
Petit Veizit	9	0	9

[1] ***Number and type of nest-boxes on the five LIFE sites in 2009.***

	2007	2008	2009
Number of nesting pairs	56-62	57	50-54
Number of nest-boxes in use	26	39	24
% of nest-boxes in use	37%	38%	23%
% of the colony using the nest-boxes	42%	68%	44%

[2] ***Number of pairs, rate of occupancy of nest-boxes and percentage of the colony using the nest-boxes on the Isle aux Dames.***

P. Morrison

[3] ***The wooden nest-boxes set up on Coquet Island in Scotland are highly used by roseate terns.***

H. Ronné

[4] ***83 dry-stone nest-boxes are developed on the Isle aux Dames. The nest-boxes seem more attractive when they are grouped together than when they are scattered.***

Fencing roseate tern colony of the Isle aux Dames against mink

From the early 1990s, predation by American mink has become the main threat to the conservation of roseate terns in Brittany (see article by Y. Jacob & M. Capoulade, this issue). The two events of predation by mink that occurred on the Isle aux Dames in 2008 led Bretagne Vivante to reconsider its strategy against this invasive exogenous species. With 37 roseate terns killed in 2008, i.e. one third of the adult breeders remaining in metropolitan France, the aim is no longer to reduce predation by mink but to put an end to it. Trapping has reached its limits with the means available to Bretagne Vivante. Moreover, the findings of recent studies conducted on mink in Brittany (Bifolchi, 2007) show no optimism regarding the reduction of the feral populations of mink in Brittany. These considerations led Bretagne Vivante to suggest the development of a mink proof fence, surrounding the entire tern colony of the Isle aux Dames – a drastic management measure we can describe as "last chance solution". The feasibility study, technical designing and administrative procedures to obtain the permission to erect such a fence in a protected natural area were carried out during the second half of 2008. Such fences exist to protect poultry farms against mustelid attacks (Kennerley, 2008; Macdonald & Harrington, 2003). A 1.2 m high wire fencing with a 26 mm mesh is recommended, with its base buried 30 cm deep (Defra, 2005). The Finistère Prefecture was in charge of questioning the relevant government services, which all gave their approval leading to the prefect's endorsement of the implementation of the work proposed before the 2009 season [1].

The project management was conducted by Bretagne Vivante with the technical assistance of professionals. By means of this organisation, the schedule

The video surveillance of birds' breeding sites – whether areas for birds of prey or bird colonies, with images available on internet for instance – has increased in recent years (see for example: birdlife.org/news/news/2006/07/belgian_terns.html and www.looduskalender.ee/en/ node/3283). Being much more than a mere web-cam, the camera set up on the Isle aux Dames provides many opportunities for site management, scientific monitoring and public awareness-raising.

1 : see notes at the end of article.

was controlled, taking into account weather conditions liable to delay the work, which had to be completed before the terns' return, by the end of April.

Proceeding of the works

The prefectoral authorisation was obtained on 4 February, and the work began on 11 February by digging a trench 55 m long on the land area of the island. The aim was to dig into the soil covering a 30 cm wide section, until reaching the source rock located between 10 cm and 1.20 m deep. The purpose of the trench was to receive the concrete base that would stop the mink from digging underneath the fence. This work was carried out by a team of ten volunteers and two employees. The soil removed was stocked on plastic tarps in order to be reused in finishes [5] [6].

From the beginning of the project, the issue of transportation of the base's building materials arose. The 175 m long fence required to bring 24 tons of cement, sand and gravel onto the island. No ramp or path here, therefore how should it be done? There is indeed a shingle bank, which is exposed at low tide and where an oyster barge could run aground during low tide. Yet, there were still 50 m to climb through a rock field to stock all these materials out of reach of the tide. And all of this was carried by hand, as the land was not appropriate for using even a wheelbarrow. This is why it was rapidly established that transportation by helicopter was the most effective and least costly solution. The operation took place on 3 March in meteorological conditions fairly difficult for the helicopter pilot and the boat's propeller! No less than 29 round trips between Kelenn beach in Carantec and the Isle aux Dames 2.7 km away were necessary to transport the big bags of cement, the sand-gravel mix, a concrete mixer and all the equipment required for such work [7].

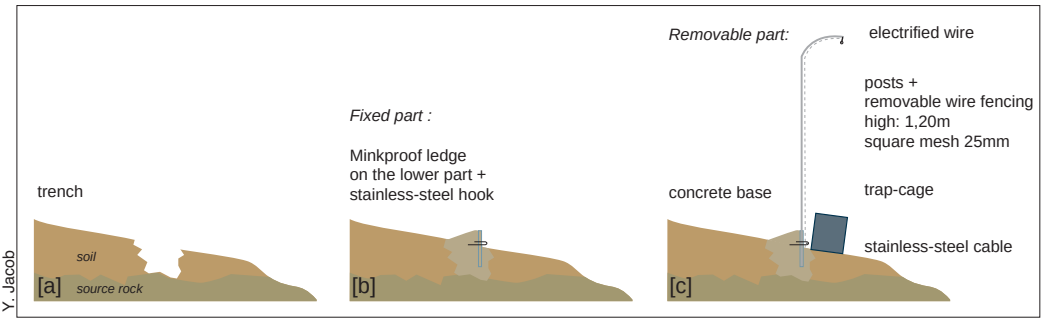
The work on the base could thus begin. Under the supervision of Pierre Le Floc'h and Yann Jacob, five to six people took turns during two weeks – from 10 to 19 March – to build the concrete base. The latter had to make a perfect juncture with the source rock and allow for the metal posts to be attached and the wire fencing to be secured. The cooperative society AGSEL sent 3-4 agents to complete the masonry work, assisted by the company "Hercule petits travaux" and volunteers. Thanks to mild weather conditions, the work was concentrated in two weeks instead of the three initially planned. The first step consisted in making a flat linear footing with little hole reservations for the posts. The land preparation work (drilling of little hole, formwork to secure the concrete to the rock field) were conducted by Pierre Le Floc'h, while the rest of the team was in charge of preparing concrete and bringing it to the sites of use. The concrete was made with seawater, which was pumped at high tide at the foot of the island and stored in 200 L barrels. Once the base footing was completed, a ledge about 10 cm high was built. It bore stainless steel hooks through which a cable was later passed and tightened to keep the wire fencing flattened against the concrete, thereby stopping the mink from getting underneath the wire fencing [8].

After a three-week period, the concrete was sufficiently set to secure the wire fence to it, which was liable to exert some pressure on the base. This wire structure is designed to be removable in order to avoid it being damaged by winter storms and to reduce the impact on landscape. It comprises 120 galvanised steel posts 1.2 m high bent outward over about 40 cm and positioned in the re-entrants of the base every 1.5 m to 2 m. Knee braces are attached in corners to stop the fence from twisting. Wire fencing sections 2 to 4.5 m long are then fastened to the posts and connected to each other with Colson ® clips. A wire rope passed through the stainless steel hooks is tightened at the foot of the fence thereby flattening the wire fencing against the concrete. The actual wire fencing comprises two parts connected to each other by iron wire braiding: one first vertical section 1 m high in galvanised wire fencing with a square mesh 26 mm wide and 1.7 mm thick and a second section bent outward, comprising a galvanised wire fencing with a hexagonal mesh 25 mm in diameter.

The system is completed with an electric wire on the edge of the fence. The wire is supplied by an electric fencer connected to a solar panel. Finally, 9 cage traps are distributed along the fence to capture any mink that may venture onto the island. The last days of April were devoted to the last touches and tidying of the site just before the settling of terns, which were already starting to gather in the bay [9].

First assessment

The first observation is that the wire fence is fairly "transparent" as soon as



Y. Jacob

[5] *Schematic diagram of the anti-mink fence.*

Y. Jacob

H. Ronné

Y. Jacob

Y. Jacob

[6] *Top left: the team of volunteers after digging the trench on the Isle aux Dames on 11 March 2009.* [7] *Top right: transportation by helicopter proved to be the most appropriate method to carry the 24 tons of materials between the mainland and the Isle aux Dames.* [8] *Down left: the removable metal posts supporting the wire fencing are secured to the concrete base.* [9] *Down right: an electrified wire supplied by a solar panel is attached to the bent edge of the wire fencing. A gate provides access to the colony for biological monitoring (count, ringing...).*

one moves away from the island. From Carantec's coast, it is completely invisible to the naked eye. The strongest impact on the landscape is due to the base, which introduces straight lines into a chaotic rock field environment and is all the more visible since the concrete is not patinated. Accounts of users (sailors, Taureau Castle visitors, boat club) collected during the season confirm the low impact on landscape. A visit by elected representatives of Morlaix

Communauté and coastal localities was organised in June, as agreed in the information meetings that took place before the work with the same representatives, thereby letting them see for themselves the low impact of the fence [10]. Likewise, following an issue raised in the local authorities' site committee, the "Architecte des Bâtiments de France" visited the island in early September 2009 to assess whether there were grounds for considering measures to reduce the impact of the developments on the landscape.

As some people were afraid the fence would dissuade the terns from settling, tern decoys were set in the centre of the usual nesting area. The fears quickly vanished as soon as the terns settled from 13 May. Finally, 1,025 pairs of sandwich terns, 85 pairs of common terns and 50 to 54 pairs of roseate terns nested on the Isle aux Dames in 2009. Another fear arose at the time of rearing the young, when the latter leave the nest's surroundings to gather into creches in the lower part of the island and come up against the wire fencing. For several days, the team of wardens observed the sandwich tern adults attempting to feed their chicks through the wire fencing, sometimes succeeding after a few tries. Once these few days were over, the adults went back to feeding their chick inside the enclosure. At the end of the season, only 3 dead sandwich tern chicks – out of several hundreds of chicks hatched in 2009 – were found along the wire fence. There was also no effect of the fence on the rearing and fledging of the young terns. While there were no cases of predation by mink reported in 2009, there were no signs of its presence recorded on the island. It is thus too early to conclude that the fence is fully effective against mink.

Dismantling

Once the season is over, it is time to dismantle the fence, a crucial step to avoid it being damaged by the waves during the winter as they may haul seaweed or other flotsam. Each section of the wire fencing is numbered then dismantled and stored flat on the island in a place sheltered from view and prevailing winds. The posts and the rest of the equipment are brought back to the mainland for wintering. Only the base remains in place [11].

Video surveillance

It was suggested to set up a videosurveillance camera within the framework of LIFE to meet three goals: to observe the tern colony, to complement the wardening and the trapping of land predators.

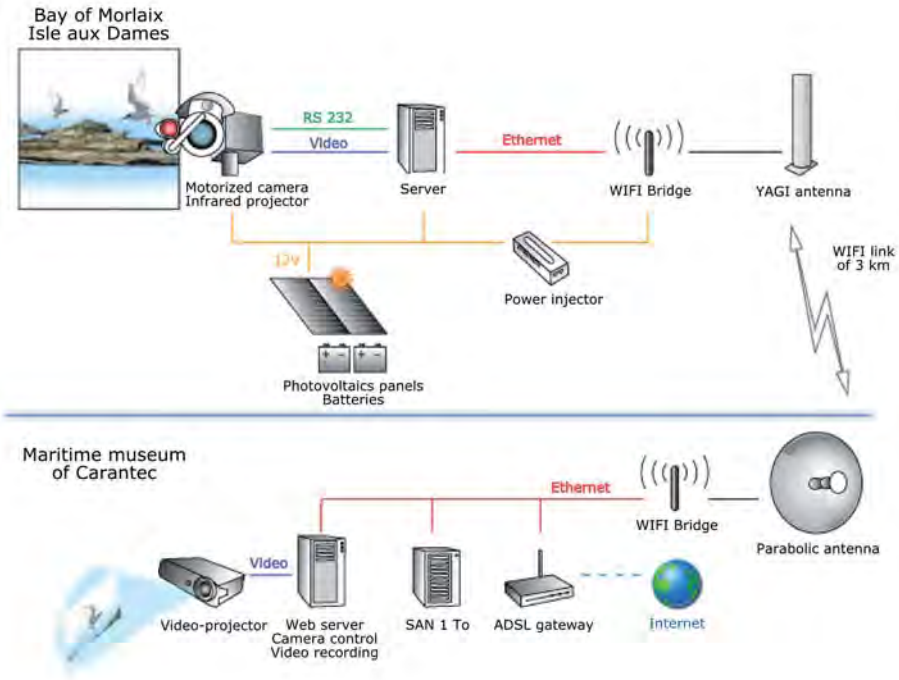
The device

Developed by the Irvi company in relation with the University of Western Brittany, this videosurveillance system comprises a waterproof camera equipped with a wiper, a rotation system, a zoom lens and an infrared spotlight for night vision. Set up in the south-western part of the island, the camera is attached to a pole about 4 metres high and provides a panoramic view of the tern colony. Its power is supplied by four photovoltaic panels connected to batteries. The solar panels are located slightly

H. Ronné

Y. Jacob

[10] The impact of the fence on landscape is minimal outside the forbidden perimeter. The fence does not disturb the terns' breeding success. [11] At the end of the season, the wire fencing is dismantled and stored flat on the island, sheltered from storms.



Irvi

Bretagne Vivante

[12] ***Top: video surveillance diagram.***
[13] ***Down: the majority of terns nesting on the Isle aux Dames can be observed with the video surveillance camera.***

away from the colony in order not to encroach on the nesting areas, and in a place that is also invisible from the Taureau Castle. A computer server in a waterproof box is connected to the camera and to the bidirectional aerial, which can transmit images over a distance of 3km, via a wireless connection, to the aerial located on the chimney of the Carantec maritime museum where a server records the video images 24/7. It is possible to control the camera remotely from the maritime museum's server. All of these controls are also accessible on the website of the LIFE roseate tern programme:
www.life-sterne-dougall.org **[12] [13]**.

Applications

The observation of the tern colony using the camera usefully complements the field monitoring. The camera provides a bird's eye view of the colony and facilitates the monitoring of sites invisible from observation posts located on the shore around the island. The camera also facilitates observation after usual wardening hours, particularly at sunrise and nightfall, or when weather conditions do not permit a boat trip. The camera provides very accurate moni-

toring of the phenology of breeding by more easily detecting key events from the settlement of the first birds to the fledging of the young. It is also useful in making estimates of the number of nest-boxes inhabited by roseate terns. The detection of ringed birds within the colony is also facilitated by using the camera, although the inscription on the roseate tern rings cannot be read (see article by B. Cadiou & Y. Jacob, this issue) [14] [15].

Video surveillance, in complementing on-site wardening, has helped detect several offences by water-sporters (kayakers or sailors) who did not observe the forbidden perimeter. Finally, while it was not possible to record mink attacks, the viewing of the recorded video images helped to precisely determine the cause of yet unexplained flights. Indeed, several cases of predation by gulls and peregrine falcon were observed in this way thereby entailing greater reactivity on behalf of the reserve's team [16].

Limitations and prospects

The numerous applications provided by this tool were somewhat disturbed by technical failures that were difficult to solve immediately due to the birds' presence. While some breakdowns were fixed by remote control, others required on-site intervention. These interventions can only be carried out when there are landings onto the island for nest-count or chick-ringing operations. They are necessarily limited in time to about thirty minutes, which is the maximum period of disturbance we currently allow ourselves for biological monitoring operations.

It would be worthwhile to further develop educational extension at the Carantec maritime museum, where images are shown on a big screen. The comments of an educator able to run the camera and interpret the birds' behaviour add a definite interest for the audience, as opposed to the passive viewing of images. This type of activity was successfully offered during the 2008 season but it was not possible to renew it in 2009 due to technical failure of the camera.

Among other extensions considered, the study of tern chicks' feeding is suggested, as the camera provides accurate monitoring of feeding frequency, verifies prey and their size, thereby giving so far unexplored valuable data on tern colonies monitored by Bretagne Vivante.

Conclusion

The management measures completed within the framework of the LIFE roseate tern programme are in line with the extension of longstanding interventionism for the conservation of terns. They contribute to the artificialising of the Isle aux Dames and raise many questions on the limitations of human intervention for the conservation of a species. The effectiveness of the fence is not yet totally confirmed and its lifespan remains a pending issue. While most of these developments are fully reversible (nest-boxes, camera), a step was taken by developing the fence. It can certainly be disassembled but its total removal would require as much effort as its construction. Moreover, this is not a hot


Y. Jacob


Y. Jacob

[14] [15] ***Using the video-surveillance camera, ringed birds can be spotted but rings cannot be read.***

Y. Jacob

[16] ***A pair of peregrine falcons and a sandwich tern captured by the female detected by the video surveillance camera: this scene was taken on 18 May 2007 at 6:05 pm.***

issue, since the presence of mink in the bay of Morlaix and on the coast of Brittany is probably far from being solved (if it actually ever is!) and in the absence of a functional alernative site for roseate terns to successfully breed in Brittany. Controlling mink on a large geographical scale as it is done in Scotland for instance (Moore *et al.*, 2003) by far exceeds intervention abilities of Bretagne Vivante, which however has already alerted public authorities to this issue. On the other hand, the restoration of a network of functional islets for tern breeding on the coast of Brittany must be conducted in parallel with powerful protection actions on the Isle aux Dames. Indeed, the last sustainable colony of Brittany showed in 2009 that it is still attractive to roseate terns in the context of increasing numbers of this species in British and Irish colonies. It is Bretagne Vivante's role to accompany this reversal of the species' demographic trend on a European scale by making good conservation decisions at the regional level, at the risk of otherwise partly undoing the efforts of our British and Irish colleagues. ■

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Notes

1 - Prefectoral authorisation of the 4 February 2009.

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Yann JACOB is a warden-educator at Bretagne Vivante, in the Ornithological Reserve of the Islets of the bay of Morlaix
yann.jacob@bretagne-vivante.org

Managing roseate terns in the UK

Paul G. MORRISON

J.-P. Rivière

There has been a steady decline of nesting roseate terns in the UK since the 1960s and 70s. In 1975 the largest UK colony was 150 pairs on Ynys Feurig, Anglesey. The number of pairs on Coquet Island reached a peak in the 1960s and then experienced a decline, falling to 18 pairs in 1985 and 24 pairs in 1996. A recovery programme was introduced on Coquet Island in 2000.

In 2009 there were only two sites from which roseate terns successfully fledged young: Larne Lough in Northern Ireland which had one fledged bird and Coquet Island, off the Northumberland coast, which had 90 nesting pairs with 101 fledged chicks. One common/roseate hybrid was recorded on the Skerries, Wales (A. Moralee, pers. comm.) and, one pair failed in Minsmere [1].

The enigma is: Coquet Island is now the sole colony in the UK so why are roseate terns attracted there?

This presentation explores the location, the topography, the bird assemblage, the management of the vegetation, the provision of suitable habitat, the threats and how those threats are managed.

[1] ***Distribution of roseate terns in British islands, 2009.***

The location

Coquet Island lies 1 mile off the port of Amble on the Northumberland coast. The Island has been a RSPB nature reserve since 1970 and was designated as a "site of special scientific importance" by Natural England in 1983, because of the nationally important bird assemblage.

The topography

The island is flat plateau 4 ha in size and the vegetation is predominantly maritime grass with nettle beds surrounding the lighthouse. There is low cliff and a sandy/shingle beach on the southernmost corner. A rocky foreshore is exposed at low tide which limits access to the reserve.

The bird assemblage

More than 35,000 birds nest on Coquet each year. The low cliffs are used by a small colony of kittiwakes (161 pairs)

and 50 pairs of fulmar. The sandy soil is undermined by 15,812 pairs of puffins, which nest across almost the entire island. Coquet Island is the southernmost breeding colony of eider ducks on the east coast of England. The eider population has been declining since the 1980s and in 2009 there were 260 nesting females recorded. In 2009, a thousand pairs of both arctic and sandwich terns nested in plots cleared of vegetation amongst the nettles. 1228 pairs of common terns nested near to the roseate colony.

Managing the vegetation

Fifty nesting plots have been created within the nettlebeds that surround the lighthouse in order to offer suitable nesting substrate for terns whilst at the same time leaving the nettles around those plots intact as a refuge for chicks. This is achieved by an annual programme of strimming and the use of herbicide. These plots are used each year by sandwich, arctic and common terns.

Provision of suitable nesting habitat

The provision of terraces and boxes started in 2000 and was based on the management for roseate terns on Rockabill, in the Republic of Ireland.

Fifty nest boxes were put out on a bed of shell shingle on terraces which were constructed in an area already used by roseate terns. The idea for adding shingle was the result of observing roseates picking shell fragments and throwing them into their nest boxes to be used as nesting material. Each box is numbered and mapped before being taken in for cleaning and repair at the end of the breeding season, to enable wardens to reinstate them in exactly the same place each year (Morrison & Gurney, 2007). Evidence from ring reading shows that they often return to the same box each year. The vegetation next to the terraces is cut to encourage common terns to nest near to the roseate colony, as advice from other sites suggest there is an association between the presence of common and roseate terns (S. Newton, pers. comm.).

At the start of each breeding season puffins and roseate terns prospect the terraces but the roseate terns dominate the terrace by May. In 2009, 88% of roseate terns on Coquet Island nested in boxes. The rest nested adjacent to a box and the chicks subsequently used the boxes for shelter. A chick-ringing programme was started in 1991 and now all chicks are ringed. In 2009, the 1000th Coquet chick was ringed. The monitoring programme on Coquet Island involves checking the nest boxes every six days in order to record the number of nesting pairs, estimate the mean clutch size and calculate the productivity, based on the entire breeding population.

The threats

Large gulls (lesser black-backed and herring gull) nest in small numbers but pose a threat in terms of competition for nest space and predation. The weather plays a significant part in the success or failure of the roseate productivity. Bad weather in 2007 and 2008 was partly responsible for a fall in the number of fledglings, and in one storm event, the lower terrace was washed away. Food availability is also a factor for fledgling success. In the period 2006 to 2008, there was a shortage of sandeels and a dramatic increase in the presence of pipefish, which offer little nutrient for chicks. Many tern chicks that were fed these were later recovered choked to death. The colony has suffered from the theft of eggs by egg-collectors who accessed the island by boat when the island was unoccupied. The terraces are close to the main jetty on the island and birds have been observed lifting from the terraces upon the arrival of pleasure boats which are allowed to dock there. Traditionally, the wardens on the reserve meet and greet these boats but ironically, as they walk up and down the path, which is adjacent to the terraces, they disturb the roseate terns. There is competition for nest space by puffins; some attempt to burrow under the terraces and 3 pairs this year nested in the nest boxes that were provided for roseate terns.

There is a growing population of grey seals on Coquet Island. Up to 550 have been counted on the intertidal and some attempt to gain access to the plateau via small gullies from the foreshore.

Managing these threats is a priority for the reserve staff. A programme of gull control starts in March each year, before the arrival of the puffins, terns and

eider ducks. Large gulls are actively discouraged from establishing nesting territories on the island using a series of scaring techniques. This ranges from installing a gas gun which is modified to fire throughout the night, pyrotechnics, electronic distress-callers (which mimic the distress calls of large gulls) and “active human disturbance” which involves staff patrolling the island wearing hi-visibility jackets and moving the birds off the reserve. Later in the season, eggs are collected every two weeks from large gulls that attempt to nest. This combination of scaring and egg collection has resulted in a reduction of the number of nesting large gulls from 233 pairs in 2000 to 11 pairs in 2009 (Morrison & Allcorn, 2006).

The roseate terns are now protected 24 h a day, using a range of measures. A CCTV system, which is used to provide live images to visitors at the Northumberland Seabird Centre on the mainland, is controlled by island staff when required. Night watches are in place throughout the breeding season and a rota of staff ensures the island is secure from disturbance. The RSPB liaises closely with the local Police who set up a formal response procedure and advise the island staff on how to deal with suspicious events.

The jetty is 25 metres from the nearest nest boxes. The skippers of pleasure boats are allowed to dock at the jetty but the landing of visitors is not allowed and boats are restricted to staying for a maximum of 10 min each trip. The RSPB has licensed a charter boat operator to provide a high quality service for visitors and the island staff provides the skipper with regular updates as to what is of interest on the island. The skipper has also been inducted into the natural history of the island and the nature of the RSPB work that is carried out there. The boat skipper now acts as an on-board guide for visitors which avoids the need for island staff to greet the boats and hence reduces the disturbance that this used to cause.

Warning signs are erected at the jetties to explain that visitors are not allowed to land, and to emphasise the law, which is in place to protect the roseate terns.

Dry stone walls have been constructed in gullies at the top of the foreshore in order to prevent seals from accessing the plateau.

The breeding population of roseate terns in 2009 was 90 pairs but 200 nest boxes were provided on the terraces. There are always more boxes available than nesting pairs, in case there is an influx of more roseate terns or if more puffins

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start to use them. The budget for managing Coquet Island is around £ 50,000 per year (57,000 €).

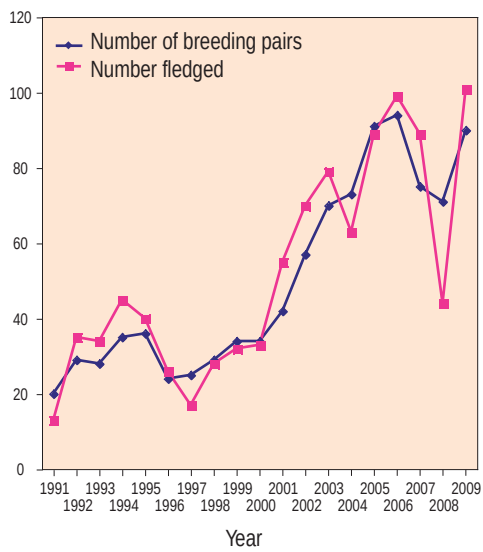
The method of providing nest boxes and terraces on Coquet Island, (originally copied from Rockabill) has now been "exported" to the Farne Islands, situated 15 miles to the north of Coquet. To date no roseate terns have used them. Concrete versions of nest boxes are in place at Larne Lough, in Northern Ireland, and in 2009, one chick successfully fledged there.

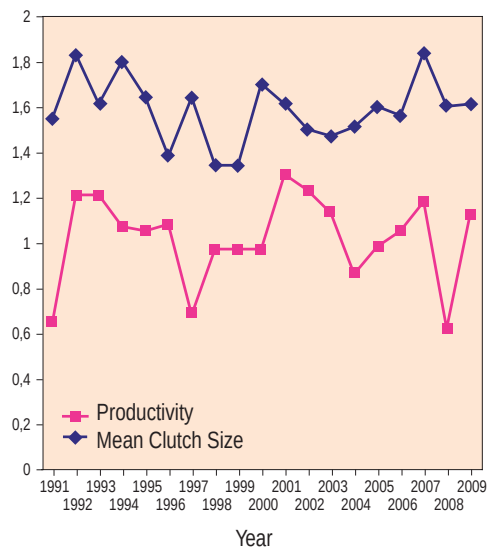
Results of the monitoring

There has been a significant increase in the number of nesting pairs of roseate terns since the introduction of terraces, boxes and the other management measures. There was a drop in the number of nesting pairs in 2007 and 2008, but this can be attributed to the shortage of sandeels and the poor weather [2] [3].

The next stage in the work on Coquet Island is to investigate the provisioning of roseate terns, initiated by a tern foraging study piloted by JNCC (Joint Nature Conservation Committee) in 2009, and using this data to support the establishment of marine protected sites where roseate terns feed. The ringing data is now the subject of a paper to investigate whether the breeding population of roseate terns on Coquet Island is self-sustaining and to what extent the island is an overspill for birds from Rockabill.

Acknowledgement:
I thank my RSPB colleagues, especially Zoe Tapping, Jenny Key and former wardens for their crucial role in safeguarding and monitoring the roseate tern colony on Coquet Island. I thank Tom Cadwallender for his time and expertise in ringing the roseate terns since 1991. I thank the Northumberland Coast Conservation Team of volunteers who construct the terraces and who maintain them annually. In particular, thank you to Hilary Brooker-Carey (volunteer warden) and John Woodhurst for their sterling efforts in vegetation management. I also thank Steve Newton for instilling the ideas that have been implemented on Coquet Island to benefit roseate terns.





[2] Left: number of breeding pairs and fledged, 1991-2009. The number fledged increased steadily following the introduction of nest boxes in 2000, with a fall in numbers in 2008. There was an increase in numbers fledged in 2009, following a summer of good weather and a recovery in sandeel stocks.

[3] Right: productivity and mean clutch size 1991-2009. The productivity "yo-yos" year on year (0.6 and 1.3), with falls corresponding to years of poor feeding or bad weather. The mean clutch size has varied very little from year to year (1.34 and 1.84). The introduction of terraces and nest boxes has enabled the chicks to be located and ringed very efficiently with minimal disturbance to the colony. Virtually all chicks are now ringed and the recovery of dead chicks assists in calculating the number successfully fledged.

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Paul G. MORRISON is Coquet Island site manager for the RSPB
paul.morrison@rspb.org.uk

H. Ronné

Management measures for (roseate) terns in Ireland

Stephen F. NEWTON

J.-P. Rivière

In Ireland management for terns is most intensively practised at east coast colonies which are either islands supporting roseate tern (Sterna dougallii) colonies or, secondly, mainland beaches used by little terns (Sternula albifrons).

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These colonies also tend to support the largest numbers (of the national population) and there could be a positive feedback loop, in that intensive wardening and positive management actions for terns does have the desired effect and, at least locally, breeding success is boosted and ultimately breeding numbers increased through enhanced recruitment. Roseate terns currently breed at three sites on the east coast [1]: Rockabill, Lady's Island Lake and Dalkey Island; management measures undertaken at each are covered in turn in the sections below, following the sequence: disturbance control, predators, habitat management, other issues for the two principal colonies.

Rockabill

Rockabill lies 6 km off the coast of north County Dublin, approximately 30 km from Dublin City centre. It is a pair of small granite islands (approximately 0.9 ha in extent), the larger "Rock" and the smaller "Bill", with a lighthouse and associated buildings on the former. The islands are a Special Protected Area (SPA) and also have a range of national designations as a strict nature reserve. The Commissioners of Irish Lights own the island and automated the lighthouse in 1989, at which point BirdWatch Ireland (BWI) and the state National Parks & Wildlife Service (NPWS) negotiated an agreement to base two wardens on the island for a 3.5 month period in the summer. The initial aim was to protect the nesting terns from disturbance and to implement management measures for roseate terns to aid population recovery following their rapid decline over the preceding decade.

The relatively offshore location of Rockabill results in a low level of "intrusion pressure" from recreational boatsmen. However, unauthorised visitors do arrive on yachts, chartered fishing boats, RIBs, jetskis and the like, though awareness of the conservation importance of the island is reasonably well known amongst the communities in the nearest towns and villages (Skerries, Balbriggan, Rush and Loughshinny). There is some signage on the island to discourage prospective visitors from landing and the resident wardens are the key players in limiting access from the general public. As the conservation success story on the island grows there are significantly fewer unauthorised visitors to the island compared to 20 years ago. There are no native or introduced terrestrial mammals on the island and distance from the mainland excludes regular incursions from most avian predators except peregrines (*Falco peregrinus*) and large gulls (*Larus argentatus and L. marinus*). Turnstones (*Arenaria interpres*) depredate some untended eggs though these are mostly "rolled" or abandoned. Herring gulls formerly nested in large numbers on the island, particularly the Bill, but an active programme of control measures (both baiting adults and removal of nests and eggs, under licence) between 1989 and 1991 reduced the numbers attempting to nest (see Casey *et al.*, 1995 for details) and for much of the last 10 years only occasional nests need to be removed. A .22 calibre rifle is available to scare large flocks of loafing and roosting gulls (mostly from the east end of the Bill) but effects are short-lived. Arctic terns (*S. paradisaea*) are currently the most numerous nesting species on the Bill and the recent run of very poor productivity in this species stems from poor summer weather and maybe the attention of gulls. Peregrines do not nest on the island but pairs nesting on Lambay Island (11 km south) and a quarry in Skerries (about 7.5 km southwest) are likely to include Rockabill in their foraging range. When present on Rockabill, peregrines cause prolonged "dreads" and if they make a kill they often eat or pluck their meal on the northside of the Bill where they are impossible to detect from the Rock, where wardens are based and spend the vast majority of their time. In some years they kill mostly adults early in the season and in others near- or recently-fledged young. There is little that can be done practically to minimise peregrine visitation to Rockabill, though food supplementation at the mainland site may be an option to explore if depredation levels threaten the viability of the colony.

Habitat management is crucial to the continued growth of the Rockabill tern colony. The current challenge is to continually increase the area of ground available to roseate (and common) terns, which can be done by either creation or increasing the nesting density of already occupied land. Measures principal-

	Number of pairs of roseate terns		
Colony/Year	1989	1999	2009
Rockabill	180	611	1,052
Lady's Island Lake	76	116	123
Dalkey Island	0	0	1

[1] ***Number of pairs of roseate terns nesting at Rockabill, Lady's Island Lake and Dalkey 1989-2009.***

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[2] ***High density nest box deployment for roseate terns on Rockabill.***

ly comprise vegetation management, deployment of nest boxes at high density and the creation of open terraces. The requirements of the two species are opposed: roseates prefer to nest under the cover of vegetation or rocks, commons prefer open space. Thus, the compromise action developed on Rockabill has been to clear vegetation, particularly tree mallow (*Lavatera arborea*) and nonnatives such as hottentot fig (*Carpobrotus edulis*) and replace it with nest boxes. Boxes need to be on flattish ground and, given most of Rockabill is sloping, we have created a series of terraces using discarded building materials such as bricks, slates, and timber planks. In creating a more open aspect we have maximised the area available for nesting and enhanced our ability to observe birds and their behaviour remotely from hides. Each season we erect three hides overlooking our main study areas and early season monitoring and ring reading is conducted from these. This is of critical importance given we attempt to ring all roseate tern chicks and follow their life histories by ring-reading. Later in the season, the terns are more tolerant of the warden's activities and we are able to ring-read adults whilst moving about the colony. An example of nesting terrace/study area is given **[2]**. In reality, removal of the vast majority of tall cover or moisture-holding ground vegetation, though ideal, is seldom feasible as it is very time-consuming and can only be done prior to the terns settling on the island. The window of time/opportunity varies from year to year because of staff and volunteer availability, prevailing weather and so on. During this time hides have to be constructed and 600-700 nest boxes deployed. Two wardens are based on the island full-time for the length of the breeding season; they are joined by 2-3 persons (SFN and one or two experienced volunteers plus fresh food, water and fuel for generator) for two to three days each fortnight.

The only significant factors over which we, as colony managers, have no control are the weather and sea surface temperature, the incidence of avian botulism and the number (and diversity) of fish in the sea. The prevailing climate change scenario in the northeastern Atlantic area appears to be giving us wetter and stormier weather with easterly airflow, resulting in big seas fetching across the Irish Sea. Although the majority of our roseate tern eggs and chicks are kept relatively warm and dry in their boxes, we have no real understanding of how poor weather impacts foraging adult terns. Each year a small number of adult terns die in circumstances which lead us to believe they have contracted avian botulism. The condition appeared to be more prevalent in hotter summers when small pools of water on the rocks below the nesting

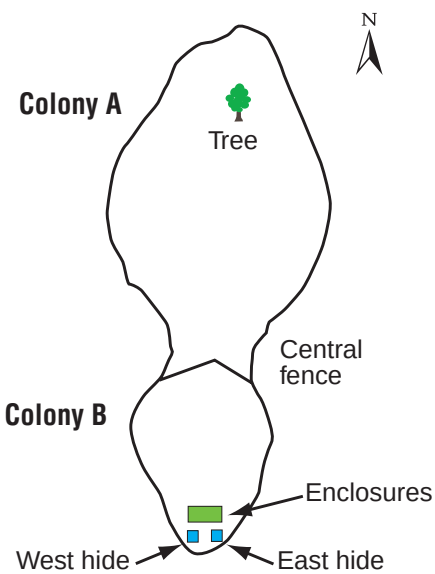
areas became highly “fetid” bacterial “soup”; this phenomenon is becoming less frequent! At present there is no industrial fishery for sandeels (*Ammodytes* spp.) or sprats (*Sprattus sprattus*) in the northwestern Irish Sea and snake pipefish (*Entelurus aequoreus*) are seldom seen. This may be the result of Rockabill’s location on the edge of a wedge of cold stratified water to the northwest of the island.

At the time of writing, the Rockabill tern Project lacks a specific management plan with key targets and timeframes. Numbers of all three species of nesting tern on Rockabill are increasing and over 21 years have risen from under 400 pairs to over 3,000 pairs with years of poor productivity relatively rare. We have ceased making predictions about the carrying capacity of the island but we hope that sufficient roseate tern young are fledged, and disperse to boost numbers at other presently occupied colonies and perhaps colonise some former sites and thereby sustain the recovery of the northwest European metapopulation overall.

Lady’s Island Lake

The setting and conservation issues at Lady’s Island Lake tern colony are a complete contrast to Rockabill. The colony is on an island, Inish, in a brackish lagoon separated from the sea by a permeable shingle barrier. Water level in the lake rises each winter, often more or less submerging the island and some of the surrounding farmland. A peninsula projects into the lake and this is the site of a religious pilgrimage. Thus, to permit access to the latter, in an annual tradition, a channel is excavated through the shingle barrier allowing the lake to discharge (usually partly but occasionally, nearly completely) into the sea [3]. The channel is usually washed over and closed by the sea within 24-48 hours depending on weather conditions. Water-level in the lake can thus vary dramatically between years and if low for prolonged periods in the spring before terns and gulls start nesting, then terrestrial predators can

Lady's Island Lake



Inish Island

[3] ***Map of Lady’s Island Lake and Inish Island, County Wexford. The cut through the barrier of pebbles allows a discharge of lake waters in the sea for temporary access to the island during the annual religion ceremony.***

access the island more easily. Engineering solutions to control water level are occasionally discussed, but funding from either Wexford County Council or central government has not been made available. The colony has been wardened full-time during the breeding season since about 1993 by NPWS or BWI staff. In the earlier years the warden was based in a caravan on the mainland close to Inish, but lately staff have resided at home and travelled to the island in daylight hours to undertake management work and tern monitoring. Thus, the island is not strictly protected through all daylight hours and egg-theft/interference has been recorded once in the last 14 years; otherwise serious trespass has not occurred since a major incident virtually lead to desertion/abandonment prior to 1989. The lake itself is about 3.5 km long and recreational boating is restricted to the southern half, while the colony on Inish is in the northern part. Incursions into restricted waters around the colony do happen and the warden does spend some time on intercepting boats that may attempt a landing on the island.

Despite long-term control measures, a brown rat (*Rattus norvegicus*) population has proved impossible to permanently eradicate. This is likely due to reoccupation by animals from the mainland during periods of low lake levels, when only about 250 m of shallow water separate the island from the mainland. In theory terrestrial carnivores such as red foxes (*Vulpes vulpes*) or badgers (*Meles meles*) could get to the island, but this has rarely happened and an electric fence is maintained across the "neck" of the island separating the higher ground of the north of the island from the lower-lying south end where the majority of terns nest [3]. Rat bait is deployed in permanently placed clay pipes in the north part of the island during February - March. It is checked and topped up over about three visits and as long as water levels are reasonable (medium-high), recolonisation by rats is unlikely before the majority of young gulls and terns have fledged. If baiting is not completed prior to significant vegetative growth (late March/early April) then the colony is likely to experience depredation from rats sometime in July. This situation arose in 2009 and also in 2001 when Foot and Mouth Disease movement restrictions prevented access to the colony. Otters (*Lutra lutra*) occur in the lake but have not been proved to be predators of the terns and their presence appears to exclude American mink (*Mustela vison*). There is the potential for a wide range of avian predators to cause problems but the most serious are usually peregrines and the pair of hooded crows (*Corvus cornix*) that usually attempt to nest on the single pine tree at the north end of the island. Nests of the latter are usually removed.

Nest boxes and observation hides are stored on the mainland overwinter and redeployed in the spring, when fence maintenance is also undertaken. Old car tyres are also provided and a small number of roseate terns nest inside them. At the beginning of the season, vegetation in the colony area has usually died back from being submerged and clearance is not required [4]. It rapidly regrows by June, often hampering observation of terns but by this time the whereabouts of all nests and mobile roseate tern chicks is known (they are ringed before they can mix with offspring of other neighbouring pairs). Water quality in the lake is variable and in some years agricultural run-off is so high that fish kills have been recorded. However, of the four regular nesting tern species only a few individuals of common tern ever forage in the lake for small fresh-brackish water prey. All other terns fly south over the shingle barrier to forage in the open sea, though sandwich terns often head overland in the northeastern sector to Rosslare Harbour (5-6 km).

Dalkey Island

In 1986 a single roseate tern clutch was found in the small common and arctic tern colony at Dalkey on the southeastern edge of Dublin City. Subsequently, the idea lodged that it would be good to attempt to establish a roseate colony here, given the loss of the species at most of its former west coast haunts (see Hannon *et al.*, 1997). Effort to this end has been sporadic but has been most determined in the last 12 years; in 2002 a probable roseate clutch was laid very late in the season but the following year five pairs bred, then 11 in 2004. Unfortunately, only 1-2 pairs have nested subsequently and the tiny island on which the terns prefer to nest is now over-washed regularly by easterly summer storms.

Birdmatch Ireland

[4] ***The roseate tern nesting area at the south end of Inish, Lady's Island Lake.***

At Dalkey there is one main island and two islets, one of these is connected to, and accessible from, the main island at low tide (Lamb). The other islet (Maiden Rock) is the one preferred by terns and is a low, exposed bare mass of granite about 10 x 25 m in extent. Although, this islet is suboptimal we have created flatter mini-terraces (paving flags on a concrete base) on which we can deploy nest boxes. When possible, these are screwed down into the rock but this does not guarantee they are secure in a big storm. The island is rarely disturbed and has no terrestrial mammals, but at only 300 m from the mainland is vulnerable to visitation by magpies (*Pica pica*) and other corvids. Gulls, mostly herring, nest on nearby Lamb and they do depredate eggs and in 2009 appeared to take the majority of common and arctic tern clutches during the laying period. A new strategy to mitigate against this needs to be devised prior to the 2010 season. In theory, both the other islands are more secure from the sea and have vegetative cover which would increase options for roseate terns. Various measures have been implemented on Lamb as the terns do sometimes attempt to nest here following a "wash-out" on Maiden Rock. The negative factors are: presence of rats, rabbits (*Oryctolagus europaeus*) and feral goats (*Capra hircus*). The former certainly take eggs, rabbits undermine nests and the goats trample clutches. To add to these are the breeding gulls and occasional visits from boatmen, kayakers and scuba divers. We have fenced an area off to exclude goats (see Newton & Crowe, 2000) and this needs to be better managed in the future. Additionally, rat baiting needs to be instigated to give breeding terns better options from 2010, given Maiden Rock is vulnerable to rising sea levels and increased stormy conditions. ■

Acknowledgements

Roseate tern conservation action in Ireland has been undertaken by National Parks & Wildlife Service and BirdWatch Ireland staff, and volunteers from the Fingal and South Dublin branches of BWI. Funding has principally come from NPWS, EU Maritime INTERREG (Ireland-Wales), the RSPB and Dún Laoghaire Rathdown County Council. I am grateful to all wardens and volunteers who have worked tremendously hard to deliver this conservation success story.

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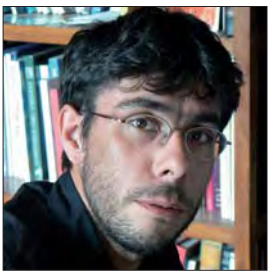
Stephen F. NEWTON is senior conservation officer with BirdWatch Ireland
snewton@birdwatchireland.ie

H. Ronné

Preliminary analyses of the 30-year management of tern sites in Brittany

Yohan CHARBONNIER & Matthieu FORTIN

Y. Charbonnier



Bretagne Vivante

Among all tern species nesting in Brittany, roseate tern is unquestionably the most threatened. References only mention very rare cases of nesting in mono-specific colonies for this species (Olsen & Larsson, 1995). Hence, considering the conservation of roseate tern colonies in Brittany means, to a greater extent, considering all tern colonies.

Historically, terns – all species collectively – have nested in a large number of sites, i.e. approximately three hundred on a regional scale. While each of these sites has its own features, it is yet possible to find a common denominator: the threats encountered by the colonies.

Despite their diversity, these threats can be classified into several large categories: degradation of hosting capacity, action of predators, depletion of trophic resources… In terms of the origin of these threats, it is possible to distinguish both natural and anthropogenic threats.

In order to face these threats, many protection and management actions have been developed for over thirty years to try to impede the reduction in numbers of nesting terns in Brittany (Jonin, 1989; Ganne & Le Nevé, 2002). Now is the time to assess the actions that were undertaken and possibly redirect some of them according to this assessment.

This preliminary study aims to create an adaptive management for terns on a regional scale. The principle of this type of management is based on the concept that the assessment plays a predominant role. It helps to readjust goals on the basis of the analysis of results obtained. Moreover, exchange and communication developed thanks to this work will indirectly influence future conservation goals [1].

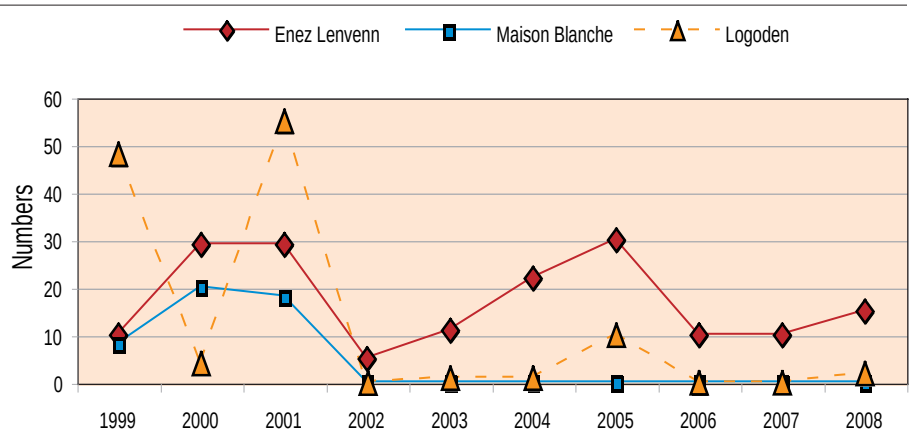
It seems important to assess the efforts undertaken for over thirty years, for three main reasons:
- to analyse results obtained and better understand the impacts of actions implemented;
- to optimise actions in line with results obtained, in order to achieve more effectiveness;
- to exchange knowledge, acquired experience and more easily justify moral and financial investment to the various actors and partners.

[1] ***Theoretical diagram of the adaptive management principle (from Shindler et al., 1999).***

Method

In order to develop these first assessments, a functional tool was needed to integrate the various data recorded in a range of media (paper form, field notebook, computer files in various formats…). These data represent all the information accumulated over time regarding breeding colonies (biological data, management actions…). Once all the data were made homogeneous and comparable, the first analyses could begin. Hence, a rich data set of thirty years of monitoring comprising more than 330 sites, 1,356 breeding cases and 1,047 management events was made available in a digital format.

Though this may seem very theoretical, the use of statistical models rapidly becomes essential. While for one or two sites it is possible to assess the actions undertaken in practical terms, it is indeed no longer the case with such a bulk of information.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Enez Lenvenn	1	1	1	1	1	1	1	1	1	1
Maison Blanche	1	1	1	0	0	0	0	0	0	0
Logoden	1	1	1	0	1	1	1	0	0	1

[2] ***Transcription in the table of the status of presence - absence of the colony (1= presence, 0= absence) based on the evolution of numbers (number of nesting pairs) according to the evolution of numbers of three colonies in Brittany from 1999 to 2008.***

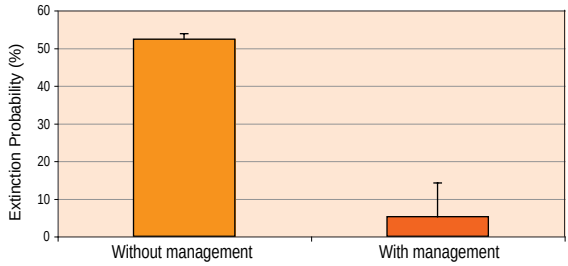
The method used – developed in association with Christophe Barbraud (CEBC-CNRS) – has led to considering the tern population of Brittany as a metapopulation. It comprises units that are represented by colonies. The metapopulation dynamic is thus considered to be determined by events of nesting sites disappearing or being colonised (Barbraud *et al.*, 2003; MacKenzie *et al.*, 2003). The colony is hence assimilated to the status of individual commonly used in capture-recapture (Lebreton *et al.*, 1992). This thus provides the history of occupancy / non-occupancy of sites that can be analysed using statistical tools recently developed (MARK, White & Burnham, 1999; M-SURGE, Choquet *et al.*, 2004).

In the matrix thereby created, the presence of a colony on a site in a given year is encoded as 1, whatever the nesting numbers, and its absence as 0. Therefore, the probability of shifting from 0 to 1 is the colonisation probability (first known settlement or resettlement after more or less extended desertion). Conversely, the probability of shifting from 1 to 0 refers to local extinction [2]. This method can estimate colonisation and local extinction probabilities, and test the factors affecting these probabilities (year, management measures), used as covariates in mathematical models.

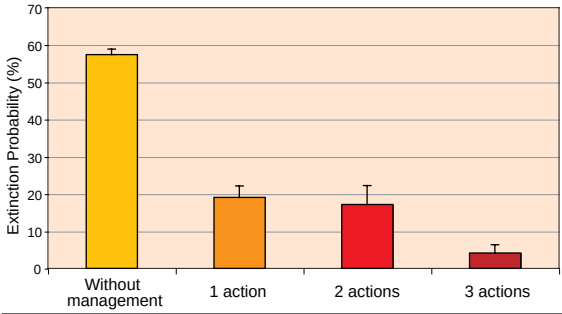
Results

The first question to be raised is whether the actions undertaken for over thirty years had an impact on the probabilities of colony extinction. The model seems to show there is a significant difference between the risks of colony extinction on managed and unmanaged sites. The extinction probability amounts to more than 52% on unmanaged sites, whereas it is only 5% for managed sites [3].

It then seemed interesting to determine whether the combination of several actions had an effect on the probability of colony non-extinction. Management actions were grouped together according to three large categories: those affecting the sites' hosting capacity, those aiming at reducing biological impacts and those aiming at reducing anthropogenic impacts. The test was carried out by combining the intervention of one or several categories. In other words, is it more interesting for the manager to begin one,



[3] *Impact of management on probability of colony extinction.*



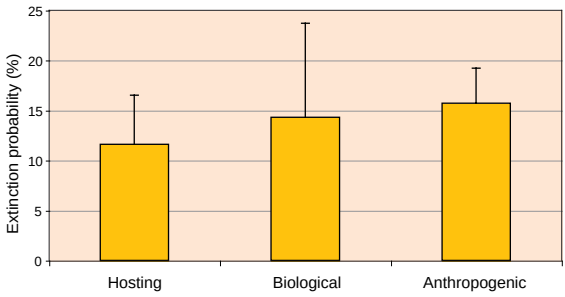
[4] *Impact of the number of management actions undertaken on extinction probability.*

two or three broad types of actions? It seems there is no significant difference whether one or two types of actions are undertaken. Extinction rates obtained are 19% and 17% respectively. The difference is yet again significant when there are three types of actions implemented with the extinction probability declining to 4% [4].

Finally, it seems important to hierarchise the types of actions according to their effectiveness in maintaining colonies. Which would be the most relevant action to be implemented, in the event of a site manager not having the means to undertake several types of actions? The model only provides little information to meet this question, as no significant difference appears: 11% of the extinction probability when acting on hosting capacity, 14% for biological threats and 15% for anthropogenic threats [5].

Discussion

This study has established encouraging results. The management actions deve-



[5] ***Impact of the type of management action undertaken on extinction probability.***

loped in the field seem to have been fruitful. It is however important to bear in mind that this work is innovative, and above all preliminary, and that it will need to be refined.

In addition to these results, it has highlighted a number of lacks. It is now possible to list the three main ones:
- considerable gaps in filed information;
- important heterogeneity in source data;
- lack of "test" sites.

It will be possible to partly remedy the first two issues by means of major work in processing files and meeting local actors. In future, it seems essential to homogenise information as soon as it is collected in order to avoid the same "faults" in data. This could be achieved by developing a standardised protocol shared by all field actors at the scale of Brittany.

It would thus be possible to integrate data into the model such as the extent of actions, for instance. Indeed, it is essential to compare actions according to their intensity in order, for instance, to differentiate mere manual mowing and mechanical land-clearing over several days.

On the other hand, the lack of sufficient numbers of sustainable, unmanaged colonies in data sets is unsuited to provide a test sample. Yet the development of such sites cannot be considered given the current situation of tern populations. Indeed, how can stopping all management actions on sites hosting healthy colonies be justified with the sole aim to obtain experimental results?

In parallel to this assessment work, the establishment of scenarios of colony evolution will be required. Predictive models, based on population dynamics parameters, will therefore be key tools. It will be interesting to work on a greater scale than that of the colony, and to try to understand the impact of managed sites on regional numbers: do actions undertaken only affect one site or can they have positive outcomes for the population of Brittany?

Finally, recent history stresses the fact that a site's equilibrium is precarious. The tern metapopulation system requires the definition of sites favourable to resettlement. Considerations in the context of a network of sites will lead to the development of measures essential to maintaining the hosting capacity.

The whole of these data, analyses and forecasting can provide input to considerations related to the main issue: "What conservation goals for the future in Brittany?"

Conclusion

This preliminary work is the result of important fieldwork carried out for many years by the organisation Bretagne Vivante, its associational and institutional partners, and also of the synthesis of data and files collected.

It has shown that the work conducted in the field was purposeful and that the management measures implemented were successful. Indeed, without the considerable field involvement during those years, providing the results obtained, the assessment for tern populations in Brittany would be considered to be particularly negative.

In addition, it has also contributed to highlighting a number of lacks and deficiencies. It will be important to solve them in order to develop a more accurate and functional assessment tool.

Further considerations at the tern observatory of Brittany, in a dynamic of adaptive management, will aim to specify the new conservation and management goals for roseate tern and also for all tern populations found in Brittany. More than an end in itself, this work will determine a starting point for tern actions to be conducted once the LIFE programme is closed.

Acknowledgement
Christophe Barbraud, CNRS researcher at CEBC (Center of biological studies of Chizé).

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Yohan CHARBONNIER is a research manager at Bretagne Vivante
yo.charbo@gmail.com
Matthieu FORTIN is a project manager at Bretagne Vivante
matthieu.fortin@bretagne-vivante.org

WORKSHOP 5

National conservation plan

Roseate tern in New Caledonia

Julien BAUDAT-FRANCESCHI, Vincent BRETAGNOLLE, Vivien CHARTENDRAULT & Nicolas DELELIS

SCO

Located east of Australia, New Caledonia is a subtropical archipelago with a two-season climate: warm (November to April) and cool (May to October; annual temperatures: 19 to 26°C; Météo France, 2007). We hereafter describe the state of information on roseate tern: systematics, biology, numbers, distribution, conservation.

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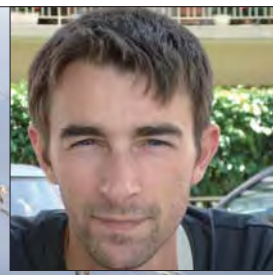

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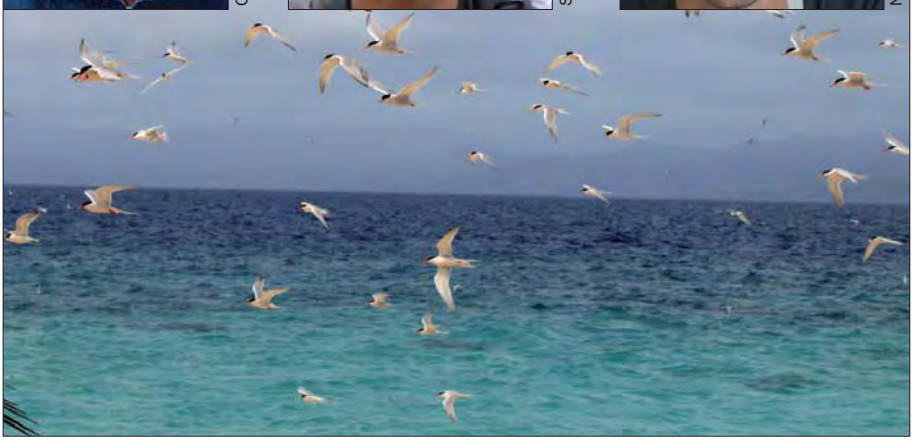

J. Baudat-Franceschi

Systematics

The New Caledonian population is on the south-eastern boundary of the distribution area (de Naurois & Rancurel, 1978). Its taxonomic status remains controversial. Cramp (1985) and Higgins & Davis (1996) include the New Caledonian population in the Australian subspecies *S. d. gracilis*. Gochfeld & Burger (1996) comprise it in the subspecies *S. d. bangsi*, observed from China to the Southwest Pacific. All these authors make a distinction between these subspecies and the nominal subspecies, based on the beak's colour shifting from blackish in the non-breeding season to bright red during incubation,

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and on a shorter wing (208-228 mm) and a longer beak (33-42 mm). Measurements overlap between *S. d. gracilis* and *S. d. bangsi*, particularly between *S. d. bangsi* of Indonesia and *S. d. gracilis* of Queensland (Australia; Higgins & Davis, 1996). A variation in types according to latitude is observed by all aforementioned authors: populations in subtropical areas comprise smaller individuals (shorter wing, lesser mass) with a longer, very red beak. Cramp (1985) highlight the fact that, in populations of the nominal subspecies *S. d. dougallii* (Atlantic), these features vary in a similar way and with the same range as within the species. The presence of populations linked to *S. d. gracilis* in Australia and *S. d. bangsi* in Indonesia, combined with the observed cross-reference of the biometric data between both subspecies according to latitude, raises the question of the identity of the New Caledonian population. The closest populations (1,600 km) are those on Australia's eastern coast (equal latitude) and belong to *S. d. gracilis*. Lashko (2004) determined the existence of two main lineages based on genetics, one tallying with the nominal subspecies (Atlantic) and the other with the Indo-Pacific area. This study shows no significant genetic distance between *S. d. gracilis* and *S. d. bangsi*, thereby highlighting variation of a geographical nature within a monophyletic group. Moreover, O'Neill *et al.* (2005) put forward a wintering case in the south of the Great Barrier Reef (Australia) with birds from Asian colonies (Japan and Taiwan). The New Caledonian roseate tern population, not included in Lashko's study (2004), seems to belong to this Indo-Pacific lineage.

Biology

Biotope

The non-pelagic marine environment comprises 23,400 km² of lagoons, hun-

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dreds of islets and 8,000 km² of reef constructions (Ifrecor, 2007). A wide diversity of lagoon and reef habitats covers this large surface area (Andréfouët & Torres-Puliza, 2004). In lagoons, the temperature of surface waters ranges from 19 to 27°C, according to latitude and seasons. ENSO (El Niño Southern Oscillation) and cyclones have an influence on local meteorology and the hydrographic characteristics of surface waters (Laboute & Richer de Forges, 2004; Météo France, 2007).

Food-hunting behaviour and types of prey

In tropical areas, the species fishes a lot in the wake of large marine predators (mammals, tunas (*Thunnus* sp.); Gochfeld & Burger, 1996), a typical strategy for tropical seabirds (Ballance *et al.*, 2002). In New Caledonia (J. Baudat-Franceschi, pers. obs.), it is observed following schools of trevally (*Caranx* sp.), skipjack tuna (*Katsuwonus pelamis*) and shark (*Carcharhinus* sp.), often in plurispecific groups possibly including *S. sumatrana*, *S. nereis*, *S. bergii*, *Anous minutus*, *Anous stolidus* and *Sula leucogaster*. It is seldom observed from the coast and in the open sea ("2,000 individuals between Grande Terre and Lifou" have been reported; Barré & Dutson, 2000). Details of the food diet are unknown. Rancurel (1976) refers to feedings using *Pranesus pinguis*. A study on the Great Australian Barrier Reef shows a majority of Gobiidae, followed by Atherinidae, then Clupeidae (Higgins & Davies, 1996).

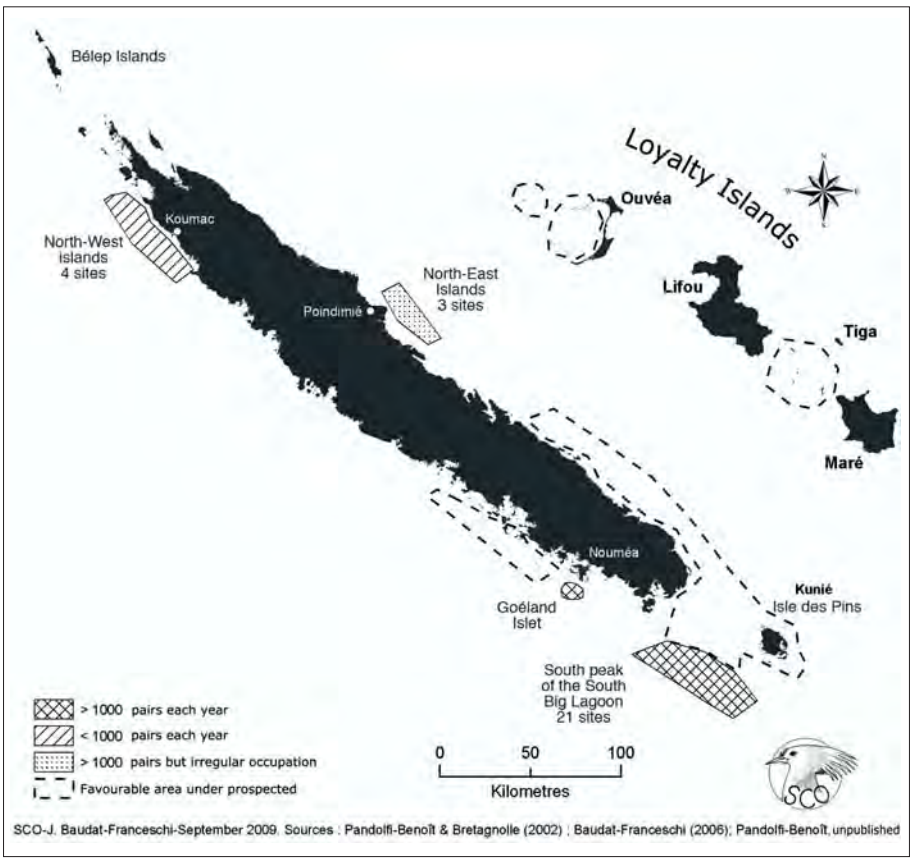
Breeding

In New Caledonia, known colonies are all located on islets of the Grande Terre lagoon (De Naurois & Rancurel, 1978; Hannecart & Letocart, 1980; Pandolfi-Benoît & Bretagnolle, 2002; Baudat-Franceschi, 2006). The types of habitats used include sandbanks or dead coral beds, sandy headlands or backshores with short vegetation. Some pairs settled beneath bushy vegetation have been observed (Baudat-Franceschi, 2006; V. Bretagnolle, pers. obs. on Koko). Sites can be shared with *S. sumatrana*, *S. bergii*, *S. anaethetus*, *Anous stolidus* and *Sula leucogaster*; large colonies tend to be monospecific (De Naurois & Rancurel, 1978; Pandolfi-Benoît & Bretagnolle, 2002; Baudat-Franceschi, 2006). The egg-laying period ranges from early November to late February (extreme dates from October to July; Rancurel, 1976; De Naurois & Rancurel, 1978; Vassard, 1988; Baudat-Franceschi, 2006; M. Pandolfi-Benoît, pers. obs.). A much spread-out cycle is typical in tropical areas (Hamer *et al.*, 2002): the phenology of breeding seems to be mainly under the influence of the marine environment's food productivity and/or of social parameters. In Queensland, breeding thus occurs all year round (Higgins & Davis, 1996). In roseate tern, early breeding related to high food availability is sometimes recorded (Gochfeld & Burger, 1996). Nests show a small hollow, with two-egg clutches seemingly more frequent than in Europe (De Naurois & Rancurel, 1978). No accurate data are available on the length of incubation and of young-rearing periods in New Caledonia, which are supposedly similar to those of populations in subtropical Australia (21 to 26 days of incubation and 22 to 30 days of young-rearing; Higgins & Davis, 1996). The species is

no longer observed in the cool season and modalities of post-breeding dissemination are unknown.

Numbers and distribution

The New Caledonian roseate tern population seems to fluctuate between 5,000 and 10,000 breeding pairs, i.e. nearly 10% of the world population (70,000-82,000 pairs; Birdlife International, 2009). Some years, nearly 5,000 pairs breed in one single colony of the southern lagoon, thereby suggesting that the total population is probably much closer to 10,000 pairs. The species is observed on the entire Grande Terre lagoon and occasionally on the Loyalty Islands (Barré & Dutson, 2000). The data regarding numbers were provided by Pandolfi-Benoît & Bretagnolle (2002) for the southern lagoon and by Baudat-Franceschi (2006 & pers. obs.) for the northern lagoon: 2,000 to 5,000 pairs in the south from 1994 to 2000, up to 4,000 in the north in 2005 and 2006. Interannual variations in numbers are high: 1,500 to 4,600 pairs in the south and 1,000 to 4,000 in the north. The southernmost part of the lagoon is the main breeding area of the territory [1], with a minimum of 1,500 pairs a year. In the northern lagoon, breeding areas are in the northwest (Koumac; minimum of 500 pairs a year) and the northeast (Poindimié; up to 3,500 pairs). Overall, 29 breeding sites (islets) are currently known. Loyalty to sites is low: of the 74 islets in the southern lagoon, 21 have been colonised in 5 years of monitoring, with only 4 over two successive seasons, and none over three. The overall annual number of colonies appeared to strongly vary, from 1 to 11 with an average of 6 per year (Pandolfi-Benoît & Bretagnolle, 2002). Available data for the north of the lagoon, though sketchier, show the same trend. Loyalty seems to apply at a scale of areas colonised on a yearly basis. It is highly likely that colony transfers occur between the south and the north of the lagoon,



[1] ***Population of roseate tern in New-Caledonia.***

under the influence of factors yet to be determined. Some islets hosting large colonies are inhabited on a more regular basis; for instance in the southern lagoon (M. Pandolfi-Benoît, pers. obs.): Goéland (up to 5,000 pairs), Kouaré (1,600 pairs), N'Di (1,200 pairs). In the northern lagoon (M. Baudat-Franceschi, pers. obs.): Carrey (400 to 500 pairs) in the northwest; in the northeast, an area seems to be inhabited by a large colony (3,500 active nests) on an irregular basis – located in January 2006 (Bois de Fer Islet; Poindimié), it was not seen again since then, however an amateur video shows a similar-sized colony on Karu Islet, a dozen kilometres away (Ponérihouen), in December 1998.

Conservation

Threats

Roseate tern does not seem threatened in the short term due to high numbers and the ecological quality of the New Caledonian lagoon, registered with the UNESCO since 2008. The species is however undermined by the degradation of its breeding sites through disturbance by human activity and introduced predators. De Naurois & Rancurel (l978) thus mention the desertion of the Amédée Islet (Nouméa), an "important nesting site" in the 1940s. A tradition involving egg-collecting likely influences the dynamics of tern populations of the lagoon, in the same way as all places where man is in contact with seabirds (Boersma *et al.*, 2002). Clutches of great crested terns *S. bergii* are poached, as previously noted by De Naurois & Rancurel (1978). This practice has an impact on all breeding species in visited sites, if only due to the disturbance caused to the colonies, as was observed yet again in the northernmost area in 2009 (M. Baudat-Franceschi, pers. obs.). Predators introduced on the islets also have a negative impact on the breeding rates of seabirds that nest on the ground (Burger & Gochfeld, 1994; Towns *et al.*, 2006; Jones *et al.*, 2008). On the islets of New Caledonia, the black rat (*Rattus rattus*) and the Pacific rat (*Rattus exulans*) are the two most widespread species (Pascal *et al.*, 2006; Baudat-Franceschi *et al.*, 2008). The most serious threat however is still human activity.

Management

Goéland Islet, listed since 1995, is the only protected breeding site in Caledonia, although the others are included in IBAs (Spaggiari *et al.*, 2007). The eradication of rats was initiated on the islets of the southern lagoon (Bell, 1998) then in the north, as part of combined management (COS and Birdlife Pacific project; Baudat-Franceschi *et al.*, 2008). The mobility of colonies requires a logic of zonal management (work per groups of islets). A ringing campaign, the prospection of areas with missing data [1] and colony monitoring are essential to better comprehend the numbers and the dynamics of the New Caledonian roseate tern population. It would be interesting to conduct a quality study of the species' biology, particularly in terms of food ecology. Finally, we advocate a scheme for the conservation of terns in the area based on the creation of reserves including a network of islets in the lagoon, for which roseate tern would be a priority species.

Acknowledgement

To the northern (environmental department, J.-J. Cassan) and southern (DENV) provinces, as well as the Packard foundation, for their financial support. Mireille Pandolfi-Benoît (DENV) instigated the creation of the Goéland islet reserve. We hereby wish to pay tribute to her work carried out for more than fifteen years towards the conservation of New Caledonian seabirds. Many thanks to Mrs. Mocellin for her video, to A. Lebouteiller and N. Baillon (COS) for their photos.

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Julien BAUDAT-FRANCESCHI & Vivien CHARTENDRAULT are project manager for the Caledonian Ornithological Society
julien.bf@sco.asso.nc
Vincent BRETAGNOLLE is research director at CEBC/CNRS UPR 1934
breta@cebc.cnrs.fr
Nicolas DELELIS is project manager for the study department Biotope
nico.delelis@gmail.com

The importance of France in the conservation of the various roseate tern populations

Gaëlle QUEMMERAIS-AMICE

Bretagne Vivante

Roseate tern (Sterna dougallii) is one of the rare cosmopolitan seabird species. Five subspecies are generally distinguished (Olsen & Larsson 1995; Roselaar, 2001): S. d. dougallii in the Atlantic and on the western coasts of North America and eastern coasts of Africa, S. d. arideensis around Madagascar, S. d. korustes in India and southwest Asia, S. d. gracilis in southeast Asia and Australia and S. d. bangsi from Japan to Australia and in the Pacific islands. However, according to a recent genetic study, the species is divided into only two lineages; one is Atlantic, S. d. dougallii, and the other Indo-Pacific, S. d. gracilis (Lashko, 2004). The current estimate of the world population ranges between 120,000 and 130,000 pairs (Newton, 2004).

Like roseate tern, French territories are present in the three main oceans. Therefore, it is legitimate to integrate them in the development of a national protection strategy for the species. Yet, does roseate tern breed there and what is the actual status of populations?

Status of colonies

According to the references used, roseate tern does not breed on the French islands of the Indian Ocean, though it occasionally comes to Reunion Island (SEOR, 2009) [1].

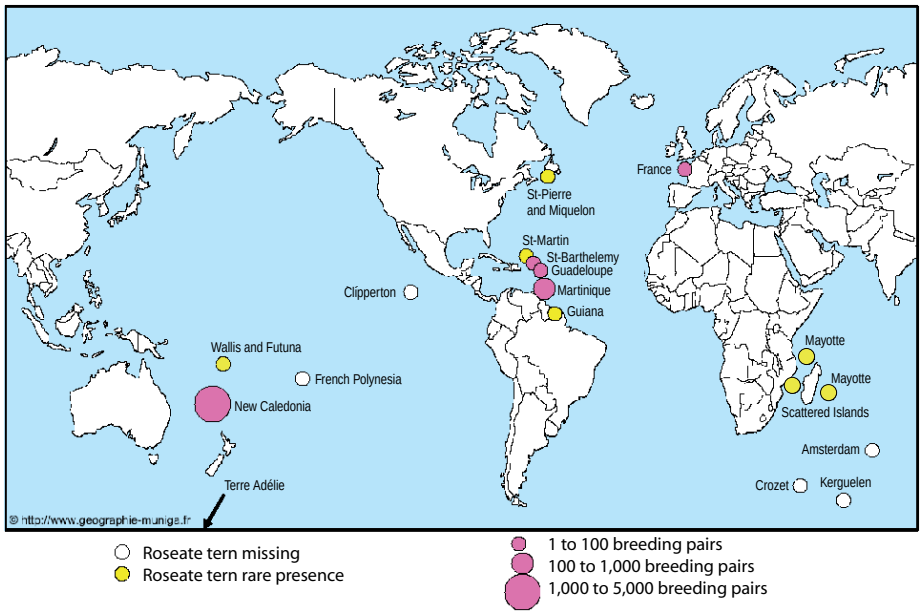
In the Atlantic, it was reported a few times in Saint-Pierre and Miquelon (Avibase, 2009) and French Guiana (GEPOG, 2009). The status in Saint-Martin is harder to assess in the absence of regular monitoring (É. Dubois-Millot, pers. comm.). Roseate tern breeds in Brittany (50 to 54 pairs in 2009; see article by Y. Jacob & M. Capoulade, this issue), Saint-Barthélémy (30 to 50 pairs in 2003; Leblond, 2003), Guadeloupe (37 pairs in 2005; Leblond, 2006) and Martinique (400 pairs in 2006; Dubief, 2009; see article by L. Dubief & G. Leblond, this issue).

In the Pacific, besides its few recordings in Wallis and Futuna (Avibase, 2009), it breeds in New Caledonia where the estimate of numbers for regular colonies ranges between 5,000 and 10,000 pairs (see article by J. Baudat-Franceschi *et al.*, this issue).

French breeder numbers thus represent 4 to 8% of the world population.

Threats and protection measures

While roseate tern is not considered to be threatened on a global scale, the status of French populations varies: the species is endangered in metropolitan France and Guadeloupe; it is threatened in Martinique and New Caledonia. Disturbance in breeding is mainly caused by predators, often introduced, and activity around the islets which is increasing due to the development of yachting. Effective monitoring and care-taking are only provided to the Isle aux Dames colo-



[1] ***Location of roseate tern colonies on French territories.***

ny in Brittany, thanks to the EU LIFE programme [2]. In Saint-Martin and Saint-Barthélémy, the lack of monitoring makes the assessment of needs difficult. In other sites, they are well identified but managers are lacking the means to deal with them. Indeed, the most effective actions are often rat extermination, trapping of other predators and care-taking which require extensive working time and are thus very costly [3]. These solutions need to be implemented soon or maintained in all the French sites that host nesting roseate tern. A national action plan seems to be the most consistent answer toward coordinating actions at the scale of the French population.

Development of a national conservation plan

Roseate tern does not have the same biological and behavioural features in the various geographic areas it breeds in. It most generally settles in mixed colonies

	Metropolitan France	Saint-Barthélémy	Guadeloupe	Martinique	New Caledonia
Monitoring	X		X	1 (2006)	
Ringing	X				
Wardening	X		X	X	X
Vegetation management	X		X		
Management of predators and unwanted animals	X		X		
Development of artificial colonies to multiply sites	X				
Activities, awareness-raising, communication	X				X

[2] ***Actions in progress and to be continued for roseate tern conservation.***

	Metropolitan France	Saint-Barthelemy	Guadeloupe	Martinique	New-Caledonia
Finding a manager		X			
Enhancing the protection status of colonies	X	X		X	X
Monitoring		X		X	X
Wardening		X	X	X	X
Vegetation management		X	X		X
Management of predators and unwanted animals		X	X	X	X
Development of artificial colonies to multiply sites			X		
Activities, awareness-raising, communication		X	X	X	X
Grant and fund raising	from late 2010	X	X	X	X

[3] ***Actions to be developed for roseate tern conservation.***

and in a sheltered location in the North Atlantic, yet in tropical regions it can nest in open spaces and in mono-specific colonies of several thousands of pairs, such as in New Caledonia for instance (see article by J. Baudat-Franceschi *et al.*, this issue). Loyalty to colonies also varies. These differences between populations must be taken into account in the set-up of conservation projects and require reliance on local teams that know the specificities of their roseate terns well. This is all the more relevant since the particular statuses of Saint-Barthélémy (overseas authority) and of New Caledonia (overseas authority with a peculiar status) require good knowledge of local official frameworks. Conversely, the measures to be implemented are similar from one site to the next, and a national coordination would provide greater effectiveness of managers.

There are a number of funds and programmes, particularly at the European level, but they all require specific conditions that cannot take into account the French roseate tern populations as a whole (the Natura 2000 network and the LIFE+ Nature programmes do not exist in overseas territories; FEDER funding varies for each region) or particular actions essential to their maintenance such as monitoring or care-taking (LIFE+ Biodiversity programmes are implementable overseas but they cannot fund monitoring or recurrent actions). It therefore appears that a national action plan would be the perfect tool: it would provide consistency at the scale of the French territories and its coordinator, by centralising experiences and information, would save managers' as well as national and international partners' time. The distinctive features of roseate tern justify that it should be part of a national action plan; it is however important to note that all actions in favour of this species are of benefit to other terns when colonies are multi-specific and also to seabirds in general. An action programme will help to enhance the sites' protection status, particularly overseas, to develop monitoring on a regular basis and adequate care-taking, to restore degraded islets (vegetation management and predator eradication), to raise awareness of elected representatives and the public, to share our experience with other managers and to communicate about the French government's commitment in favour of threatened species. The national strategy for biodiversity approved by France in 2004, actually aims at the development of restoration and protection plans for the most threatened species, among various actions.

A number of threats, such as the development of yachting overseas, are increasingly present and require prompt action, ideally from 2011, to preserve the French populations of the rare roseate tern.

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Gaëlle QUEMMERAIS-AMICE is the coordinator of the programme LIFE Dougall
life-dougall@bretagne-vivante.org

Mission and role of the French Marine Protected Areas Agency in protecting roseate tern

Laurent GERMAIN

Bretagne Vivante

Due to its marine area ranking second in the world (over 10 million km²), its presence in the 5 oceans and its major preservation stakes, France is fully committed by international agreements to dealing with the conservation of marine biodiversity [1].

In addition to the United Nations Convention on the Law of the Sea (1982, Montego Bay) making this compulsory, an intertwined system of texts must lead both to the protection of the most outstanding species and habitats and to the development of consistent and effective networks of marine protected areas (MPAs).

At the international level, the convention on biological diversity[1] aims at ending the erosion of this diversity and at developing a consistent network of marine protected areas on the 2012 horizon. This general convention is specified by thematic conventions such as those on migratory species (Bonn convention)[2]. Conventions at the regional level state these commitments:
- OSPAR convention (North-East Atlantic);
- Barcelona convention (Mediterranean);
- Helsinki convention (Baltic);
- Cartagena convention (Caribbean);
- Nouméa convention (South Pacific);
- Nairobi convention (Eastern Africa);
- convention for the conservation of Antarctic fauna and flora (Southern Ocean).

As regards the OSPAR convention[3], a first deadline was set at 2010 for a consistent and well-managed network of MPAs.

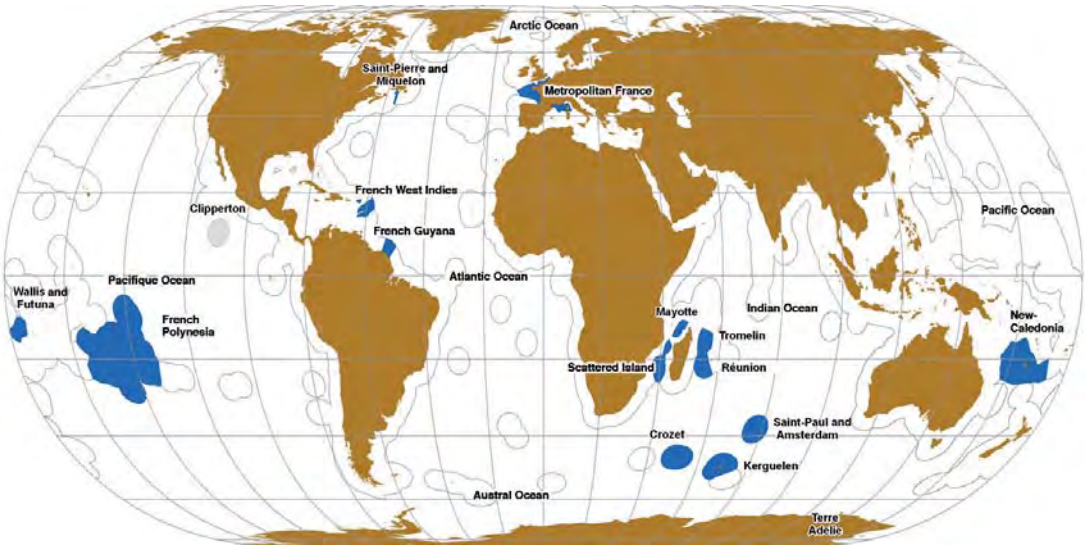
The European Union fully took part by approving the “Birds” directive from 1979 then the “Habitats, wild fauna and flora” directive in 1992. The Natura 2000 network that pertains thereto and totally applies to sea – on the territory of metropolitan France for the time being – should be considered as a coherent network of marine protected areas.

As was developed throughout this conference, the status of roseate tern refers to a high level of protection[4]. On this ground, it requires the implementation of effective protection measures, including the marine protected areas. This is actually the case as regards the “Birds” directive (appendix I) and the OSPAR convention, for the Brittany Region.

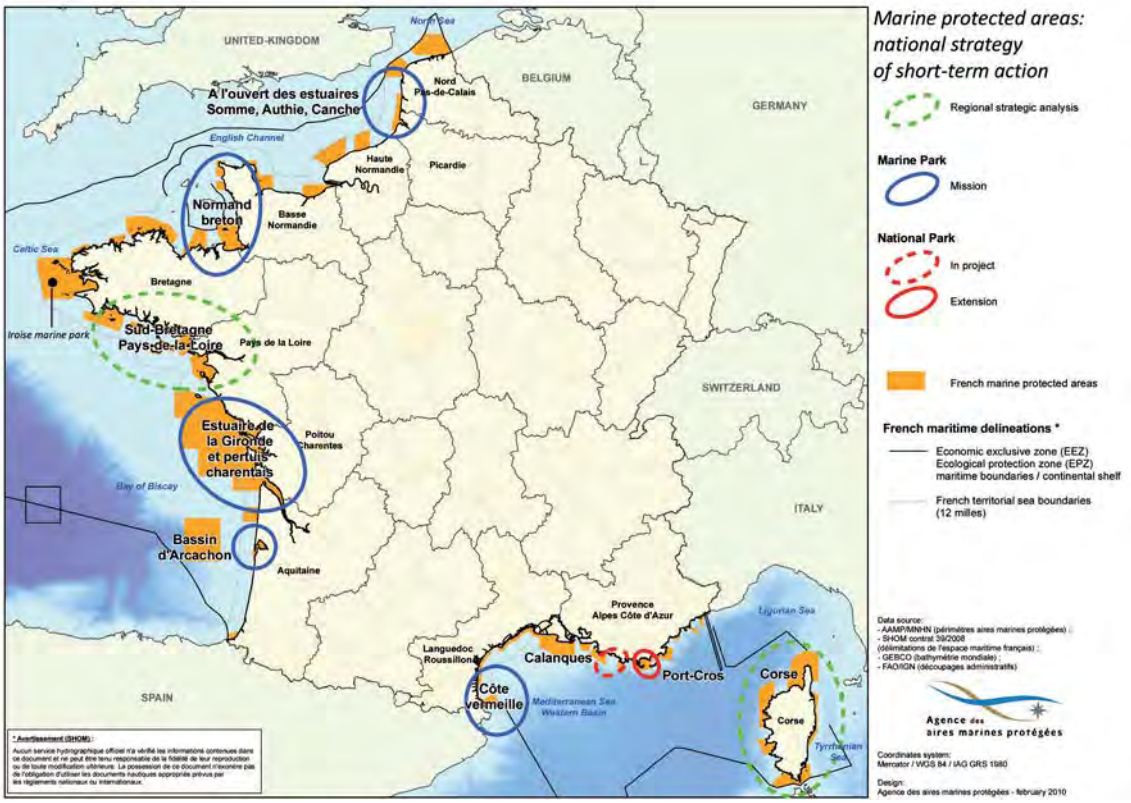
A national strategy of marine protected areas

The Law of 14 April 2006 determined the scope of marine protected areas by firstly scanning the list of protections that could implement these international commitments, each of which has their own logic:
- national parks;
- natural marine parks (new tool created by the law);
- Natura 2000 sites;
- natural reserves;

1-4 : see notes at the end of article.



[1] *Global map of French jurisdiction areas (in blue: exclusive economic zone).*



[2] *Marine protected areas in Metropolitan France.*

- prefectoral decrees for biotope protection;
- areas of the maritime public domain pertaining to the Conservatoire du Littoral.

This non-restrictive list is yet being complemented.
The law also created a new public institution, the French Marine Protected Areas Agency[5], based in Brest, in charge of:
- supporting the creation and management of marine protected areas;
- managing marine protected areas such as natural marine parks;
- developing a network for managers of marine protected areas.

In order to compensate for its slight delay, the French government then developed a national strategy for marine protected areas – that covers metropolitan France – stemming from that on biodiversity, in November 2007[6], which is enforceable. Its extension to all overseas regions is in progress [2].
In the short term, this strategy aimed at:
- strengthening the Natura 2000 network at sea;
- developing 10 natural marine parks including 8 in metropolitan France;
- supporting ongoing projects such as the MPD strategy of the Conservatoire du Littoral.

In the medium term (2020), the commitments of the Sea Grenelle focus on the development of 20% of marine protected areas on all waters under French jurisdiction versus barely 1% at present.

The strategy in Brittany

Within the national strategy, analyses at the regional level are to be carried out on three territories:
- Corsica: launching in progress;
- the area between the island of Batz and La Hague Point: nearing completion;
- the area between Penmarc'h Point and the bay of Bourgneuf: official consultation initiated on 1 December 2009.

These two last areas are thus widely related to roseate tern and its main populations in metropolitan France, which is the purpose of the LIFE programme.

These analyses are carried out by the French Marine Protected Areas Agency with the support of the prefects. The presentation of the method is based on the example of the area between the island of Batz and La Hague Point.

The first phase includes the collection of data and the formalisation of stakes among scientists as well as socio-professional actors, with reference to three issues:
- ecosystems;
- natural and cultural heritage;
- human activity.

The representation of stakes leads to collegiate validation.

In the second phase, proposals for marine protected areas on relevant entities are presented (5 were defined for this study area). This phase requires local consultation meetings at the scale of each area.

Several types of proposals are thereby generated:
- consideration of a natural marine park from Cape Fréhel to Cape La Hague;
- strengthening the Natura 2000 network at sea;
- development of reinforced protection tools such as national natural reserves for the bay of Morlaix or the areas with strong stakes on the plateau of Triagoz or the island of Bréhat.

In the bay of Morlaix, the presence of a major tern colony is one of the stakes justifying the consideration of a national natural reserve. This consideration should be tackled in the development of Natura 2000 at sea. As regards the area under consideration for a natural marine park, stakes in terms of food resources or peacefulness for seabirds will be key points of the project.

As regards the area under analysis from Penmarc'h Point to the bay of Bourgneuf, consulting should begin, yet the preparatory document particularly suggests considering a natural marine park in the area of Mor Braz and of the islands, effectively managing Natura 2000 at sea and developing a reinforced protection tool around the Glénan archipelago. Here, the ornithological stake is also crucial.

Prospects and role of the agency

To conclude, ornithological stakes, and particularly those related to roseate tern, have been at the root of proposals for marine protected areas in the cases of both regional analyses referring to Brittany. The government is in charge of implementing the suggested tools, which will be effective once the management tools and a manager are established, i.e. after a number of years. However, together with the necessary efforts toward increasing knowledge, this implementation will provide a marine counterpart to conservation actions for land colonies: conservation of feeding areas and trophic resources, in particular.

5-6 : see notes at the end of article.

It seems essential to develop a coordinated approach to the conservation of this species at the scale of its biogeographic distribution areas, towards which must be an actual effective network rather than the juxtaposition of individual protected areas. A North-East Atlantic-scale project would have all the necessary technical and financial frameworks and could be a pilot-project in implementing the EU directive on marine strategy.

On a global scale, France has a responsibility towards all roseate tern subspecies. The current implementation of MPA regional strategies also relies on ornithological stakes. MPA projects will materialise in the years to come for marine areas inhabited by roseate tern: natural marine park, national natural reserves, development of UNESCO world heritage sites in New Caledonia… Within the framework of its roles defined by the law and as it is present in all French maritime regions, the French Marine Protected Areas Agency can operate on various grounds:
- support in developing marine protected areas for roseate terns: studies, consultation, definition of statutes and management rules, representation in international committees;
- assistance in managing marine protected areas: support to managers regarding marine aspects (e.g., UNESCO world heritage);
- management of marine protected areas: supervision of missions to consider natural marine parks and management integration of tern feeding strategy;
- federation of managers: development of a network of managers, supervision of international projects, national-scale work in response to a scheme for the conservation of roseate tern.

In all cases, it will provide support to projects resulting from the extension of this LIFE programme as regards marine aspects. ■

Notes

1 - www.cbd.int
2 - www.cms.int
3 - www.ospar.org
4 - inpn.mnhn.fr
5 - www.aires-marines.fr
6 - www.aires-marines.fr/images/stories/aires/Strategie_metropole.pdf

Laurent GERMAIN is project manager at the French Marine Protected Areas Agency
laurent.germain@aires-marines.fr

National action plans for threatened species

Valère MARSAUDON & Sabine MORAUD

Bretagne Vivante

The fight against the loss of biodiversity is a strong commitment on behalf of the French government and the European Union. It is being increasingly reflected in national, community and international agreements and policies.

This reflection appears in both regulations and incentives schemes increasingly involving multiple aspects of human activity that impact on natural areas and the species which inhabit them.

The tools of this policy include national action plans for the conservation or re-establishment of species with an unfavourable conservation status. They have become essential tools in the policies of the French Ministry of Ecology, Energy, Sustainable Development and Sea (MEEDDM), whether regarding the implementation of voluntary actions for the protection of species or the consideration of these species in planning and infrastructure projects that require official authorisations.

What is a national action plan?

National action plans – previously named "national restoration plans" – are in line with the extension of "National Plans for the Conservation of Biodiversity" initiated by the French ministry of environment in the early 1990s in order to increase knowledge of wild fauna and flora.

National action plans however exceed this target and suggest a list of hierarchised operational actions to favour the restoration of species threatened on the national and European territory. These operations are defined in reference to the threats encountered by these species and complement the legislative and regulatory scheme for the protection of living species. National action plans thus determine an actual strategy for the re-establishment of species to a favourable conservation status.

National action plans are unopposable documents. They provide information to the relevant actors and the public, and facilitate the integration of the protection of species in human activity and public policies.

Strategic framework of national action plans

The first national action plans drawn up in 2009 – in comparison with the first national restoration plans constituted in the late 1990s – comprise improvements towards strengthening the role of these plans and their appropriation by the relevant actors.

These amendments resulted from various national discussions, particularly the national strategy for biodiversity approved in November 2004 and the Grenelle of the Environment organised in 2007.

The assessment completed upon the development of the national strategy for biodiversity thus considered the national

restoration plans “as a catalyst that undeniably contributed to the rationalisation of conservation actions developed to support the species they involve” and highlighted the need to reform and strengthen the tool especially in order to favour the appropriation by actors and the integration in the relevant territorial and sectoral policies (land planning, urban planning, agriculture).

In its programme aiming at “stopping the loss of biodiversity”, the Grenelle of the Environment in turn required the implementation of 5-year conservation and restoration plans for species present on the French territory and considered critically endangered on the IUCN world red list, thereby giving a new scope to national actions plans.

National action plans are also in line with community and international strategies in terms of conservation of biodiversity. They therefore take into account the action plans developed within the framework of international agreements ratified by France and take into consideration the action plans for species found in Europe, established by the European Commission (e.g., red kite, great bittern).

Legal framework of national action plans

At the national level, regulations referring to the protection of threatened fauna and flora species, in accordance with articles L.411-1 and L.411-2 of the French environmental code, aim to guarantee the maintenance or the re-establishment of these species to a favourable conservation status. The scheme structured accordingly consists of a number of activity or operation bans, potentially involving these species.

The conservation status of some of these species however requires specific actions, especially voluntary, in order to restore their populations and habitats. National action plans were developed to meet such needs and thereby complement national regulations regarding the conservation of biodiversity.

National regulations comprise a system of derogations to the basic protection of species, which are granted under the conditions determined in §4 of article L.411-2 of the French environmental code. These derogations are only issued provided that authorised operations do not degrade the conservation status of the relevant species and thus occasionally require the implementation of complementary measures. Within this framework, national action plans can provide useful elements to assess the impact of a project and more so to facilitate the definition of actions to be implemented towards reducing it and/or compensating for it. These actions will thereby contribute to the enhancement of the conservation status of the relevant species.

In parallel, as a result of the Grenelle of the Environment’s conclusions, the legal basis of national action plans was strengthened. The tool is indeed mentioned in article 23 of the law “Grenelle I” of 3 August 2009 and the bill “Grenelle II” aims to insert an article L. 411-9 about them in Book IV of the French environmental code.

Selection of species that must be part of a national action plan

The choice of species that must be part of a national action plan relies on several criteria.
A first criterion is the level of threat encountered by these species, determined in the red lists of the International Union for Conservation of Nature (IUCN). Based on a global or national record, these lists classify species according to their risk of extinction. The latter is defined on the basis of various parameters related to each species such as the size of its population, the level of loss of its natural habitat, the state of fragmentation of its distribution, its rate of decline Several red lists are currently available and used as a reference in choosing the species to be part of a national action plan in France. This is particularly the case of:
- world red lists updated in 2007; these lists were used to set a number of targets of the Grenelle of the Environment that refer to stopping the loss of biodiversity;
- national red lists particularly including that of mammals, nesting birds, amphibians and reptiles, and also orchids.

In addition to the risk of extinction, other criteria were determined by the National Museum of Natural History (MNHN) to hierarchise the species eligible for a national action plan. These criteria particularly include European/international

commitments and the environmental responsibility of France.

Development, implementation and assessment of a national action plan

On a yearly basis, the French Ministry of Ecology, Energy, Sustainable Development and Sea defines the priority species to be part of a national action plan according to the aforementioned criteria.

The plans are drawn up by external contractors, selected following a call for tenders, and assisted by a committee monitoring the plan's development, including scientists, government services and future stakeholders of the action plan. This committee is established by the ministry of ecology.

Throughout the plan's development, all potential partners of the plan – including government services – are consulted in order to favour a better appropriation of the actions to be implemented.

The plan is eventually validated at the national level by the ministry of ecology, following the consultation of the various relevant ministries and the national council for the protection of nature.

The monitoring of the plan's development and, subsequently, the coordination of its implementation are achieved by a regional environmental authority that specifically deals with the species, on behalf of the ministry of ecology. This decentralised department of the ministry of ecology is thus named "coordinating DIREN / DREAL".

The coordinating DIREN / DREAL keeps an eye on the implementation of actions defined in the plan and to the observation of strategic directions.

It is assisted by an operator in charge of the plan's technical and scientific coordination. This operator is chosen by the coordinating DIREN / DREAL and the ministry of ecology, and can be of various types (organisation for the protection of nature, area manager, public institution).

The operator is the key contact for field workers implementing the actions defined in the plan. These actors can be associations for the protection of nature, managers of natural areas (regional conservatories of natural areas, regional natural parks), public institutions (national parks, national office for hunting and wildlife, national agency for water and aquatic environments, national forests office...), socio-professional actors (farmers, foresters, fish farmers…), scientific partners (French National Centre for Scientific Research, Cemagref…) or government services.

The coordinating DIREN / DREAL plays its part in close collaboration with the steering committee of the national action plan, which is set up from the plan's development and includes government services, managers of natural areas, associations for the protection of nature, socio-professionals, local authorities and scientists.

The committee suggests strategy and budget directions of the plan and its mission comprises the monitoring and assessment of the plan's completion and financial means as well as the definition of priority actions to be implemented.

To facilitate the monitoring of the plan's implementation, the coordinating DIREN / DREAL is in charge of assessing actions carried out by the operator on a yearly basis.

At the end of the plan, the latter is evaluated by an external contractor chosen by the coordinating DIREN / DREAL following a call for tenders. The aim is to determine the outcomes of the plan as regards the conservation status of the species or subspecies for which it was established. On the basis of these elements, the evaluation will define the next steps of the plan and, particularly, the opportunity to continue actions within the framework of a new national action plan.

Contents of a national action plan

A national action plan is built in three sections.

The first section synthesises acquired knowledge on the subject and, specifically, the biological and ecological requirements of the species or subspecies considered, the causes of decline and the actions previously carried out.

The second section describes the needs and stakes for the conservation of the species or subspecies concerned by the plan and the definition of a long-term stra-

tegy towards re-establishing and maintaining the species or subspecies considered in a favourable conservation status.

The third section states:
- the targets to be achieved at the end of the plan;
- the conservation actions to be conducted in the three fields of protection, study and communications. They are presented in order of priority and, for each of them, the modalities of their implementation, monitoring and assessment are specified;
- the organisational modalities of the national action plan's implementation.

A national action plan is generally carried out over a 5-year period. However, there are some exceptions, especially for long-lived species.

A national action plan for roseate tern?

Roseate tern (*Sterna dougallii*) is protected in France and at the community level (Appendix I of the "Birds" directive). The species is highly threatened in France as it is in the "critically endangered" category of the French red list of nesting birds in metropolitan France (UICN France & MNHN, 2008) and threatened in Europe ("rare" SPEC 3 category, Birdlife International 2004). France has an important heritage responsibility for the conservation of roseate tern. Moreover, threats encountered by this species are well-known, particularly thanks to inputs of the 2005-2010 LIFE programme.

The national action plan tool thus seems interesting towards coordinating actions for increased knowledge, conservation and awareness-raising regarding this species or, to a greater extent, the various tern species.

There are several elements to be considered in order to define the scope of this "tern(s)" conservation strategy and the seminar represents an important milestone for the preparatory discussion that will lead to selecting the conservation strategy most adapted to this species or the various tern species. These elements particularly include:

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- the level of threat encountered by the different species (criteria such as the "IUCN red list");
- the types of threats (overall the same for the various tern species);
- the overall consistency, the implementation's effectiveness and the visibility of the approach (MEEDDM will not have manifold specific plans and instead group together species with close ecological requirements and conservation-related needs);
- intervention capacity (naturalist associations often highly mobilised for the various tern species, numerous conservation actions carried out) dependent upon threats and existing means;
- the geographic area and the number of relevant regions (more or less important coordination actions, potential risk of weakening the actions).

It is important to note that the tool is relatively flexible and that it is totally conceivable to draw up a national strategy for the conservation of tern, then to extend it at the regional level (Brittany, West Indies, etc.) in the form of regional plans by putting forward one or several species in terms of action priorities. The advantage of this approach is to guarantee the consistency of conservation actions conducted, by developing a general framework – the strategy – while facilitating the specific adaptation of suggested actions to the regions and to the species considered in the regional plans.

In practical terms and subject to the validation of the development of a national action plan (or strategy) for roseate tern, it could be planned for the year 2011, with the launching of the call for tenders early in the year and the writing throughout the year. Depending on the selection as to the strategy, one or two DIREN / DREAL (e.g., Brittany and Guadeloupe or Martinique) could be accepted as coordinators. In accordance with the proceedings established for the development of a national action plan, all potential partners of the plan should be consulted. The development and implementation of the national action plan, to a great extent, would take into account the knowledge and experience acquired throughout the LIFE programme "conservation of the roseate tern in Brittany". ■

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Valère MARSAUDON is project manager for the DIREN / DREAL (Regional Environment Authority) of Brittany
valere.marsaudon@developpement-durable.gouv.fr
Sabine MORAUD is project manager for the French Ministry of Ecology, Energy, Sustainable Development and Sea
sabine. moraud@developpement-durable.gouv.fr

The part of Natura 2000 in post-LIFE

Valère MARSAUDON

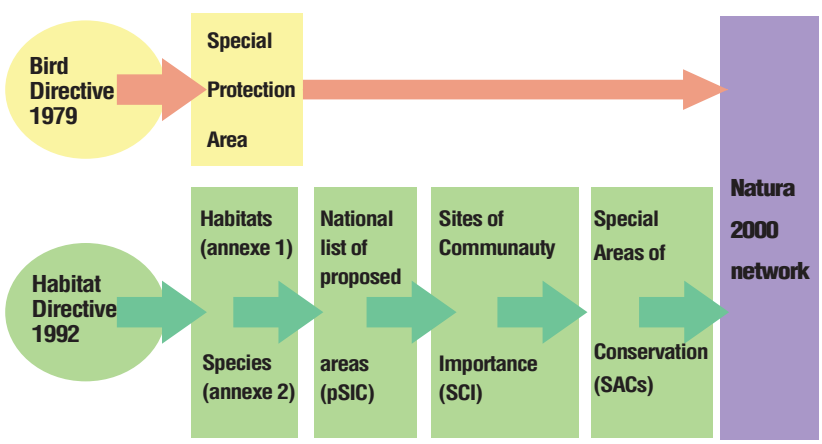
Bretagne Vivante

This presentation aims at reviewing the various existing schemes in France, and the associated means of financial support, to maintain some of the actions conducted within the framework of the LIFE Dougall program from 2011. Possibilities offered by the Natura 2000 network will mainly be tackled (contractualisation of management measures, awareness-raising, monitoring, etc.) as well as additional opportunities (coordination of the conservation strategy, management of measures for which Natura 2000 contractualisation is not possible, etc.) that the development of a national action plan would provide.

Natura 2000 network: aim, composition, implementation in France

The Natura 2000 network derives from the enforcement of two EU directives 79/409/CEE ("Birds" directive) and 92/43/CEE ("Habitats-Fauna-Flora" directive). Its main objective is to preserve biological diversity (fauna, flora and natural environments) on the EU territory by maintaining or restoring the most threatened habitats and species (listed in the appendices of both directives) to a favourable conservation status.

The implementation of Natura 2000 leads, on the one hand, to the development of general protection measures for species (protected species regime) and, on the other hand, to the establishment of a consistent network of areas where the conservation management of species and habitats is operated. The composition of this network (SPA and SAC) is presented in [1].



[1] *Composition of the Natura 2000 network (SPA and SAC).*

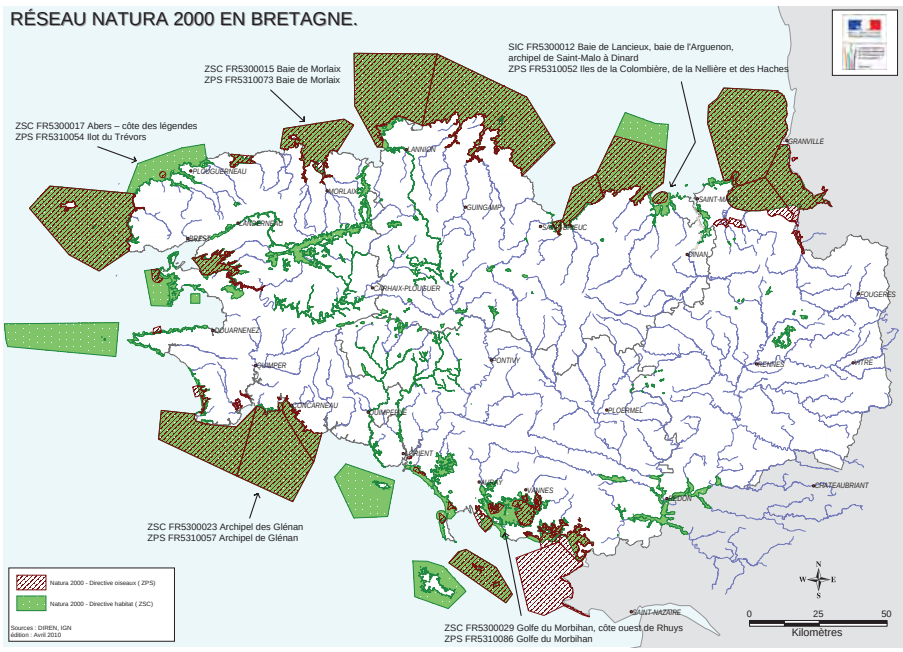
EU member states have an obligation of results with regard to these two directives (maintenance or effective restoration of habitats and species to a favourable conservation status). They can however choose the means to be developed in order to achieve this.

France decided to base its scheme on the voluntary participation and accountability of actors. It focused on three fundamental principles:
- the necessity of transparency and consultation (at the scale of each site and with an important part played by local authorities);
- the favouring of a voluntary commitment in management (contractual management);
- the need to take into account the Natura 2000 network in public policies (particularly by means of the regime assessing the impact of planning documents, programmes, projects, events or interventions with regard to the conservation objectives of Natura 2000 sites).

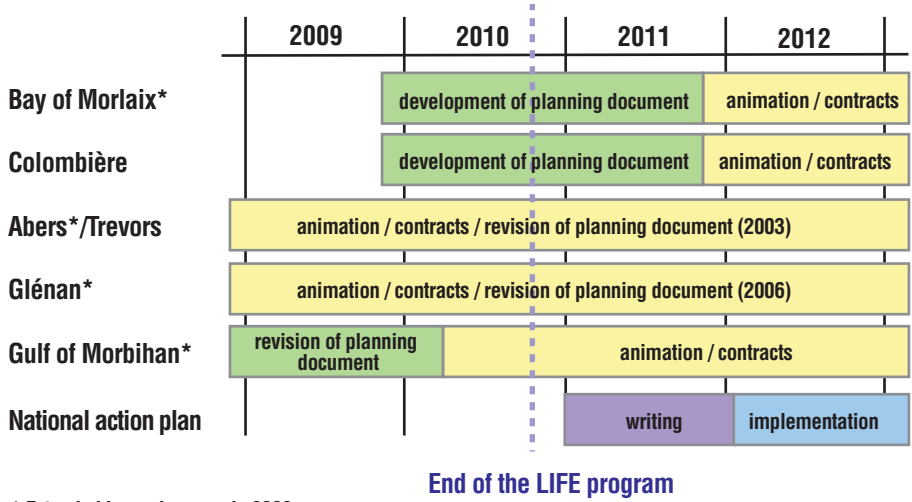
At the scale of each Natura 2000 site, the various steps toward acquiring knowledge, defining conservation objectives, then defining and developing management actions are carried out under the supervision of a steering committee. A guidance and management document resulting from the consultation – the objectives document – is developed by a local operator, validated by the steering committee then approved by the prefect. It specifies the management measures liable to conserve habitats and species in a good status while taking into account human activity. For mixed SAC/SPA sites, e.g. for the 5 sites part of the LIFE programme [2], the diagnosis section of the objectives document is shared yet the section referring to the objectives and actions is specific – “Habitats-fauna-flora” or “Birds”.

State of progress in the 5 Natura 2000 sites of the LIFE program

The state of progress of proceedings varies from one site to the next. Objectives documents have previously been developed for the sites of Glénan (2006), Abers (2003) and gulf of Morbihan (supplements underway), however they require to be revised in order to take into account the important evolutions of the proceedings (bills of 21 November 2007 on contractual management of Natura 2000 sites and of 26 April 2007 on the writing of Natura 2000 charters), on the one hand, and the expansion of these sites to sea in 2008, on the other hand.



[2] ***Map of the Natura 2000 network in Brittany and of the 5 LIFE sites.***



[3] *State of progress of the Natura 2000 action on the 5 LIFE sites.*

As regards the sites of the bay of Morlaix and the bay of Lancieux, the development of the objectives documents will be launched in late 2009-2010. The mean development duration is two years; contractualisation becomes possible thereafter (so-called coordination phase). For these two key sites in the conservation of roseate tern in France, management contracts could thus be signed from 2012, thereby implying the need to find further funding for the year 2011 as the LIFE programme will expire at the end of 2010. This funding can be provided by DIREN / DREAL grants dedicated to the preservation of animal and plant species.

A national action plan (see article by V. Marsaudon & S. Moraud, this issue) could be drawn up in parallel, in 2011, with the implementation of actions from 2012 [3].

Natura 2000 management measures and conservation of roseate tern

Conservation measures suggested by Natura 2000 are Natura 2000 contracts, Natura 2000 territorialised agri-environmental measures and Natura 2000 charters.

Type of measure of the LIFE programme	Natura 2000 code and title
Wardening	Non eligible
Site developments	A32304R Management by maintenance mowing of open environments A32323P Artificial developments in favour of species justifying a site's designation A32324P Works for grazing regulation and closing or developing access areas
Predator control	A32320P-R Undertakings to eliminate or reduce an undesirable species
Information / awareness-raising	A32326P Developments aiming at keeping users informed to reduce their impact

[4] *Main types of measures of the LIFE programme and their eligibility for Natura 2000 contractual measures.*

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Natura 2000 contracts
Natura 2000 contracts tally with a voluntary commitment on behalf of natural or legal persons who have rights to use land plots, towards conserving or restoring habitats or species, according to precise specifications that meet the conservation targets defined in the objectives document. These contracts generally last 5 years. They entail financial support from the government and the EU, which can amount to 100% of the action's cost, as well as a tax incentive (exemption of the local council part of the property tax on unbuilt land).

The measures eligible for a Natura 2000 contract were specified in the bill of 21 November 2007 referring to the management of Natura 2000 sites and included in the ministerial decree of 17 November 2008. The table [4] shows the main types of measures of the LIFE programme and states their eligibility for Natura 2000 contractual measures.

Measures such as "developments of nesting sites" are thus totally eligible for a Natura 2000 contract. As for predator control and awareness-raising, contracts are also possible under certain conditions. On the other hand, no action in the wardening category is eligible; as it is among the essential actions of the strategy for the conservation of roseate tern, other financial means will have to be sought (e.g., DIREN / DREAL funds dedicated to the preservation of animal and plant species, operating budget of a nature reserve).

Generally, for actions regarding the conservation of terns (roseate tern in particular), the homogenisation of some specifications of management measures is desirable at the scale of Brittany, on the basis of the elements included in each of the 5 management plans drawn up within the framework of this LIFE programme. The contractualisation of these measures on each of the Natura 2000 sites will however only be possible once the objectives document of the actual site is validated.

Natura 2000 charters
The Natura 2000 charter of a site comprises a list of commitments (referring to the entire site or to certain sections only) that tally with common and sustainable land management practices or with sports or leisure activities respectful of natural habitats and species, and requiring no financial compensation for their implementation. This 5 or 10-year scheme is a supplement to the contract, which also entitles to tax exemptions.

As regards the conservation of roseate tern, the Natura 2000 charters could be used to raise awareness and give a "seal of approval" to water sports or leisure activities respectful of the species' ecological requirements (in terms of disturbance especially). This contractual approach

would be a supplement to regulatory zoning such as decrees for biotope protection.

Assessment of actions and funding sources

The funding sources presented in this last section are those only from the ministry of environment (within the limits of the available budget allowances and the priorities set by the ministry and the DIREN / DREAL). It is certainly desirable to seek additional funding, whether community funding (e.g. FEDER, Interreg) or funding by local authorities.

To conclude, it will be possible to sign Natura 2000 contracts provided that the management measure is “listed” [4] and the objectives document of the actual site is validated. In other cases, DIREN / DREAL funds dedicated to the preservation of animal and plant species can be mobilised, with guidance in the case of a national action plan.

For general information and awareness-raising actions, Natura 2000 coordination funds can be mobilised (in the specific case of signs aiming at reducing the impact of users on a habitat or species, a Natura 2000 contract would be applicable).

For measures regarding the monitoring of species and their habitats, it will be possible to mobilise Natura 2000 coordination funds or DIREN / DREAL funds dedicated to the preservation of animal and plant species.

For other studies, DIREN / DREAL funds dedicated to the preservation of animal and plant species can be mobilised, with guidance in the case of a national action plan. If the purpose of the study involves the marine environment, the French Marine Protected Areas Agency can provide funding.

As regards coordination actions of the strategy for the conservation of roseate tern, DIREN / DREAL funds dedicated to the preservation of animal and plant species can be mobilised, with guidance in the case of a national action plan.

Finally, in terms of actions, it is important to note that the DIREN / DREAL can contribute to the potential revision of sites’ regulatory protections, including decrees for biotope protection. ■

Valère MARSAUDON is project manager for the DIREN / DREAL (Regional Environment Authority) of Brittany
valere.marsaudon@developpement-durable.gouv.fr

Which projects for the conservation of roseate tern?

Summary of the round table,
hosted by Bertrand RIVOAL,
Laurent GERMAIN & Valère MARSAUDON,
reported by Marie CAPOULADE

Roseate tern is a rare species whose conservation stakes are related to inter-colony exchanges, migrations and wintering areas, site specificity, climate change all of which is centred around the maritime issue of foraging zones that require the development of consistent action on the international scale. However, projects including all these parameters on a large scale have so far never been carried out.

As stated in the article by G. Quemmerais-Amice regarding the importance of France in the conservation of roseate tern (this issue), there are various tools that could be developed and combined: Natura 2000 network at sea and on land, national conservation plans, EU LIFE and Interreg programmes. Yet several points are worth being raised for a potential project on roseate tern: what would be the specific and geographic scales, what would be the most appropriate types of projects, what organisations would be in charge, with which partners and especially what policy and financial support?

Specific scale

A project focused on all tern species would scatter the means developed for roseate tern as almost all the geographic areas would be relevant. On the other hand, since roseate tern nests within pluri-specific colonies, a project targeting this species with a high heritage value would also facilitate work on other tern species. The conservation of roseate tern thus contributes to maintaining a network of protected sites for all nesting seabirds, including other tern species.

Geographic aspect

In the Atlantic, the issue of the French roseate tern should be examined taking into account two distinct bio-geographic areas: North-East Atlantic and West Indies. These two regions include several countries in which the yearly exchange and migration of the same terns is similar: United Kingdom, Ireland, France and Portugal for the North-East Atlantic

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Laurent Germain, Bertrand Rivoal and Valère Marsaudon during the round table.

area and the numerous countries of the Caribbean space, including France (overseas departments: Guadeloupe, Martinique; overseas communities: Saint-Barthélémy, Saint-Martin), for the West Indies area.

In the Pacific, New Caledonia, which hosts 5,000 to 10,000 pairs of roseate terns every year, can be considered as a distinct geographical entity.

National-scale projects

There are tools that would favour action for roseate tern on a national scale (metropolitan France and overseas). Among the National Strategy for Biodiversity tools, the national action plan – which generally lasts five years – can thus be considered for the conservation of roseate tern. It would require a DIREN or DREAL coordinatrice and, in the case of several regions being involved (metropolitan France and DOM in our case), a relay DIREN / DREAL could be appointed (Guadeloupe or Martinique).

LIFE Nature EU projects can only be implemented in metropolitan France but cannot fund recurrent actions. LIFE Biodiversity projects can be implemented overseas and promote actions for the preservation of biodiversity that take into account several species and particularly innovative schemes in the Natura 2000 framework.

In New Caledonia, all actions must be discussed with the local government. However, the strong commitment of organisations such as the Caledonian Ornithological Society (SCO) or the French Marine Protected Areas Agency (AAMP) is an essential on-site relay.

International - and interregional - scale projects

An international or interregional project would facilitate carrying out consistent actions for a given population without being restricted to borders, which birds obviously do not know of. Moreover, the EU directive on marine strategy (2008/56/CE) stresses the notion of regional seas (East Channel, West Channel, bay of Biscay, Western Mediterranean, etc.), applicable overseas since the Grenelle of the Environment. This directive aims at a “good ecological status of the marine environment” by 2021 and, among others, compels all member states to create a consistent network of marine protected areas (MPAs), representative and able to protect biodiversity at the scale of these regions while being able to absorb population exchanges. At these regional scales, the Directorate-General for Maritime Affairs and Fisheries (DG MARE) of the European Commission also has an important part to play in terms of strategic sea planning. Constantly in search of pilot-projects, these community tools thus seem likely to support a programme such as those concerning roseate tern in the West Channel region and/or Caribbean region.

LIFE Nature projects can be implemented in metropolitan France on a transnational scale. However, as previously mentioned, this type of project cannot fund twice the same type of action and, moreover, LIFE programmes are very complex to develop and community funding resulting thereof is increasingly difficult to manage on a daily basis.

EU Interreg projects, especially Interreg IIIB applicable to the Atlantic seafront of the United Kingdom, Ireland, France, Spain and Portugal, would be suited to the tern issue, all the more so because these projects seem to be currently underexploited. For instance, an Interreg IIIB on balearic puffin (*Puffinus mauretanicus*) and northern gannet (*Morus bassanus*) is about to begin on the themes of marine protected areas, the impact of fisheries, offshore wind farms, the improvement of bird monitoring protocols, etc. An Interreg programme on roseate tern would thus be totally appropriate on the Atlantic coast and also in the Caribbean area with the Interreg IV programme relevant to this region.

The caretaking issue

Experiences of Bretagne Vivante, the RSPB or Birdwatch Ireland show that wardening is a priority action to carry out for the conservation of tern colonies. This care-taking consists of awareness-raising, daily informing and thus stopping the various categories of sea-area users (sailors, shellfish gatherers, sea professionals) from disturbing the birds during their nesting season. Natura 2000 funding, drawn up according to input regar-

ding the management of habitats and not species, currently cannot implement this action. Conversely, a national action plan could intervene in this critical mission, as is already the case within the framework of the Osprey plan for instance, in which approximately one third of funding is dedicated to surveillance outside Natura 2000 zones. Likewise, among the new criteria for the allocation of the State's nature reserves, the French ministry of environment has considered policy and care-taking missions as priorities at the expense of action for education, awareness-raising and research purposes. A project regarding a nature reserve of Brittany's marine islets is in progress and could thus eventually perpetuate various actions including wardening. However, this network of islets would comprise a restricted number of sites and would exclude many potential hosting areas for roseate tern.

In the bay of Morlaix, a national nature reserve project that would include the islets of the current ornithological reserve and sea areas not yet defined (sea grass, resting places for seals, mudflats) is being submitted to the elected representatives of Morlaix local authorities.

Organisation managing such projects

Small organisations such as Bretagne Vivante obviously find it difficult to manage large projects and the LIFE roseate tern programme is, to date, the biggest project the organisation has ever conducted, with much effort. However, provided that sound organisations can be managers of such projects, a partnership may take place to coordinate on-site action with smaller organisations, most of which are associational. The AAMP could thus take part in the set-up and coordination of a LIFE or Interreg project, with support from the French ministry of environment and the overseas secretariat, as well as the various local relays in the West Indies that could be mobilised such as the ONCFS or the Guadeloupe National Park, which are reference organisations in terms of wildlife management.

As regards national cooperation overseas, there are successful examples such as IFRECOR (French Coral Reef Initiative) or TEMEUM (Terres et Mers Ultramarines) that support organisations managing ultramarine natural areas.

Policy and financial support

In terms of mobilising means, the French Ministry of Ecology, Energy, Sustainable Development and Sea, the French Marine Protected Areas Agency and the DIREN / DREAL confirmed their strong motivation toward committing themselves to such a substantial project.

Among the various points addressed throughout this conference, it seems that at least two projects could be jointly and consistently carried out between land environments and the marine environment, on the theme of seabirds, and hence roseate tern:
- a general project for the designation of MPAs but also for the protection of land areas (national action plan) with the development of consistent national-scale management, communication, awareness-raising, etc.;
- projects with higher targeting on concrete management actions at the biogeographic scale, in which issues of breeding colonies or feeding areas are similar (Interreg, LIFE or other projects in the Caribbean, North-East Atlantic and Channel, New Caledonia regions).

The challenge for the conservation of roseate tern now lies in the development of these projects with support from our national and international partners. ■

Bertrand RIVOAL is Director of Bretagne Vivante
bertrand.rivoal@bretagne-vivante.org
Laurent GERMAIN is project manager for the French Marine Protected Areas Agency
laurent.germain@aires-marines.fr
Valère MARSAUDON is project manager for the DIREN / DREAL of Brittany
valere.marsaudon@developpement-durable.gouv.fr
Marie CAPOULADE is project manager for Bretagne Vivante
marie.capoulade@bretagne-vivante.org

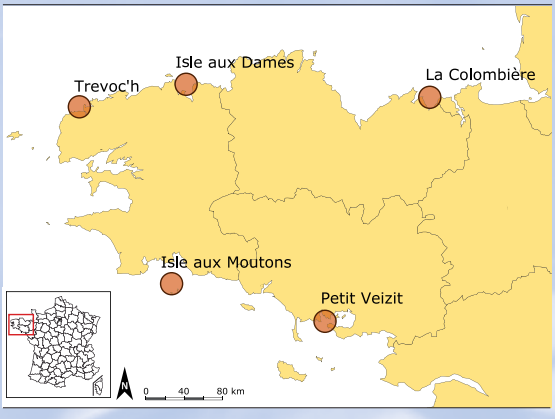
LIFE-Nature programme "Conservation of the roseate tern in Brittany" LIFE05NAT/F/137

Gaëlle QUEMMERAIS-AMICE & Laurent GAGER

Bretagne Vivante

Bretagne Vivante

Roseate tern is the rarest European seabird with approximately 2,500 pairs in 2008 (LIFE Dougall, 2009), including about fifty in France, where it is considered critically endangered (UICN France & MNHN). Currently, the only French colony is settled on the Isle aux Dames, together with sandwich and common terns, in the ornithological reserve of the bay of Morlaix managed by the organisation Bretagne Vivante since 1962. Due to the decline of the species since the 1970s, Bretagne Vivante in partnership with the Côtes d'Armor Council, the Lighthouse & Beacon department of Concarneau and the DIREN / DREAL Brittany proposed a LIFE programme in favour of this species in 2004, with a total budget of 1,436,119 € including 75% funding by the European Community. The goals of the programme, which started in 2005 and will finish at the end of 2010, are to maintain present colonies, increase their numbers and multiply sites that are appropriate for the species. The main threats are related to disturbance by human activity and predation.



[1] ***The five LIFE roseate tern sites.***

In Brittany, five sites in Natura 2000 areas [1] were selected for the implementation of conservation measures for roseate tern. These sites are the Isle de la Colombière which hosts the species on a regular basis, the Isle aux Dames in the bay of Morlaix, the Isle aux Moutons which is the second most important tern colony in Brittany but no longer hosts roseate terns, and the Trevoc'h Islands and Isle du Petit Veizit where no terns are currently nesting. On the first two islets, the priority is to protect the colonies in order to avoid all disturbance (wardening and clear signalling), and to eradicate predators such as rat, herring gull, mink and red fox. On the other three islets, measures mainly aim at attracting

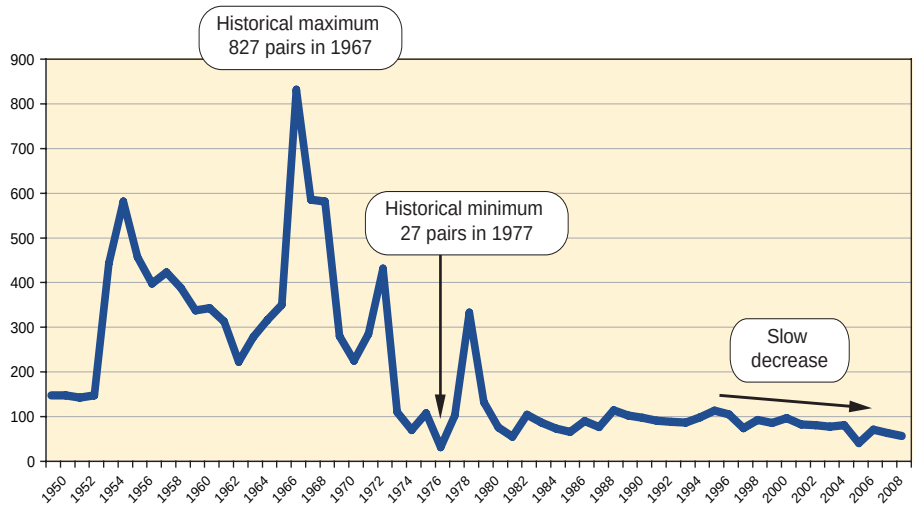
common and sandwich terns first, then roseate terns by installing nest-boxes, decoys and by using playback of tern calls. On all the islets, an area of vegetation is kept short to conform to the requirements of sandwich terns whose presence is an essential precondition for the settlement of roseate tern. On the Isle aux Moutons, the wind turbine supplying the lighthouse – dangerous for terns – was replaced with a solar power station. From May to September, all of these islets are monitored by eco-volunteers, who patrol by boat, and warden-educators who coordinate the surveillance, monitoring and activities. It is possible to partake in this wardening by registering on the LIFE roseate tern website: www.life-sterne-dougall.org/devenir-gardien-de-sternes.php

Besides on-site activities, numerous communication actions have conveyed further information on roseate tern, and the stakes related to its conservation to the general public: bird-watching excursions on the shore or by kayak, discussion forums with reference to the film on roseate tern made within the framework of the LIFE programme, comments by an educator on the images of the Isle aux Dames colony viewed live on internet thanks to a surveillance camera and articles in the press. Fieldtrips are organised with elected representatives, in order to get them involved in the project. Various awareness-raising documents, such as an annual newsletter, a leaflet and a plastic covered brochure for identifying seabirds, are distributed to beach attendants, shellfish gatherers, sailors and kayakers near tern colonies.

Moreover, actions aiming at acquiring and sharing scientific knowledge have been carried out. Campaigns for ringing roseate tern on the Isle aux Dames (7 chicks ringed in 2007 and 28 in 2009) were organised in order to improve understanding of exchanges between the Isle aux Dames and the other European colonies. A database gathering information on the management of tern colonies since the 1960s was created. The tern observatory, established in 1989, was also maintained thanks to the programme and is henceforth integrated into the Seabirds Regional Observatory. It also facilitated the mutualisation of data collected on terns at the scale of historic Brittany (including the Loire-Atlantique department) and the development of a regional strategy in favour of the four tern species of Brittany – common, sandwich, little and roseate terns. By organising a seminar in late 2009, for which the proceedings are hereby published, and thanks to the participation of the organisation Bretagne Vivante in other conferences within the framework of the LIFE programme, we have continued taking an active part in the network of European managers of tern colonies.

After four years of work, it seemed that the main issues were related to predation by mink and red fox. Despite numerous efforts and the involvement of teams on site, it proved to be impossible to invert the trend of the decreasing French roseate tern population [2]. In 2006, mink caused the failure of tern breeding on the Isle aux Dames. However, around twenty pairs of roseate terns managed to find refuge on the Isle de la Colombière, which played its role. In 2008, mink eliminated one third of the French breeders on the Isle aux Dames, despite the trapping system set out all around the bay of Morlaix. Due to this major threat, we developed a solution described as the “last chance”, which consisted of the colony’s protection by means of wire fencing 175 m long, 1.20 m high, buried 30 cm deep and bearing an electrified wire. In 2009, no mink managed to cross this fence and the colony was able to breed normally. Today, the issue of the necessity of a scheme for the eradication of mink in the west of France is raised, in the same way as that carried out in Scotland since 2001 (see article by I. Macleod, this issue). Indeed, it is totally possible to imagine a large-scale trapping campaign that would put the mink population below a threshold tolerable for birds.

As regards red fox on the Isle de la Colombière, a number of methods were experimented with support from the National Office for Hunting and Wildlife (night shooting) and the Côtes d’Armor Council (trapping), but have so far been unsuccessful. The insularity of the site makes it difficult to carry out regular trapping and maintain the traps for long periods of time while avoiding too strong a human scent. Moreover, as the islet is rocky, it is impossible to set inconspicuous traps. Finally, foxes have their shelter on the very close Isle des Hébihens, itself regularly connected to the mainland, thereby making the permanent eradication of fox illusory on this site. Two measures are currently being tested: winter trapping – the season most favourable to fox – on the one hand, and night surveillance of the shingle bank during spring tides, on the other hand, to stop foxes from reaching the Isle de la Colombière. This requires high com-



[2] ***Evolution of roseate tern pair numbers in France from 1950 to 2009.***

mitment on behalf of the on-site employee and the volunteers collaborating, which will have to be maintained following the LIFE programme.

The future of roseate tern in France will most probably take some strengthening of the regulatory protection status of colonies on the Isle de la Colombière, Isle aux Dames and Isle aux Moutons. One of the main threats to terns is indeed disturbance. Strong regulations would help to dissuade repeat offenders and designating reserves would provide the means to maintain the site. A “marine islets” Regional Nature Reserve project is under consideration and will shortly be developed. As it comprises around a hundred islets, including four of the five in the LIFE programme, it would facilitate the consistent management of seabirds. Besides, the bay of Morlaix, which includes the Isle aux Dames, is a remarkable site worthy of the National Nature Reserve status. Scientific argumentation is in progress, meetings and study trips with elected representatives in other reserves will be organised to show the significance of this project. Finally, it appears achievable that the Glénan National Nature Reserve will eventually integrate the Isle aux Moutons in its perimeter.

Besides land-borne threats, feeding areas for seabirds can also be disturbed, whether by (over)fishing or recreational water activities. Data are currently insufficient to assess this problem and the development of Natura 2000 areas at sea will soon facilitate the acquisition of information required to better comprehend the areas to be protected in the maritime domain.

Most of the actions implemented in the LIFE programme will need to be extended in the long run. These comprise recurrent management measures in particular, i.e. wardening, trapping of predators and vegetation management, which will have to be maintained. Also, monitoring, ringing and exchanges with the national and international network will have to be continued, as well as activities and links with elected representatives and sea users. Besides the local authorities already involved in the LIFE programme and whose support can be maintained, a number of actions can be funded by Natura 2000 contracts. Others, such as wardening, require specific statuses – e.g. the creation of a Nature Reserve – to receive funding. Supposing certain sites may shortly be integrated into a reserve, there will still be potential hosting sites for roseate tern in Brittany, where other tern species already breed and where care-taking may not be provided, thereby taking away all hopes of seeing roseate tern settling there. At the end of the LIFE programme, the tool most relevant to roseate terns of Brittany would be a national action plan that would include wardening as well as the management of roseate tern colonies of the West Indies and New

Y. Chérel

Caledonia. Indeed, roseate tern numbers overseas are far higher than those of metropolitan France and are also threatened by human activity or predators. Their immediate protection would perhaps avoid reaching the critical situation of the last colony in metropolitan France.

Acknowledgements
The entire team of the LIFE roseate tern programme, full-time and volunteer, current and former, that works in favour of maintaining roseate tern in metropolitan France.

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Gaëlle QUEMMERAIS-AMICE is coordinator of the LIFE roseate tern programme
life-dougall@bretagne-vivante.fr
Laurent GAGER is voluntary in charge of the LIFE roseate tern programme for Bretagne Vivante
laurent.gager@wanadoo.fr

Closing Speech

Marc GIRARD

Bretagne Vivante

I am always impressed with the amount of knowledge accumulated by voluntary or full-time naturalists and with their concern to share it with great conviction. This was naturally confirmed throughout this workshop.

Everyone will have appreciated the relevance and rigour in the presentations of speakers who successively appeared on stage; with a special mention to our friends from Britain and overseas, as well as our Ghanaian colleague, who all agreed to join us to tell us about their experience and share our work.

The fight for roseate tern is the symbol of what justifies our commitment and our activism in associations like Bretagne Vivante: to partake in the vast undertaking for the preservation of biodiversity.

I remember Hubert Reeves' talk when he came to Morlaix on the occasion of the organisation's fiftieth anniversary: "*As long as there still is hope to save a species, even for a few individuals, it must be seized; because beyond the conservation of this species, it is the quality of our environment, the actual survival of humankind that is at stake*".

For roseate tern, the accounts revealed throughout this seminar show that we are on the right track and reinforce our respective actions, with our beliefs, yet also our doubts, our questions, or even our discouragements.

Before parting, I would like to acknowledge the work of volunteers and especially of the pioneers who worked for long years in the reserves of the Isle aux Moutons and Isle aux Dames. Without the relentless work of Éliane and Charles Le Roux, Even De Kergariou and Michel Querné, we most likely would not be together in Brest today to discuss the protection of roseate tern.

One last word about the organisers of this seminar. Congratulations to Gaëlle Quemmerais-Amice – the kingpin of this gathering –, to Bernard Cadiou, Marie Capoulade and Yann Jacob who managed the smooth progress of these three days flawlessly.

All the best to all of you and let us meet again for the twelfth seminar; how about in the West Indies? Gilles Leblond and Lionel Dubief made our mouths water during the presentation of their islets on Friday morning.

Thank you all for your participation and see you soon!

Marc GIRARD

Voluntary curator of the islets of the bay of Morlaix

G. Quemmerais-Amice

Even de Kergariou in front of the Isle aux Dames.

Excursion to the bay of Morlaix on 1 October 2009

Thanks to unexpected weather conditions, we were able to appreciate the technical aspects of the developments in favour of roseate tern on the Isle aux Dames, as well as the beauty of the bay and its highlight, the Taureau Castle. A very successful buffet complemented the event.

Bretagne Vivante

Presenting the Isle aux Dames to our English-speaking colleagues.

Bretagne Vivante

Small groups follow one another on the Isle aux Dames in order not to damage vegetation or developments.

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An excellent and refreshing buffet at the Taureau Castle, made available for this occasion thanks to the CCI of Morlaix.

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Satiated, participants have a break before exploring the castle. Many thanks to staff and elected representatives of Morlaix Communauté for partaking in this event.

Bretagne Vivante

Boarding to return to the mainland in the sunshine.

J.-P. Rivière

The reserve's boat, in front of Louët Island. Many thanks to Yann Jacob - warden-educator of the ornithological reserve of the bay of Morlaix - for organising this beautiful day!

Paper from sustainable forest sources

Letters for *Penn ar Bed* editing (article projects, letter for authors) have to be addressed to: *Penn ar Bed*, Bretagne Vivante - SEPNB - B.P. 63121 - 186, rue Anatole France - 29231 BREST Cedex 3 - France - Tél.+33(0)2 98 49 07 18 - Fax +33(0)2 98 49 95 80 - Email: contact@bretagne-vivante.org - The opinions expressed in articles are those of the authors, and are not necessarily those of Bretagne Vivante - This issue has been printed at 200 copy - Registration of copyright: May 2010 - Publication Director: F. De Beaulieu - Editorial board: M. Capoulade, G. Quemmerais-Amice et B. Cadiou - Draft: B. Coléno - Printing office PAM, Brest, France - I.S.S.N. 0553-4992.

Cover photography - Roseate tern (Y. Chérel) and Isle aux Dames (H. Ronné)

Programme LIFE Nature
“Roseate tern conservation in Brittany”