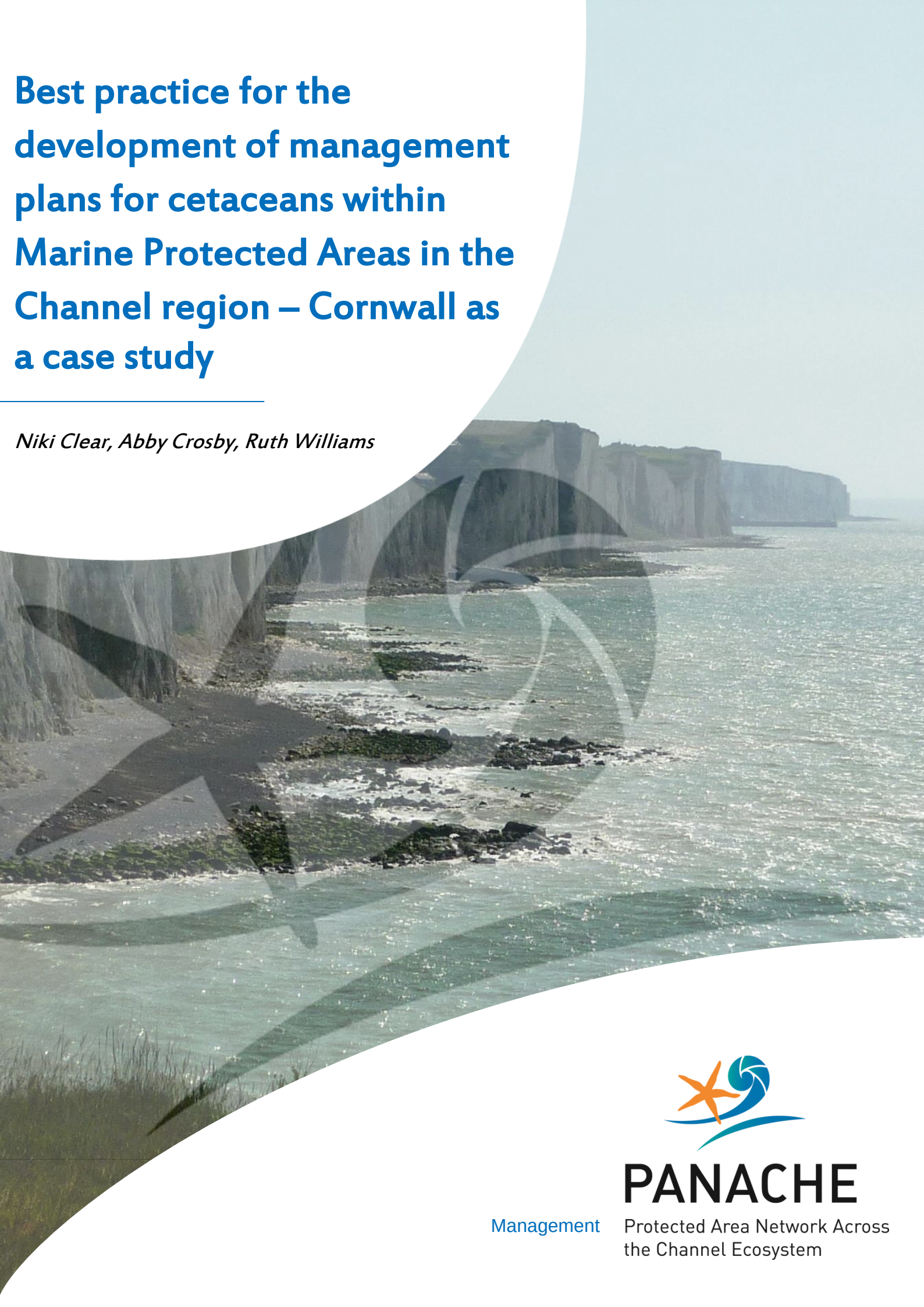
Best practice for the development of management plans for cetaceans within Marine Protected Areas in the Channel region – Cornwall as a case study

Niki Clear, Abby Crosby, Ruth Williams



PANACHE

Management

Protected Area Network Across the Channel Ecosystem

Best practice for the development of management plans for cetaceans within Marine Protected Areas in the Channel region – Cornwall as a case study

Monitoring

Prepared on behalf of / Etabli par

Cornwall

by / par

Author(s) / Auteur(s) : Niki Clear, Abby Crosby, Ruth Williams

Contact : Cornwall Wildlife Trust Marine Team, ruth.williams@cornwallwildlifetrust.org.uk

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Best practice for the development of management plans for cetaceans within Marine Protected Areas in the Channel region – Cornwall as a case study

Bonnes pratiques pour le développement de plans de gestion des cétacés dans les Aires marines protégées de l'espace Manche – étude de cas en Cornouailles

ABSTRACT

Fourteen species of cetaceans have been recorded in the waters of English Channel, with the species encountered most frequently being the harbour porpoise (*Phocoena phocoena*), common dolphins (*Delphinus delphis*) and bottlenose dolphins (*Tursiops truncatus)*. Since 1995, Cornwall Wildlife Trust has been collecting data on all cetaceans using Cornish waters through projects including the Marine Strandings Network, Seaquest Southwest and Seaquest Netsafe. These projects have provided a deeper understanding of cetaceans' distribution and their habitats via visual sightings, acoustic monitoring and strandings investigations. Cornwall Wildlife Trust has also worked to find solutions to some of the major threats facing these animals in inshore waters, such as entanglement in fishing nets. Working closely with the local fishing industry, acoustic deterrent devices have been tested as a tool, in addition to Marine Protected Areas (MPAs), with the aim of reducing bycatch of cetaceans in nets to protect cetacean populations.

The reason for marine mammal mortality varies from natural disease to anthropogenic pressures such as pollution and accidental bycatch in fishing gear. The fact that the English Channel lays claim to the world's busiest seaway and is ranked among the highest globally for cumulative human impacts on marine ecosystems increases the level of such pressures to local cetacean populations. Bycatch in particular has been identified as the leading cause of death for stranded cetaceans in Cornwall. In 2012 the cause of death in 30% of necropsied cetacean carcasses was found to be entanglement in fishing gear, and a further 26% had physical external injuries consistent with interactions with fishing gear. The vast majority of these animals were harbour porpoise and common dolphin.

RÉSUMÉ

Quatorze espèces de cétacés ont été recensées dans les eaux de la Manche, les espèces les plus fréquemment rencontrées étant le marsouin commun (*Phocoena phocoena*), le dauphin commun (*Delphinus delphis*) et le grand dauphin (*Tursiops truncatus)*. Depuis 1995, le Cornwall Wildlife Trust collecte des données sur l'ensemble des cétacés dans les eaux de Cornouailles grâce à des projets tels que le Marine Strandings Network, Seaquest Southwest et Seaquest Netsafe. Ces projets ont permis une meilleure compréhension de la répartition des cétacés et de leurs habitats par le biais d'observations visuelles, de surveillances acoustiques et d'enquêtes sur les animaux échoués. Le Cornwall Wildlife Trust a également travaillé à la recherche de solutions à certains dangers majeurs auxquels ces animaux font face dans les eaux côtières, tels que l'enchevêtrement dans les filets de pêche. En proche collaboration avec l'industrie halieutique locale, l'emploi de dispositifs de répulsion acoustique a été testé, en plus des Aires marines protégées (AMP), afin de réduire le nombre de prises accidentelles de cétacés dans des filets de pêche et d'en protéger les populations.
On dénombre plusieurs causes à la mortalité des mammifères marins, allant de la maladie naturelle aux pressions anthropiques telles que la pollution et les prises accidentelles dans du matériel de pêche. La Manche pouvant prétendre au titre de route maritime la plus active au monde et se classant parmi les zones aux impacts humains cumulatifs sur les écosystèmes marins les plus élevés au monde, l'impact de ces pressions sur les populations locales de cétacés s'en trouve augmenté. Les prises accidentelles, en particulier, ont été identifiées comme la première cause de décès chez les cétacés échoués en Cornouailles. En 2012, les autopsies de carcasses de cétacés ont révélé que, dans 30 % des cas, l'enchevêtrement dans du matériel de pêche était

Chemical pollution such as from organochlorines has been linked to lower immunity to infectious diseases, which is the second leading cause of death seen in harbour porpoise in the UK. Other threats facing marine mammals within the English Channel include increased marine noise pollution, disturbance and habitat degradation.

In European waters, 46 cetacean species and their habitats are included in various conventions, treaties and agreements, many of which embrace the creation of Marine Protected Areas (MPAs) which are increasingly suggested for use as a conservation management tool. However, collection of necessary local population and distribution data to back up such recommendations is difficult as most cetacean species are highly mobile and spend a substantial time below surface. This makes detection, identification, and group size estimation problematic. The knowledge of cetaceans within Cornish waters has been gathered from casual sightings records, photo-identification work, intermittent effort-based surveys both from land and on boat, and in more recent years acoustic monitoring using underwater acoustic monitoring devices.

The understanding of cetacean populations is essential for the designation of Marine Protected Areas as management tools for these species. The variability in range and abundance of some species, such as the harbour porpoise has caused problems for site identification for MPAs. However MPAs are undoubtedly an extremely powerful conservation tool where a species has a small home range that can be covered more or less in its entirety or for migratory species with very clearly defined breeding/feeding areas, or where the threats faced are localised and appropriate management can be put in place to counteract those threats. Using a static, site specific MPA for a cetacean population which (i) routinely or seasonally migrates out of the MPA or (ii) where the home range of a population shifts towards areas outside of the MPA, means that such a site becomes inadequate for the protection of the designated species. Therefore, it is essential for these sites to be supported by schemes or plans which will deal with the complex interaction of different management issues so that cetacean populations are maintained, significant threats reduced, and the habitats of cetaceans are preserved.

la cause du décès, et dans 26 % des cas, les carcasses comportaient des blessures physiques externes concordant avec des interactions avec du matériel de pêche. La plupart de ces animaux étaient des marsouins communs et des dauphins communs. La pollution chimique comme celle produite par les organochlorés a été reliée à une baisse de résistance aux maladies infectieuses, seconde cause de décès constatée parmi les marsouins communs au Royaume-Uni. Les mammifères marins font face à d'autres menaces dans la Manche, telles que la pollution sonore marine, la perturbation et la dégradation de leur habitat.

Dans les eaux européennes, 46 espèces de cétacés et leurs habitats sont inclus dans divers traités, conventions et accords, dont beaucoup adoptent la création d'Aires marines protégées (AMP). L'utilisation de celles-ci comme outils de gestion de conservation est de plus en plus proposée. Cependant, les données sur les populations locales et leur répartition, nécessaires à l'appui de ces recommandations, sont difficiles à collecter, car la plupart des espèces de cétacés se déplacent beaucoup et passent un temps considérable sous la surface. La détection, l'identification, et l'estimation de la taille des groupes s'en trouvent compliquées. Les connaissances actuelles sur les cétacés présents dans les eaux de Cornouailles découlent de rapports d'observations fortuites, de travaux d'identification photographique, d'études intermittentes avec effort aussi bien à terre qu'en bateau et, plus récemment, de surveillances acoustiques à l'aide de dispositifs sous-marins de surveillance acoustique.

La compréhension des populations de cétacés est essentielle à la désignation d'Aires marines protégées comme outils de gestion de ces espèces. La variabilité de certaines espèces, telles que le marsouin commun, en termes de répartition et d'abondance, a posé problème lors de l'identification de sites pour les AMP. Cependant, les AMP constituent sans aucun doute des outils de conservation extrêmement puissants lorsqu'une espèce dispose d'un domaine vital de petite taille pouvant être couvert plus ou moins entièrement, pour les espèces migratrices disposant de zones de reproduction et d'alimentation clairement définies, ou encore lorsque les menaces sont localisées et qu'une gestion adaptée peut être mise en place pour les contrer. L'utilisation d'une AMP statique, spécifique à un site, pour une population de cétacés (i) qui migre régulièrement ou de façon saisonnière hors de l'AMP, ou (ii) dont le domaine vital se déplace vers des zones hors de l'AMP, signifie que ce site devient inadapté à la protection de l'espèce désignée. Par conséquent,

il est essentiel que ces sites soient soutenus par des projets ou plans destinés à faire face aux interactions complexes entre différents problèmes de gestion afin de préserver les populations de cétacés, de réduire les menaces importantes et de préserver les habitats des cétacés.

KEYWORDS: Cetaceans, conservation, management, monitoring, Marine Protected Areas, bycatch.

MOTS-CLÉS : Cétacés, conservation, gestion, surveillance, Aires marines protégées, prises accidentelles.

Contents

Image 1: Harbour porpoises. Photo by Niki Clear.

I. Introduction

1.1 PANACHE

The main aim of PANACHE is to develop stronger protection and a sense of wider ownership of the marine environment in the Channel. With significant developments taking place in this shared marine space to utilise Marine Protected Areas (MPAs) to meet European and International marine biodiversity protection obligations; this project will ensure that approaches being taken in the Channel are more effective and focused than at present.

As a result, PANACHE will lead to better protection and management of the marine environment through the development of a more coherent approach for MPAs in the Channel region. The project focuses on areas of MPA management and monitoring and will carry out an evaluation of whether the network of MPAs proposed by England and France meets internationally recognised ecological coherence criteria. In addition to this, the project will jointly develop stakeholder awareness and citizen science programmes across the Channel region that will increase awareness of MPAs amongst key community and stakeholder groups. This will encourage a wider ownership in the marine environment and participation in its protection.

To do so, the PANACHE project will build close ties at many different levels across the region and ensure that experience and best practice is shared across the partnership. The PANACHE project is closely aligned with another EU Interreg funded project called ValMer which aims to assess ecosystem services within the Channel ecosystem. Together both projects will focus on better management, sustainable use and protection of the Channel marine area. PANACHE will also capture and share the particular strengths that exist between the partnership organisations in England and France. Both countries have been working to meet their requirements under the EU Birds, Habitats and Marine Strategy Framework Directives and under international agreements such as the Oslo Paris Convention (OSPAR), and both face similar challenges to ensure that their Marine Protected Areas are properly managed and that monitoring is undertaken in an efficient and robust way.

PANACHE will operate at different scales across the Channel region:

- The ecological coherence analysis of the MPAs will take place across the whole Channel region.
- Stakeholder awareness and citizen science programmes will involve surveys in Kent, Sussex, Hampshire and Isle of Wight, Dorset and Cornwall and the Natural Marine Park ‘Estuaires Picards et Côte Opale’.

- MPA monitoring case studies will be taken from across the region and monitoring trials will be carried out in Lyme Bay, Torbay, Flanders Bank SAC, Natural Marine Park 'Estuaires Picards et Côte Opale' and 'Baie de Seine'.

- Management case studies will be taken from across the region and management of vulnerable coastal bird species will be carried out at Baie de Somme, Baie d'Orne, Flanders Bank, Langstone Harbour and Chesil Beach.

The project has five key objectives:

- **Assess the existing MPA network and its ecological coherence** – PANACHE will provide a retrospective analysis of the existing and planned network of MPAs in the Channel area. This will be a valuable exercise to determine ecological coherence criteria established in science and international convention; whether the current and planned MPA network configuration meets these criteria; and to identify any gaps in the network.

- **Build greater coherence in the monitoring of MPAs** – PANACHE will facilitate a scientific exchange of expertise that will determine how the results and techniques of existing monitoring programmes can be shared to give a greater overall indication of the impact that MPAs in the Channel have on humans and biodiversity. The project will also enable the development of transferable monitoring approaches for MPAs using multibeam sonar, towed video and a methodology for measuring socio-economic impacts and bird populations.

- **Coherence enhancing in the management of those MPAs** - PANACHE will bring together best global practice to provide the Channel with a management plan framework that will be used to gain greater consistency in MPA management in the Channel region. Work will also take place to develop a joint approach to achieving more stakeholder involvement in the management of MPAs and sharing approaches for the management of vulnerable nesting birds and cetaceans.

- **Develop and increase general awareness of MPAs and build common ownership and stewardship through engagement in joint citizen science programmes** – PANACHE will develop a common methodology for citizen science programmes, involving members of the public and divers to survey intertidal and sub-tidal areas around MPAs and potential MPAs as well as bringing together educational professionals to share best practice in mobilising groups and individual citizens in providing support for MPAs.

- **Establishment of a GIS database to support the project and develop a portal for providing information to the public about the network of MPAs in the Channel region** - The GIS database will bring together English and French GIS data into a single layer that will be used by project partners and shared publicly through the Web GIS.

1.2 PANACHE Work Package 3 - Sharing best practice in the management of Marine Protected Areas and developing modelling tools for management of cetaceans

PANACHE has been tasked with leading the development of a number of innovations and tools that will be applicable across Europe with regard to Marine Protected Areas (MPAs). A large element of the project is the cross border sharing of experience, information and expertise. Work Package 3 is specifically about the analysis of management plans and identification of best practice. The aim is for this framework and model to be used more widely as a tool to help in the development of future management plans and achieve more coherence across the region.

Cornwall Wildlife Trust, a partner in the PANACHE project, has been tasked with providing a report specifically focusing on management plans for mobile species. Cornwall Wildlife Trust has experience of acoustic monitoring of cetaceans around the coast of Cornwall, coupled with effort-based visual monitoring from shore, working with a network of volunteer observers. The results of this survey work have informed the development of management strategies for the protection of mobile species, in particular cetaceans (dolphins, porpoise and whales) around the Cornish coast. Cornwall Wildlife Trust's experience has also included research into the practicalities and effectiveness of acoustic deterrent devices on inshore set net fisheries to determine a practical way forward towards preventing accidental bycatch of cetaceans.

Cornwall Wildlife Trust is a registered charity (No. 214929) and is leading on the production of this report under the PANACHE project due to its previous experience of investigating cetacean populations and methods for their conservation.

Cornwall Wildlife Trust has had a long history in cetacean research. Dr. Nick Tregenza, the former Secretary of the European Cetacean Society and a respected cetacean researcher, is also a Cornwall Wildlife Trust trustee and has led this area of work within the organisation's work programme. Dr. Tregenza instigated and ran one of the first bycatch observer schemes in Cornwall between 1992 and 1994 in the Celtic Sea bottom set gillnet fishery for hake. For many years his work has focused on developing cetacean acoustic monitoring technology and testing bycatch mitigation techniques. His acoustic monitoring devices (C-PODs) are now being used around the globe to assess cetacean distribution and to study cetacean behaviour.

Cornwall Wildlife Trust has been encouraging and recording public sightings of dolphin, whales and porpoise, as well as other marine megafauna for many years, through its Seaquest Southwest Project.

This sightings data has been invaluable in building a picture of the species that use our waters and has helped develop the Trust's priorities with regard to cetacean conservation programmes.

Image 2: Seaquest sea watch off Cornwall. Photo by Joana Doyle.

Since 1992, Cornwall Wildlife Trust has also been recording cetacean strandings and has a unique, well-established and respected network of trained volunteer strandings recorders who undertake this work. As the official, licensed strandings recorder in Cornwall and the Isles of Scilly, the Trust works closely with its partners, the Institute of Zoology and the Natural History Museum as part of the UK Cetacean Strandings Investigations Programme. Members of the Cornwall Wildlife Trust Marine Strandings Network (CWT MSN) have attended the European Cetacean Society Conference in recent years, presenting findings of the research and running workshops.

Through its close working relationship with the University of Exeter in Cornwall, Cornwall Wildlife Trust has co-authored a paper on cetacean strandings and bycatch in Cornwall (Leeney et al. 2008) and on spatial and temporal trends in cetaceans around Cornwall from sightings and strandings data (Pikesley et al. 2013). We have worked together on several projects in the past, including conducting aerial surveys around the Cornish coast to record megafauna.

In 2008, the Trust established the Seaquest Netsafe Project which aimed to improve protection of the inshore cetacean populations around Cornwall and the Isles of Scilly. This was achieved through providing a deeper understanding of cetaceans and their habitats via visual sightings, acoustic monitoring and strandings investigations, and by working with the local fisheries to test mitigation devices to prevent bycatch and protect cetacean populations as well as promoting responsible fishing practices. Over the five

years since the establishment of this project, the Trust has continued its investigations into cetacean populations, strandings, and bycatch mitigation and will be using this information as a case study for the purpose of the production of this report.

II. Threats facing cetacean populations in the Channel region

2.1 Cetacean populations

Fourteen species of cetaceans have been recorded in the waters of the Channel (JNCC Atlas, CWT MSN and CWT SQSW), with the species encountered most frequently being the harbour porpoise (*Phocoena phocoena*), common dolphin (*Delphinus delphis*) and bottlenose dolphin (*Tursiops truncatus)*.

Cetaceans of Channel region	
From JNCC Atlas of Cetacean Distribution	
Harbour Porpoise	Eastern and Western Channel
Bottlenose Dolphin	Eastern and Western Channel
Short beaked Common Dolphin	Western Channel
Minke Whale	Western Channel
Risso's Dolphin	Western Channel (edge of range)
Atlantic White Beaked Dolphin	Eastern Channel (edge of range)
Long Finned Pilot Whale	Western and Mid Channel
Rare additions from CWT Marine Strandings Network	
Atlantic White Sided Dolphin	Western Channel (edge of range)
Fin Whale	Western Channel (edge of range)
Sowerby's Beaked Whale	Western Channel (edge of range)
Striped Dolphin	Western Channel (edge of range)
Rare additions from Seaquest Southwest project	
Humpback Whale	English Channel (edge of range)
Killer Whale	Western & Eastern Channel (edge of range)
Sperm Whale	Western Channel (edge of range)

Table 1: Cetacean records from the Channel region, sourced from JNCC Atlas of cetacean distribution plus additions from the CWT Marine Strandings Network and Seaquest Southwest database.

The distribution, movements and abundance of highly mobile marine species such as bottlenose dolphins are best studied at large spatial scales, but previous research effort has generally been focused on relatively small areas occupied by populations with high site fidelity, occasionally referred to as 'resident pods'.

With limited funding Cornwall Wildlife Trust has collected data on cetaceans over the past two decades via its Seaquest Southwest, CWT MSN, and Seaquest Netsafe projects. This work has highlighted the need for measures to be developed to protect cetaceans in this region.

Research on cetacean strandings has shown that there has been a significant increase in cetacean stranding reports in Cornwall since 1970 (Leeney *et al.* 2008), see Figure 1. The increase in the 1970s and 1980s may, to an extent, have been due to an increasing awareness and effort by the public to report strandings. However, particularly from 1990 onwards, during which time the CWT Marine Strandings Network has run a comprehensive strandings programme, the increase in strandings is more likely to indicate an increase in mortality in the region: Figure 2.

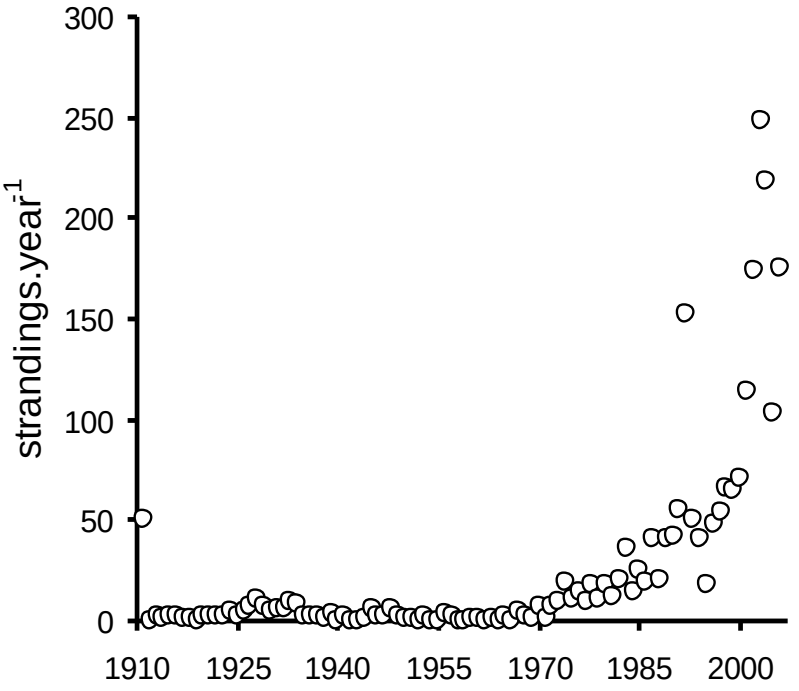

Figure 1: Total number of cetacean stranding per year in Cornwall, from 1911 to 2006 (No data for years 1912, 1919, 1940, 1942, 1943, 1952, 1954, 1955, 1958, 1959, 1962, 1964, 1966). Taken from Leeney et al. 2008.

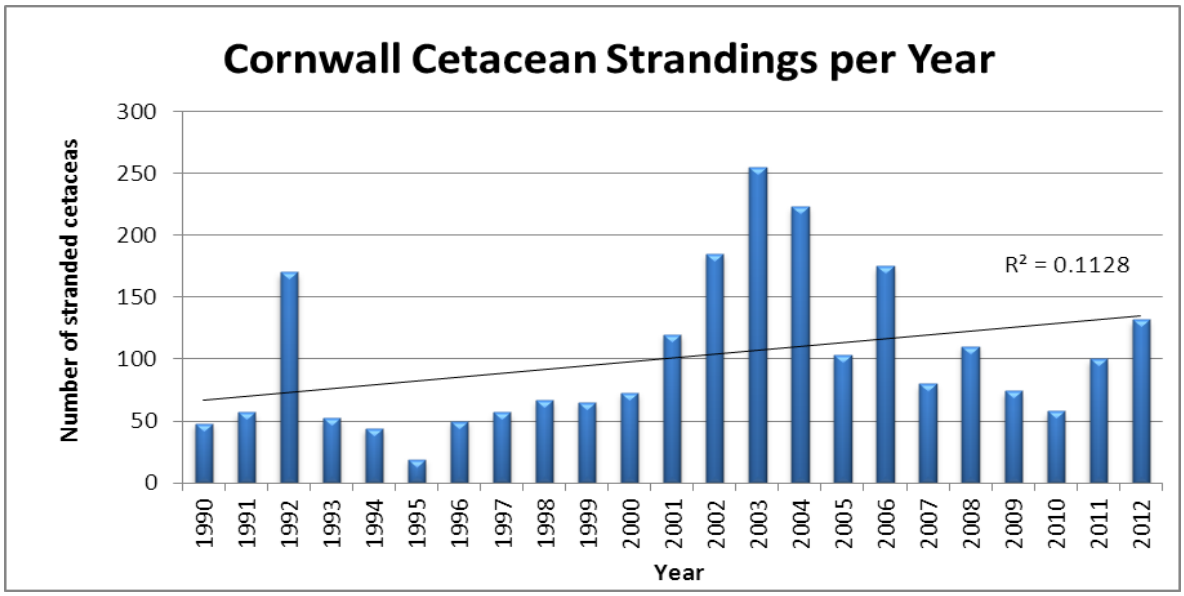

Figure 2: Total number of stranded cetaceans per year in Cornwall between 1990 and 2012. Linear regression trend line shows increase over time (r^2=0.1128). Data sourced from the CWT Marine Strandings Network.

The reason for the stranding of marine mammals varies from natural disease to anthropogenic causes such as pollution and accidental bycatch in fishing gear. Particularly relevant is the fact that the English Channel lays claim to the world's busiest seaway and is ranked among the highest globally for cumulative human impacts on marine ecosystems (Halpern et al. 2008). Therefore a variety of issues affect cetaceans in the Channel region, many of which are related to human activity including fishing, pollution and the effects of noise from shipping, oil and gas exploration, military activity and tourism. The degree of impact of any human activity varies considerably between different species and depends on their ecology, distribution and abundance.

2.2 The Threat of bycatch on cetaceans

Through our Marine Strandings research Cornwall Wildlife Trust has designed a protocol for recording evidence of bycatch on dead stranded animals (BEEP – the Bycatch Evidence Evaluation project). This protocol allows trained volunteers to credibly diagnose bycatch from external injuries and evidence from the animal on the beach, in the absence of a post-mortem examination. Signs of bycatch can be consistently recorded as reliable indicators of bycatch. The BEEP protocol has already been translated into several different languages and is being trialled in other European countries.

Findings from the organisations BEEP work, together with pathology reports from stranded animals that underwent post mortems, have shown that accidental entanglement in fishing gear is a serious threat to our cetaceans and a primary cause of death. Cornwall Wildlife Trust therefore identified reducing bycatch

and developing management plans to protect cetaceans as priorities in its marine work in Cornwall and the Isles of Scilly as part of its Strategic Plan.

The seas in this region are renowned for being rich in biodiversity and are one of the UK's four hotspots for cetacean activity. The Western Channel and Celtic Sea are also known to be fisheries hotspots (Witt & Godley 2007); Image 3.

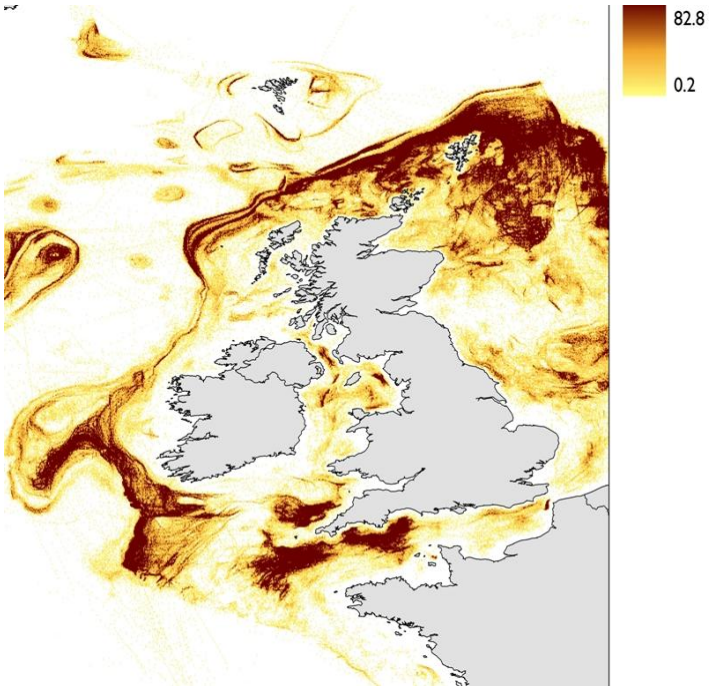

Image 3: Mean annual spatial distribution of fisheries activity (2000–2004) derived from Vessel Monitoring System (VMS) records. The colour scale indicates the mean annual number of VMS derived data points within 9 km2 pixels. (Witt & Godley. 2007)

Bycatch has been identified as the leading cause of death for stranded cetaceans in Cornwall. In 2012, bycatch was found to be the cause of death in 30% of necropsied cetacean carcasses and a further 26% had physical features consistent with interactions with fishing gear; the vast majority of these were harbour porpoise and common dolphin (CWT, 2013).

Between September 1990 and December 2004 inclusive, entanglement in fishing gear was the most common cause of death in UK stranded cetaceans subjected to detailed post-mortem examination (Jepson *et al.*, 2005). Between 2000 and 2004 a total of 116 out of 190 cetaceans (61.1%) were found to have been bycaught: 113 of these (59%) were found in the South West of England (Jepson *et al.* 2005).

However, it is not just offshore trawl fisheries that have a serious bycatch problem. It is widely acknowledged that gillnet fisheries around the world pose a threat to harbour porpoises (Bravington &

Biscack, 1996; Lowry & Teilmann, 1994; Palka *et al*., 1996; Trippel *et al.* 1996). By-caught harbour porpoises stranded in the UK examined by veterinary pathologists also showed signs of entanglement in monofilament set nets (Jepson *et al.* 2005). Incidental mortality of dolphins and porpoises occurs in almost every marine gillnet fishery, killing many tens of thousands of animals globally each year (IWC, 1994). Monofilament gillnets and other set nets (tangle nets) are widely used both inshore (<6nm) and offshore (>6nm). Bottlenose dolphins have a similar diet, feeding strategy and habitat as the harbour porpoise and are therefore thought to be at risk from the same fishing techniques, primarily bottom set "wide-meshed" nylon gill and tangle nets (EFRA, 2004). Evidence from areas where bottlenose dolphins are in greater abundance, shows that gillnets do pose a risk to this species (Rossman & Palka, 2004; Cox *et al.* 2003).

Image 4: Stranded common dolphin with net marks on head, Photo by CWT MSN.

Image 7: Common dolphin entangled in net, Photo by CWT MSN.

Image 6: Stranded bottlenose dolphin with amputated tail, Photo by CWT MSN

Image 5: Harbour porpoise found entangled in set gill nets. Photo by Environment Agency.

2.3 Other threats facing cetaceans

Aside from bycatch, cetaceans in coastal areas are exposed to a wide variety of threats. In UK waters these include negative impacts of pollution, including the toxic effects of xenobiotic chemicals, reduced prey availability caused by environmental degradation and overfishing, direct and indirect disturbance and harassment (such as boat traffic, commercial dolphin watching and interactive programmes, and anthropogenic noise), marine construction and demolition, as well as other forms of habitat destruction and degradation.

When assessing a possible solution for the protection of cetaceans within the Channel region, such as a Marine Protected Area, the threats mentioned below must be considered and assessed to ensure effective and specific management tools are implemented within a potential MPA, or the wider environment, to ensure it is effective for the species it is protecting.

2.3.1 Chemical Pollution

Chemical pollution is thought to be one of the greatest threats to cetacean survival. Two classes of pollutants have become the primary focus of concern: the heavy metals, especially mercury (in its various forms), and the organochlorines, in particular polychlorinated biphenyls (PCBs). The effect of pollutants on the ecology of cetaceans varies from species to species and can be affected by factors such as age of the individual and sex. Chemicals which are widely used, such as pesticides, industrial chemicals and all plastics, have been linked to reduced immunity and increased instances of infectious diseases in harbour porpoise, from data collected through the UK Cetacean Strandings Investigation Programme (Law *et al*. 2012). Infectious diseases have been found to be the second most common cause of death to stranded cetaceans in Cornwall (CWT Marine Strandings Network).

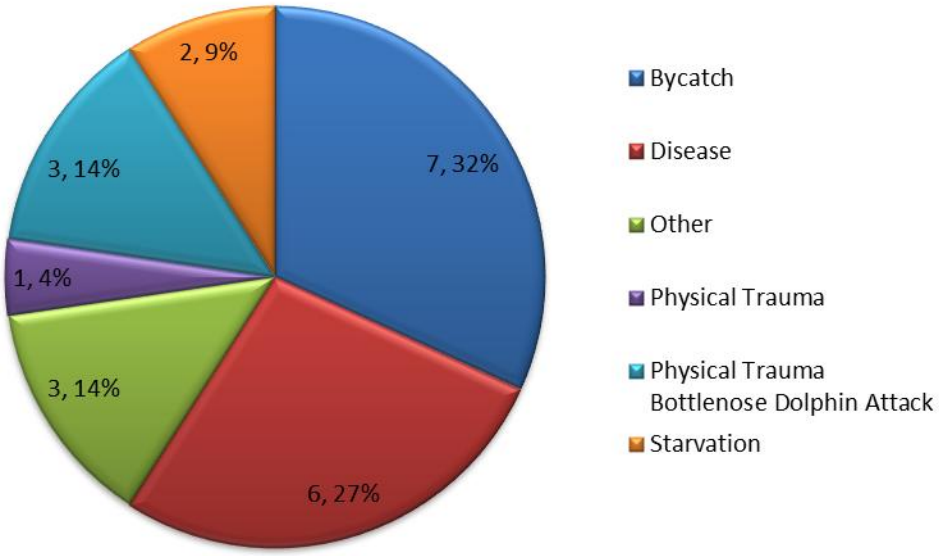

Figure 3: Cause of death for cetacean carcasses at post-mortem examination (n=23).
Source: CSIP/AHVLA.

Recent research is also investigating whether these chemicals have hormone mimicking properties which can negatively impact on the endocrine system of many species, molecules known as Endocrine Disrupting Chemicals (EDCs) (Tanabe 2002., Fossi *et al*. 2006). When these plastics break down in the marine environment they can easily enter the food chain at the lower trophic levels. EDCs inhibit normal hormone responses of the body and so affect normal processes such as reproduction metabolism and growth. Small plastic particulates have been recorded in huge quantities in the marine environment; studies in Northumberland in 1997 found between 5,000 to 10,000 fibres of plastic per litre of intertidal sand (Thompson and Hoare., 1997). These particulate plastics absorb hydrophobic chemicals present in the surrounding water thus becoming more toxic. When these particulates are ingested, absorbed chemicals are released into the body and stored in the lipid layers of the body. These chemicals accumulate up the tropic level, and so affect top predator species such as killer whale and bottlenose dolphin.

Image 8: Nurdles are pre-production plastics regularly found in intertidal sand, photo by CWT

Some European inshore groups of bottlenose dolphins have disappeared (e.g. Humber estuary, off The Netherlands) or are in decline (e.g. in the Sado Estuary, Augusto et al. 2011) with pollution potentially playing a role in declines through reproductive effects, such as reduced calf survivorship. Porpoises that died from disease or parasitic infection had higher concentrations of persistent organic pollutants (POPs) than animals dying from other causes (Pierce et al. 2008). PCB exposure data has also been generated for UK-stranded bottlenose dolphins (n=15) with mean levels of 100,000ng/g lipid weight (Jepson et al 2008). Although these data are from stranded animals, they show that PCB exposures are similar or greater than levels in biopsied bottlenose dolphins in the SW Atlantic such as Indian River Lagoon (Florida, US), Sarasota Bay (Florida, US) and Charleston (North Carolina, US) (Schwacke et al. 2002; Wells et al. 2005; Hall et al. 2006). Given the concerns about high PCB levels, the Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) funded the Institute of Zoology to coordinate a project to assess PCB exposure in stranded bottlenose dolphins in European waters (Project ref: SSFA/ASCOBANS/2010/3). The final report to the ASCOBANS Secretariat on this project was due in 2013.

Key contaminant levels were seen to fall in many marine mammal populations, especially in the most highly polluted areas, as a result of improved pollution controls in the late 1970s. Nonetheless, the idea that pollution controls were being effective and levels were falling seems to have significantly drawn attention away from pollution as a threat to these species and latest evidence shows that there is still a significant pollution issue for at least some species in European waters. However, despite the fact that the

use of toxic chemicals, such as PCBs, have been restricted or banned for two to three decades in the EU, alarmingly high levels are still being observed in marine top predators, for instance bottlenose dolphin and killer whale in UK and adjacent waters (Jepson *et al*. 2013). This illustrates the need to further address the issue of chemical pollution and its impact on cetaceans within EU waters and beyond.

2.3.2 Noise pollution and disturbance

Cetaceans are reliant on echolocation and passive listening for acoustic detection of prey, determining their surroundings, social communication and navigation. As mentioned above, the Channel region is a hotspot for human activity including fishing, shipping, commercial development and leisure boating activities. Marine anthropological sources of noise pollution which can have an impact on cetacean populations within the Channel region include shipping, fish finders and depth sounders, dredging, military activity, oceanographic research such as seismic surveys, wind farms, and acoustic deterrent devices. There is much research on the impact of high intensity sound on cetacean species, and in response various regulations have been put in place to mitigate, for example, on seismic survey activity. The UK's largest mass stranding of a cetacean species has been linked to naval activity in the area, including the use of sonar equipment and low-flying helicopter activity, which led to the standing and death of at least 26 common dolphin in Cornwall in 2008 (Jepson *et al*. 2013).

High intensity sounds can cause direct tissue damage, especially within the ear tissues, and cause a shift in the threshold frequency at which the cetacean is sensitive. These shifts can be temporary, Temporary Threshold Shifts (TTS), or have a longer impact: Permanent Threshold Shifts (PTS) (Parsons *et al*. 2010). The effect of marine noise is currently being investigated to gain a better understanding of the sources and impacts upon cetacean populations. However low intensity noise such as that from shipping or fish finders, which can be significant in small boat activity areas such as ports and harbours, can cause both temporary and permanent threshold shifts in cetacean species. Exposure to both low and high intensity noise has been shown to increase stress levels in cetacean species: observations such as changes in dive frequency, active avoidance of the source have been recorded and displacement from the area.

Generally, large vessels produce noise below 1kHz which has the potential to impact on large cetacean species such as fin whale. However, small boats produce between 1kHz and 50kHz, which overlap with hearing frequencies for small cetacean species such as bottlenose dolphin and harbour porpoise (WDCS. 2004). The higher abundance of small vessels within inshore waters in the Channel region has a cumulative impact on the inshore populations of small cetaceans, including bottlenose and harbour porpoise.

The bottlenose dolphins of Cardigan Bay have been shown to exhibit a negative response to small leisure boat activity (Evans *et al*. 1992), exhibiting changes in behaviour such as dive times and avoidance of

approaching boats. It was observed that quieter, faster boats posed more of a disturbance issue than slower, louder boats; the ambient noise from slower, louder vessels gives cetaceans the opportunity to detect and thus be much less likely to be startled or have physical contact with the boat. On the 20th July 2013 on the north coast of Cornwall while a pod of dolphins was being watched by several leisure boats, a juvenile bottlenose dolphin was struck and was soon after seen dead in the water. Though it is a rare occurrence, physical interactions between cetacean and boats in inshore waters is a threat.

In addition to noise pollution and disturbance, there is the additional threat of boat strike. Animals can be hit by boats of any size, causing injuries that can often be fatal.

2.3.3 Habitat degradation

Marine litter is an issue which has increased in magnitude in recent years, with a 135% increase since 2004 and the majority (60%) being plastics (MCS, 2011). Due to the nature of plastic materials, they are resistant to corrosion in the marine environment and do not fully degrade, only breaking down to smaller particles and, in this manner, can enter the food chain.

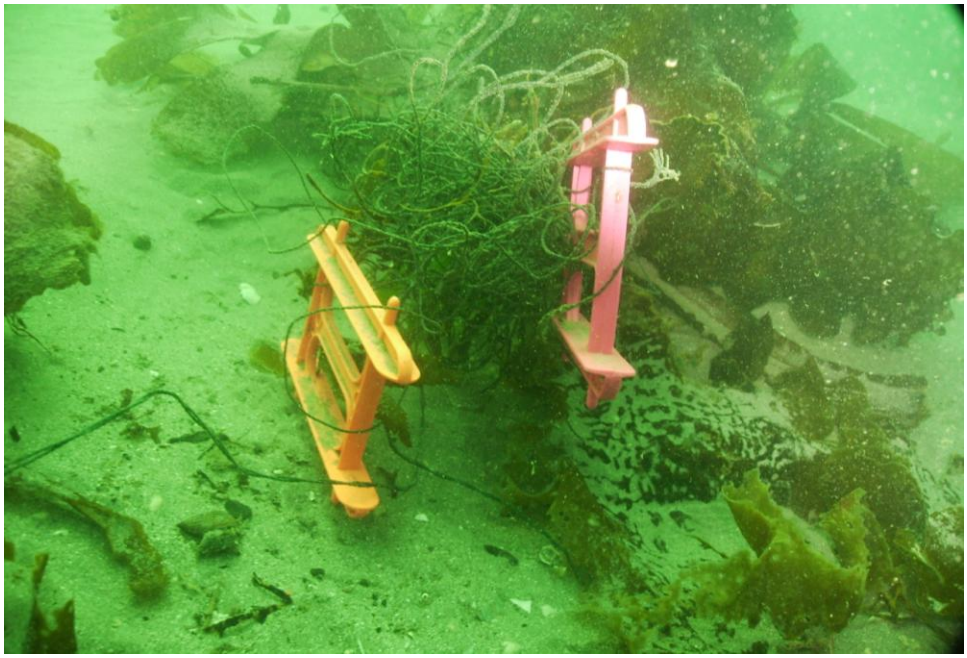

Image 9: Marine litter found on seabed in Cornwall. Photo by Steve Oakley

Entanglement in marine litter has been observed to affect many marine species including cetaceans. Data from the Ocean Conservancy's International Coastal Clean-up project shows that the majority of marine mammal entanglement involves fishing gear and nets as well as plastic bags and rope in a global context (Ocean Conservancy. 2011). However, it has proved very difficult to assess the full extent of entanglement in marine debris on cetacean species in the UK.

The widespread over-exploitation of the marine ecosystem over decades in European waters and resulting decline in commercial fish stock has been well established in recent years. This depletion of food stocks has the potential to affect the energy budgets and so reproductive success of cetaceans, especially coastal species, such as in-shore bottlenose dolphin populations and harbour porpoise, where human activity is concentrated. However further research is needed to address the gaps in knowledge of the true impact of fish stock depletion on cetacean populations (Parsons *et al*. 2010). Depletion in herring stocks in the eastern North Sea has been observed to be declining: this had been followed by a change in the wide-scale distribution in harbour porpoise around the UK coast (Evans. 1990).

III. Monitoring cetacean populations within the Channel region

In European waters, 46 cetacean species and their habitats are included in various conventions, treaties and agreements, many of which embrace the creation of Marine Protected Areas (MPAs) which are increasingly suggested for use as a management tool. However, collection of necessary local population and distribution data to back up these recommendations is difficult as most cetacean species are highly mobile and spend a substantial time below surface. This makes detection, identification, and group size estimation problematic.

The JNCC Marine Monitoring Handbook (2001) addresses the principles behind, and the procedures for, monitoring the habitats and species within marine Special Areas of Conservation (SACs) in UK waters to assess their condition. These assessments are intended to fulfil the requirements of the EC Habitats and Species Directive and the UK's common standards for monitoring. The Handbook provides guidance on the different options and their relative costs and benefits and describes best practice through a series of procedural guidelines for the common survey/monitoring techniques. It draws on the information gathered from extensive trials of different techniques and their deployment undertaken during the UK Marine SACs project to ensure all advice has a sound practical basis.

Our knowledge of how cetaceans use the waters off the UK and French coasts is limited to data gathered from casual sightings records, photo-identification work, intermittent effort-based surveys both from land on boat, and in more recent years acoustic monitoring using acoustic monitoring devices, all of which are discussed in the sub-sections below.

3.1 Casual sightings data

The data required to understand cetacean ecology is challenging and expensive to obtain as most cetacean species are highly mobile and spend a substantial amount of time below the surface, making detection, identification, and group size estimates difficult. Therefore, acoustic monitoring, incidental sightings and strandings data are highly valuable but potentially underused resources. Cornwall Wildlife Trust has been recording cetacean sighting reports for the joint Cornwall and Devon Wildlife Trusts' Seaquest Southwest public recording scheme for over 20 years, in conjunction with the Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS). These programmes encourage members of the public and other interested parties to report cetacean sightings, as well as other marine megafauna.

Bottlenose dolphins are regularly recorded around Cornwall. However, through the Seaquest Southwest recording scheme, CWT has recorded a 70% decline in the average group size of this inshore bottlenose dolphin pod from 16 in 1991 to 6 in 2007 (Doyle *et al.* 2008); Figure 4.

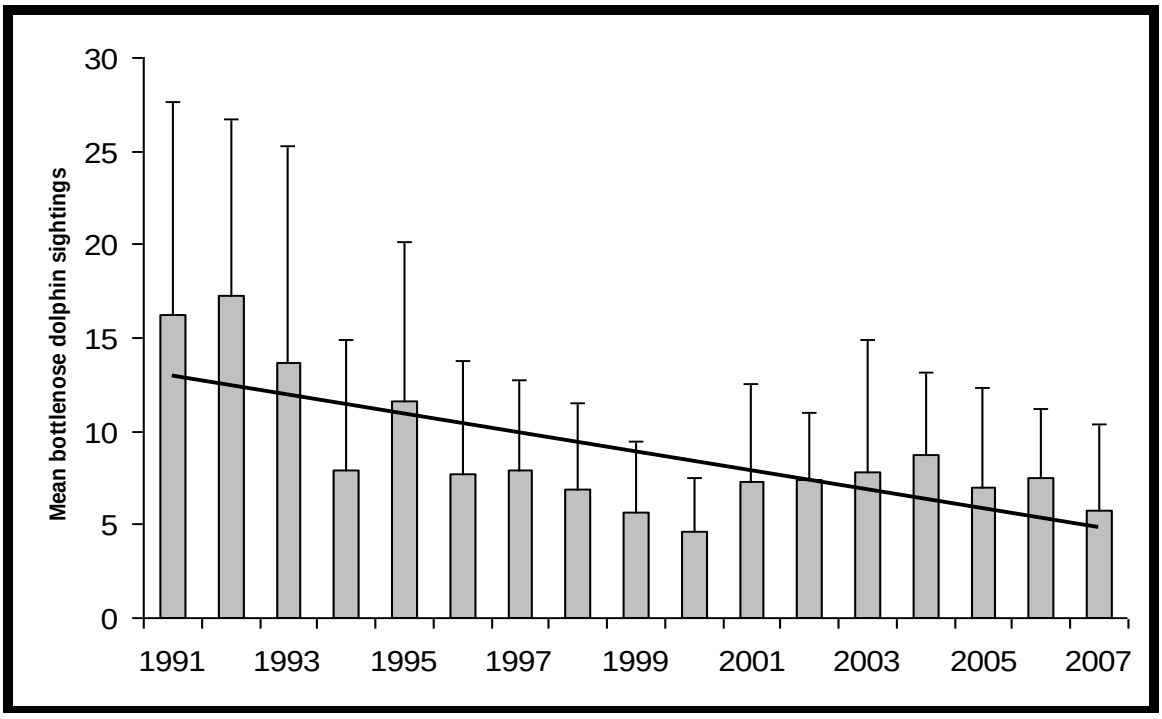

Figure 4: Mean bottlenose dolphin pod size and standard deviation recorded in Cornwall from 1991 to 2007, with linear regression line (from Doyle et al. 2008).

Public recording schemes such as this are immensely important for cetacean research and conservation; however, there are obvious limitations to the use of this data as its interpretation is made difficult without quantification of sightability and effort (Evans and Hammond 2004; Witt et al. 2007a, b). These visual counts do not involve identification of individuals and so are prone to error due to the inability to track or re-sight individuals during or between watching periods.

Although existing public sighting databases cannot provide us with accurate population numbers or distribution patterns, it has provided us with useful insight into some obvious trends, such as the decline in pod size of the inshore bottlenose dolphin group.

It has been concluded that with appropriate verification, analysis of casual sightings data can give a basic understanding of significant population patterns and trends as well as assessing the effectiveness of management actions. This highlights the importance of public engagement with such recording schemes and the potential of this underused resource (Piksley et al. 2007).

3.2 Visual effort-based and acoustic surveys

Rather than relying solely on ad hoc or casual sightings records, a better understanding of cetacean populations can be achieved through the coordination of effort-based surveys, either from land or from boats. Such surveys enable biologists to identify critical habitats for cetacean populations, and negative records during effort-based methodologies are as important as positive records for building up knowledge.

Standardised survey methods for census of seabirds and cetaceans from ships have been described (Tasker et al. 1984, Webb and Durinck 1992 and Camphuysen et al. 2004). SCANS, a large-scale line transect survey using ships and aircraft in the North Sea and adjacent waters, determined abundance estimates as a basis for conservation strategy in European waters (Hammond et al. 2002). SCANS-II aimed to update abundance estimates for the whole of the European Atlantic continental shelf, make recommendations for future monitoring and facilitate development of bycatch management models (Hammond and MacLeod 2006). Such large-scale studies have a major role to play in population estimates, but they may not produce such accurate local estimates for cetaceans as dedicated surveys carried out by qualified Marine Mammal Observers from raised platforms such as large vessels and oil rigs.

To obtain information on fine-scale distribution and seasonal changes of cetacean populations within Cornish waters, Cornwall Wildlife Trust established the Seaquest Netsafe project in 2009. One of the four main elements of research within this project was to monitor UK Biodiversity Action Plan cetacean species at key sites around the Cornish coast to develop a picture of the distribution, behaviour and movement of these animals. It did so by using the latest underwater acoustic monitoring devices (C-PoDs) which were deployed at seven sites around the Cornish coast to collect data on the presence and behaviour of cetaceans 24 hours a day.

Image 10: C-POD acoustic monitoring device. Photo by Nick Tregenza.

C-PoDs are fully automated, static, passive acoustic monitoring systems that detect porpoises, dolphins and other toothed whales by recognising the trains of echolocation clicks used to detect their prey, orientate themselves and to communicate between individuals and groups. This latest acoustic technology is capable of distinguishing between several different groups of species. Such devices are a useful tool to monitor population distribution and site fecundity of species within Marine Protected Areas by monitoring changes within small localised areas. Though acoustic devices are unable to assess proportion of individuals which have been detected to that of individuals present, it is recommended that the use of this tool together with visual monitoring and photo identification techniques can provide a robust understanding of the ecology of a local cetacean population over a wide area including the entire coverage of a MPA (JNCC, 2001)

For this reason, effort-based visual surveys from the cliff tops were also conducted at the same seven sites where the C-PoDs were deployed. By coupling passive acoustic underwater monitoring and effort-based visual surveys it was hoped to get a much more holistic view of cetacean activity throughout the year, as well as a measure of how effective the two types of survey are.

Visual and acoustic monitoring provided a large quantity of data for the Seaquest Netsafe project and each has their own specific value. When reviewing the results it becomes very clear that visual surveys are unable to match the acoustic monitoring data for gaining a holistic view of cetacean activity in a given area. However, data from visual surveys has shown that there is still a place for this type of monitoring to ground truth acoustic data as well as to provide support information such as behaviour of the species which can not be recorded acoustically. The visual sighting scheme also raised a huge amount of awareness in the areas that watches were taking place, therefore contributing towards engaging people in marine conservation. Similarly to casual sightings schemes, these effort-based surveys engaged volunteers and were seen as a useful tool in raising awareness of the issues and threats facing our cetacean populations in Cornwall.

3.3 Photo identification

Image 11: Bottlenose dolphin fin photograph used for identification purposes. Photo by John Ellis.

Mark-recapture techniques are widely used to estimate population size where animals can be identified individually through analysis of photographs. Some cetaceans typically exhibit long-lasting identifiable natural marks, which include distinctive nick and scarring on the dorsal fins and variations in dorsal fin shape. Therefore, photo-identification techniques can be used to study various aspects of ecology including social structure and association patterns, migration and site fecundity as well as reproductive success for some species. However, this technique is not appropriate for monitoring population size as it is possible to have the same individual in the catalogue more than once if there has not been an

opportunity for the photos of the left and right of the dorsal fin to be linked to the same individual,(JNCC, 2001).

In a recent study by Balmer et al (2013), photo-identification of bottlenose dolphins was deemed more effective than other tracking techniques, including bio-logging, for compiling data on large numbers of individuals within a designated study area, despite the higher financial cost, and was concluded as essential for long-term monitoring and providing additional insight into dolphin stock structure and ecology.

Photo identification research in Scotland provided the first comprehensive assessment of the abundance of bottlenose dolphins in the inshore waters of the area and highlighted that a relatively small number of bottlenose dolphins (200–300 individuals) occur regularly in Scottish coastal waters (Cheney et al., 2013). Through consistent identification of individuals as well as regular surveillance visits, the Moray Firth photo catalogue contains over 395 individuals (JNCC, 2001). A photo-identification study on Risso's dolphins, carried out off Bardsey Island in Wales, demonstrated that the combination of systematic and opportunistic photo-identification studies has complementary value as a population assessment tool in generating the first local abundance estimate for Risso's dolphins in UK waters and may provide the evidence needed to include the Risso's dolphin in future regional conservation strategies (Boer et al. 2013).

Though Cornwall Wildlife Trust's Seaquest Southwest project does not officially conduct photo-ID monitoring at present, there is occasional opportunity for an insight into the movements of individuals around the Cornish coast using opportunistic photographs submitted by members of the public and trained volunteers. For example, individuals from a pod of six bottlenose dolphins were tracked moving from Falmouth estuary on the 11th January 2013, sighted in Mount's Bay on 12th January, and St. Ives bay on 13th January 2013, covering at least 70 miles in three days.

Image 12: Bottlenose dolphin fin comparisons from Newquay (left), photo by Annabelle Lowe and Falmouth Bay (right), photo by Matthew Witt

In conclusion, although the distribution, movements and abundance of highly mobile marine species are best studied at large spatial scales, the use of photo identification to characterise the distribution, movements and abundance of cetaceans within our UK waters is an important tool, particularly when assessing the potential of a Marine Protected Area as a management tool for cetaceans in a set area.

3.4 The investigation of stranded cetaceans – Cornwall Wildife Trust Marine Strandings Network

Each year, hundreds of dead cetaceans are washed up on the beaches of Cornwall and the Isles of Scilly (CWT, 2012). In response to this, Cornwall Wildlife Trust developed its Marine Strandings Network (CWT MSN) of volunteers who collect and record information from stranded cetaceans and other marine wildlife that washes ashore. CWT MSN volunteers record the carcasses of dead animals, particularly dolphins, porpoises and seals, and, where appropriate, retrieve them for post mortem examination. This is done on behalf of the Institute of Zoology, the Trust's partner in this work, under the Defra-funded UK Cetacean Strandings Investigation Programme (CSIP).

Image 13: MSN volunteers recording a stranded dolphin. Photo by Jan Loveridge

Although the relevance of a stranding relative to the living distribution of a species is low, records of dead cetaceans provide an important source of information about the status and health of these species around the Cornish coast. Trends in the number and distribution of strandings can give us clues about the movements and population sizes of cetacean species using our waters. Post mortem examination yields vital information about the cause of death and also provides information about cetacean biology, ecology and population health and structure.

In addition to this, data from stranded animals are generally less vulnerable to misidentification issues than other public sightings schemes can be, due to volunteer training and validation from skilled officers, and the fact the animal can be studied closely on the beach without disappearing below the surface.

In conclusion, the monitoring of stranding cetaceans is considered an important tool in the work towards understanding our cetacean populations and to develop management tools for their conservation.

3.5 Bycatch evidence evaluation

As stated previously, bycatch, or accidental capture in fishing nets, is one of the main threats facing cetaceans in the Channel. Until recently, there has been no accepted method for diagnosing bycatch in cetaceans from observations made on the beach. Therefore, bycatch statistics were based on a small number of expensive boat-based observer schemes and on the animals that undergo a post mortem examination by a veterinary pathologist. However, in Cornwall and the Isles of Scilly only a small percentage (<25%) of stranded cetaceans are suitable for post mortem examination. Consequently, a lot of valuable information from animals that are not subject to post mortem was lost or ignored and current data may not reflect the true scale of bycatch mortalities.

One element of Cornwall Wildlife Trust's Seaquest Netsafe project was to establish a method for identifying bycatch on the beach, to ensure that monitoring levels of bycatch among stranded cetaceans could be achieved even with limited funding for post mortems. It was also essential that the methods designed could be used by neighbouring countries that share a cetacean bycatch problem and where there is no government-funded post mortem examination schemes.

The aim of the Bycatch Evidence Evaluation Project (BEEP) was to design a protocol for standardising the recording of bycatch evidence and credibly diagnosing bycatch in the absence of a post mortem examination. An important goal was to try to make the protocol as simple as possible and require the minimum amount of training.

It should be noted that the BEEP method of examining carcasses is not a substitute for a full post mortem examination where this is possible. Some bycaught animals exhibit few or no obvious external signs of

entrapment (net marks for example), yet internal examination may reveal features that are consistent with bycatch as the cause of death, such as recent feeding, good nutritional state and froth in the airways. However, where funding is unavailable or carcasses cannot be retrieved due to inaccessibility, safety of those retrieving the animal or state of decomposition, the BEEP method may enable a cause of death to be determined.

Volunteers were given training on how to visually assess external injuries which had been independently assessed and determined as being reliable indicators of bycatch. Such indicators included:

Encircling marks around half to full body.

Lip cuts.

Fin edge slices.

Definite amputations.

Ropes/nets entangled and embedded.

Deep cuts.

Eyes bleeding.

Ropes around tail stock.

Broken teeth (front and remaining.)

These signs can be consistently recorded, are potentially reliable indicators of bycatch and are highly predictive of bycatch. From the BEEP results, a protocol for assessing and evaluating bycatch has been designed, together with an assessment form and photographic examples, which has since been translated into French and Dutch for partners in those countries to begin using the methodology.

IV MPAs as a management method for cetacean conservation

A range of legislative instruments oblige the UK to support research that has a bearing on the conservation status of cetacean populations. All cetacean species are listed on Annex IV of the Habitats Directive (92/43/EEC). This Directive requires regular assessments of the conservation status of all species that covers abundance, distribution and the pressures and threats experienced by them. Other examples of international legislation and agreements include the Convention on the Conservation of Migratory Species (CMS or Bonn Convention), its daughter Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) and the Oslo-Paris Convention (OSPAR).

These legislative requirements and international obligations provide a number of tools through which the conservation of cetaceans can be achieved. These tools include the implementation of wider management measures, such as prohibitions of hunting, incidental killing and capture, and disturbance, the requirement to consider their needs when undertaking licensed activities, as well as the use of more specific/targeted site-based protection.

In addition to this, an important duty of the UK Marine and Coastal Access Act 2009 and the Marine (Scotland) Act 2010 is to create an ecologically coherent network of well-managed Marine Protected Areas (MPAs) to deliver nature conservation priorities. In European waters, cetaceans and their habitats are included in various conventions, treaties and agreements; many embrace the creation of MPAs which are increasingly used as management tools (Villa et al. 2001; Lubchenco et al. 2003; Palumbi. 2004, Evans. 2008). For instance, bottlenose dolphin and harbour porpoise are listed on Annex II of the Habitats Directive which requires the designation of Special Areas of Conservation where population areas of these species can be identified.

As discussed in this report, an understanding of cetacean populations is essential for their management, particularly for the designation of MPAs as management tools for specific species. This has caused problems for site identification for MPAs due to the variability in range and abundance of some cetacean species, such as the harbour porpoise. However MPAs are undoubtedly an extremely powerful conservation tool under certain circumstances. These are:

- where a species has a small home range that can be covered more or less in its entirety,
- or for migratory species with very clearly defined breeding/feeding areas,

- or where the threats faced are localised and appropriate management can be put in place to counteract those threats (JNCC, 2011).

4.1 Special Areas of Conservation designation for cetacean conservation - Cardigan Bay and Moray Firth

At present there are only two recognised areas of UK territorial waters where the physical and biological factors are determined to be essential to the life and reproduction of a population of semi-resident groups of bottlenose dolphin (*Tursiops truncatus*). These are Cardigan Bay in Wales and the Moray Firth in Scotland, both of which are designated Special Areas of Conservation (SACs) under the Habitats Directive.

Image 14: Bottlenose dolphins near Mount's Bay pMCZ. Photo by Marine Discovery, Penzance.

In Wales, the southern portion of Cardigan Bay was put forward as a SAC in 1995 due to the significant presence of bottlenose dolphins in the area. A management plan for the bottlenose dolphin feature of the Cardigan Bay SAC was subsequently produced in 2001. The SAC extends from its northern boundary of Aberarth, Ceredigion to Ceibwr Bay, Pembrokeshire. The landward boundary runs along the coastline, and generally extends up the coastal slope to the coastal footpath or fence. The site extends approximately 12 miles offshore. Over 300 bottlenose dolphins are known to be using Cardigan Bay, around 200 in any year, with numbers increasing throughout the summer and reaching a peak in late September and October. Cardigan Bay dolphins appear to use the area for all essential activities including feeding, socialising and nurture of young (SAC Management Plan 2008).

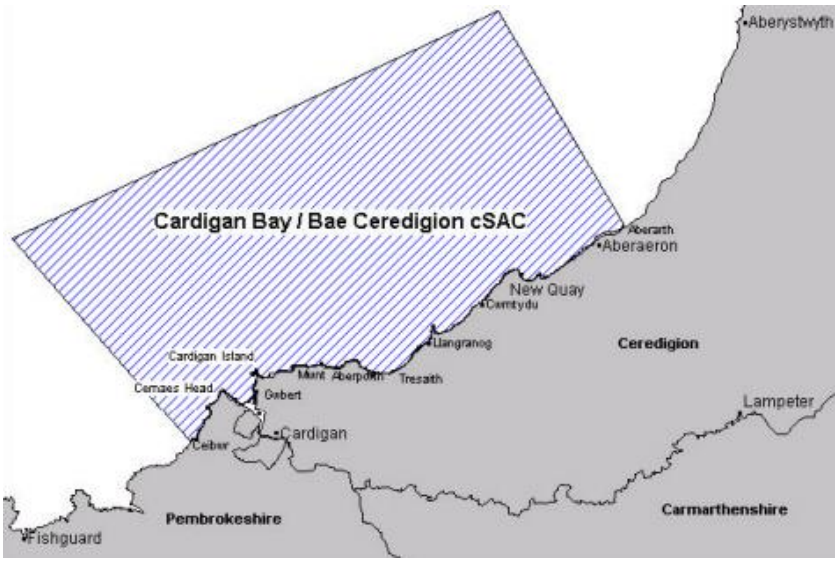

Figure 5: Map of Cardigan Bay SAC taken from Cardigan Bay Special Area of Conservation Management Plan

The Moray Firth SAC was designated in 1996 due to it supporting the only known resident population of bottlenose dolphins in the North Sea. This is a small population of about 120 animals that ranges throughout the Moray Firth and all the way down the east coast at least as far as the Firth of Forth (Moray Firth Partnership SAC Management Scheme 2009). The designated site is one of the largest marine SACs in the UK. It comprises the 'triangular' area of water west of a line between Helmsdale on the Sutherland coast and Lossiemouth on the Moray coast, including the Beauly and Inverness Firths, and the outer reaches of the Dornoch and Cromarty Firths. The marine boundary extends seaward from the tidal level of Mean Low Water Mark of Spring tides unless otherwise specified.

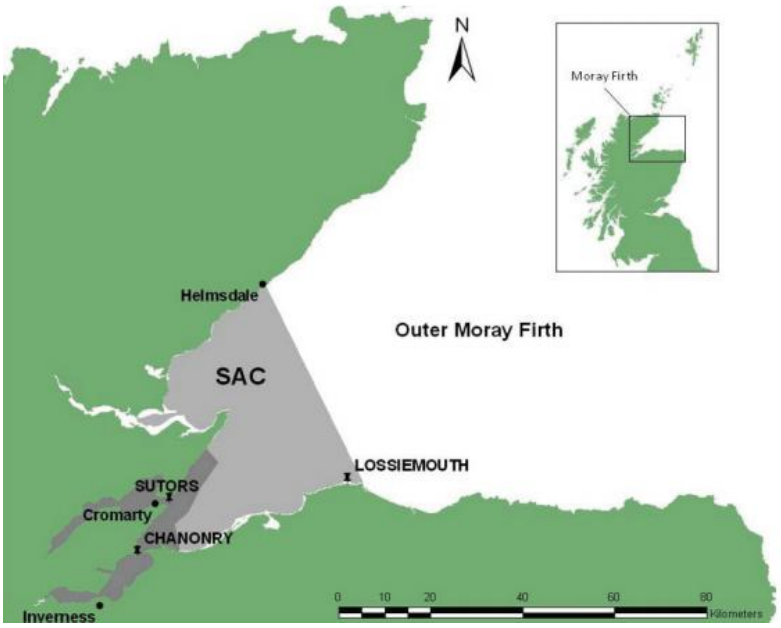

Figure 6: Map of Moray Firth SAC taken from The Moray Firth Special Area of Conservation Management Scheme Revision 2

Effective management of activities is essential to ensure the delivery of the conservation objectives of an MPA to protect the features for which it has been designated, as well as to ensure the site's contribution to the MPA network.

Existing UK MPAs, such as SACs, are generally multiple-use sites where activities are only restricted if they pose a significant risk to designated features. For these sites, Natural England produces advice packages detailing both the conservation objectives for the designated features, and advice on operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated. Relevant management authorities, informed by this advice, use a variety of tools to implement any necessary management measures (Natural England Commissioned Report NECR108).

Within the Cardigan Bay SAC, factors affecting bottlenose dolphins within the SAC have been identified through the Species Action Plan as long-range pollution (though there is no known serious pollution in Ceredigion), disturbance from underwater noise and boat behaviour, and food availability. A programme of survey and monitoring is undertaken by a variety of agencies and NGOs, together with a number of educational projects to improve public awareness and support of the dolphins.

Within the Moray Firth SAC, there are a range of operations and activities that take place which have the potential to affect the dolphin population (Moray Firth Partnership SAC Management Scheme 2009). These include activities that may cause disturbance or direct harassment, contamination, reduction in food

availability and traumatic death and injury (Curran et al. 1996). Various methods of engagement and management are therefore used to support the SAC and to ensure the protection of the bottlenose population within the area, from management schemes to public engagement projects. The Moray Firth SAC Management Scheme for the bottlenose dolphins was developed during 1998-2001 as part of the Moray Firth LIFE Project. The SAC Management Group has continued to implement and monitor progress on the Scheme which is administered by the Moray Firth Partnership, and regular SAC Management Group meetings are held. The scheme aims to set out a management strategy to help maintain the integrity of the SAC area, so that the dolphin population is maintained, significant disturbance of the dolphins is avoided and the subtidal sandbanks and the habitats that support the dolphins are maintained. The scheme also takes account of the economic, cultural, social, recreational and scientific needs of all those who live and work in the Moray Firth area, in a way that promotes sustainable development of all existing legal activities and interests, whilst having regard to the qualifying features of the site.

The Moray Firth attracts many visitors for its natural beauty. This means that disturbance, harassment and marine noise have been highlighted as key threats on the bottlenose dolphins in the Moray Firth within the SAC Management Scheme. However, although the management scheme has a legislative basis, it seeks to focus on voluntary management measures that involve widespread co-operation and consensus between organisations and individuals. An example of this is the Dolphin Space Programme (DSP), which was established in 1995 as an innovative and co-operative approach to sustainable wildlife tourism. The DSP supports an accreditation scheme for wildlife tour boat operators which provides a code of conduct, training opportunities and educational materials to encourage responsible vessel interactions with cetaceans. In doing so it achieves its objectives of;

1. Reducing the potential impact that cetacean watching boats can have on the status, distribution or behaviour of the Moray Firth dolphins;

2. Raising awareness and encouraging conservation of marine wildlife through provision of high quality training, educational materials and interpretation to DSP members and to the public;

3. Encouraging collaboration between wildlife tour operators, management agencies, conservation organisations, members of the public and other water users, including recreational boat users and shore-based wildlife watchers;

4. Encouraging long-term ecological and economical sustainability of marine wildlife tourism in the Moray Firth.

4.2 Failings of MPA designation for the protection of cetaceans

Although the sites of Cardigan Bay and Moray Firth have been pinpointed as areas of importance for one of the Annex II cetacean species, developments in population studies have identified a failing in the designations due to the nature of cetaceans as highly mobile species. The use of static, site specific Marine Protected Areas for a cetacean population which (1) routinely or seasonally migrates out of the MPA or (2) where the home range of a population shifts towards areas outside of the MPA, becomes inadequate for the protection of that designated species.

Information to date suggests that Cardigan Bay dolphins represent a mobile and wide-ranging population. Individuals recorded regularly along the southern coast of the Bay have also been seen both north and south of the SAC. Recent photo-ID comparison between the Cardigan Bay and Irish Sea catalogues has shown that bottlenose dolphins which are regularly recorded in Cardigan Bay SAC during the summer months travel up the Irish Sea and have been recorded repeatedly around the Isle of Man over the winter months.

Since the mid-1990s, Moray Firth dolphins have increasingly made extended movements eastwards and southwards, which account for regular sightings off east Scotland including the Firth of Forth. In 1992, there were estimated to be between 110 and 175 individual dolphins in the East coast of Scotland population, all of which were recorded in the inner Moray Firth at certain times of year. During the 1990s, the range of the population expanded southwards (Wilson et al. 1999). Many individuals that continue to use the Moray Firth SAC occasionally are now seen more frequently in areas off the Aberdeen and Fife coast, and some have even been reported in English waters. Dolphins are still seen regularly in core areas within the SAC, but their use of the Kessock Narrows has declined markedly in parallel with this range expansion (Thompson et al. 2000). This shift in distribution has made monitoring abundance more complex and now requires large scale surveys to estimate the overall size of the population. Although the inner and southern Moray Firth coast remains an important site for the bottlenose dolphin population, this evidence suggests that their range is changing.

Acoustic surveys carried out during the Seaquest Netsafe project in Cornwall (see section 3.2) highlighted specific regions of importance for harbour porpoise, bottlenose and common dolphin species but, more importantly, show a far wider distribution, both spatially and temporally, of cetacean activity than was expected from historic visual data (Figures 7 and 8).

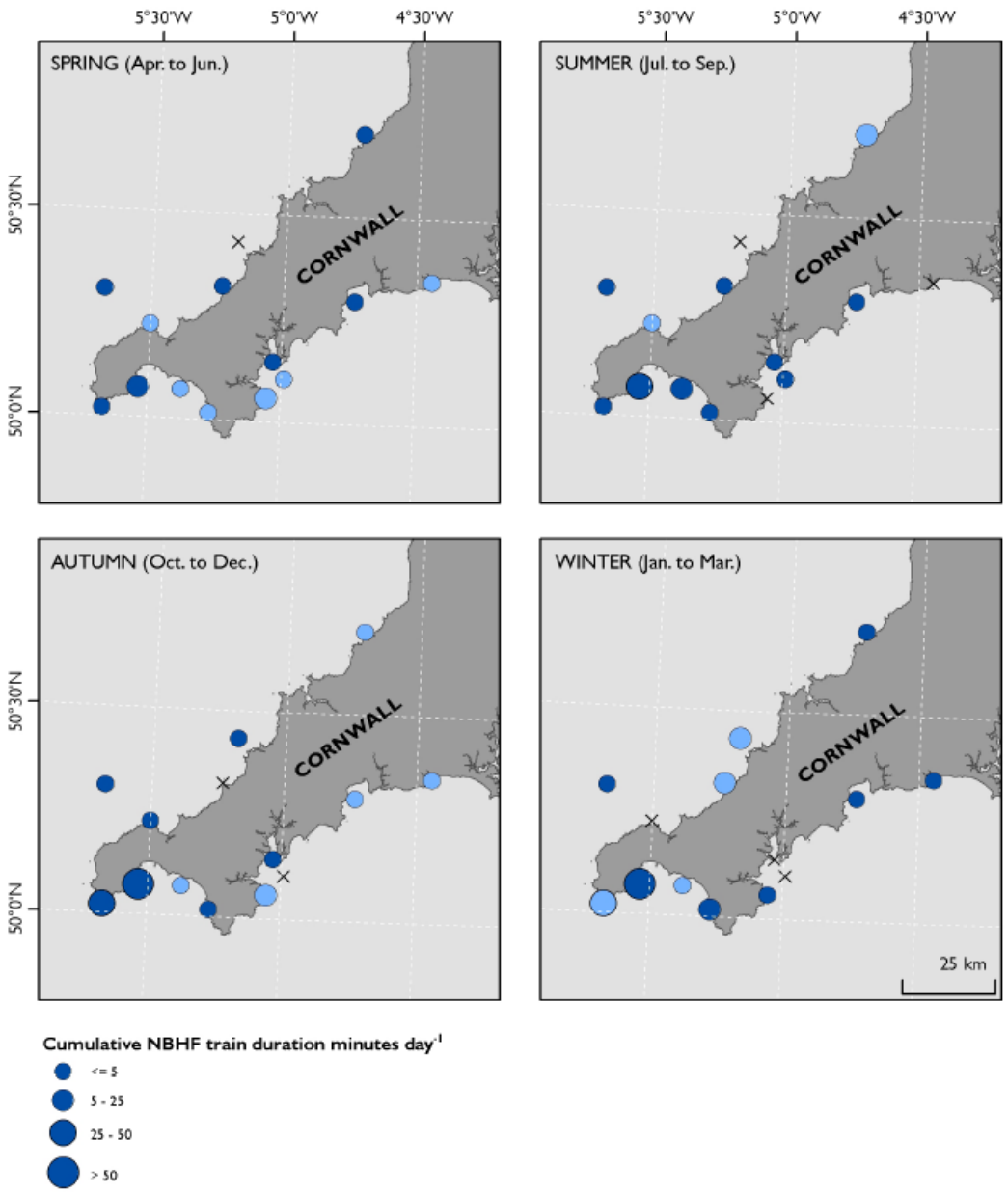

Figure 7: Comparative acoustic (click train) duration for all sites monitored through CWT's Seaquest Netsafe project for harbour porpoise activity. Light blue markers mean less than 50% of the period was acoustically monitored, whereas darker blue denotes those sites where more than 50% of the season period was recorded.

Acoustic data shown in Figure 7 highlights potential seasonal trends in harbour porpoise activity, whilst also taking into account the number of days the C-PODs were in the water. Distribution of harbour porpoise around the Cornish coast seems to be relatively even and suggests that there is no discernable season for harbour porpoise activity. However the Land's End peninsula does show an increase in activity through the autumn and winter.

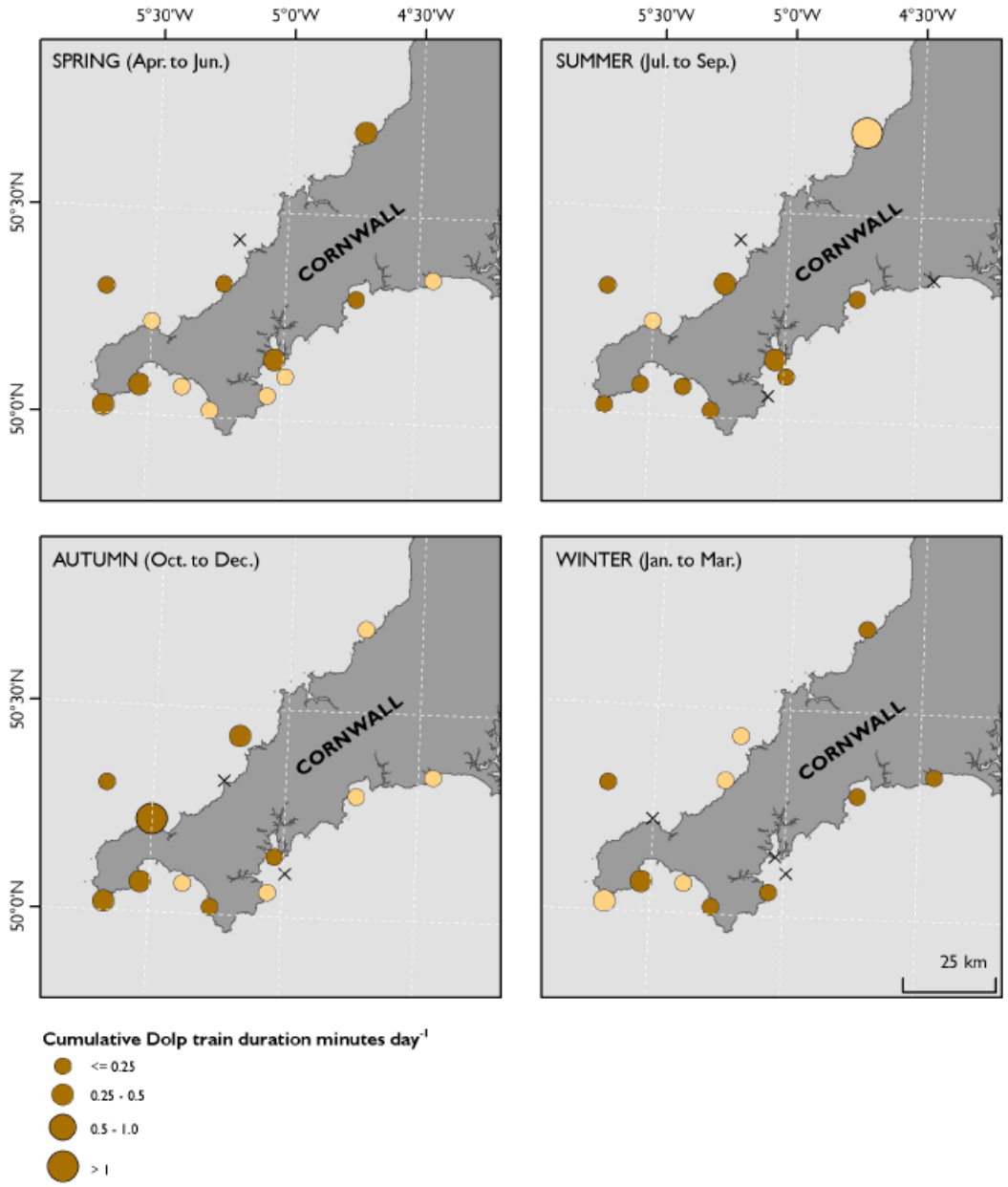

Figure 8: Comparative acoustic (click train) duration for all sites monitored through CWT's Seaquest Netsafe project for dolphin species activity. Light brown markers mean less than 50% of the period was acoustically monitored, whereas darker brown denotes those sites where more than 50% of the season period was recorded.

Figure 8 demonstrates the bottlenose and common dolphin distribution around the Cornish coast from the acoustic data collected, and shows a relatively even distribution of dolphin activity, with St Ives showing the only obviously elevated acoustic activity. The acoustic data also shows little seasonal variation, which was unexpected as from historic visual surveys it has long been thought that the winter months were best for small cetacean activity around Cornwall.

In conclusion, the use of static MPAs as a management tool without other complementary management plans in place is not considered to be a robust cetacean management option for areas with similar cetacean distributions.

4.3 Additional management tools for cetacean populations

These findings reinforce the need for regional, larger-scale or population management for cetaceans rather than site specific management. Whilst MPAs act as a useful tool in the management of critical habitats for cetacean populations, they do not currently have the flexibility in their boundaries necessary to reflect the mobile nature of cetacean populations.

In order to have any meaningful impact on cetacean conservation it is necessary to manage populations on a regional scale and ensure relevant coastal communities are involved and signed up to the project. Using management tools which address anthropological pressures on cetacean species, such as bycatch in fisheries, disturbance and chemical pollution, would be more effective than relying solely on MPA designation for the conservation of such mobile species. Cetaceans are long-lived, and so demand long-term studies to measure populations. It is possible that cetacean populations could decline to dangerously low levels before appropriate management action is taken. Combining power analysis and population viability analysis to explore the relative consequences of adopting either traditional or precautionary approaches to management is essential for effective cetacean conservation (Thompson *et al*. 2001).

The intricacies of the ecological processes which are central to the marine ecosystem are largely unknown. Even if critical habitat is identified for a cetacean population, such as key feeding areas or breeding sites which are not based on a topographical features, these may not be static. For a MPA to be effective in the management of such areas either a large area would need to be under protection or the boundaries need to be flexible (Notarbartolo-di-Sciara. 2008). The use of an MPA network, with buffer corridors to link each MPA, has been deemed a key tool for the conservation of long-ranging cetacean species such as migratory whales. The use of temporal flexibility in the designation of MPAs for mobile species such as harbour porpoise has also been suggested. This would mean establishing several ‘categories’ of MPA, each reflecting the different seasonal abundance of harbour porpoise in a specific area and so protecting the population when the population is active within the MPA (Evans and Wang. 2008), (Figure 9).

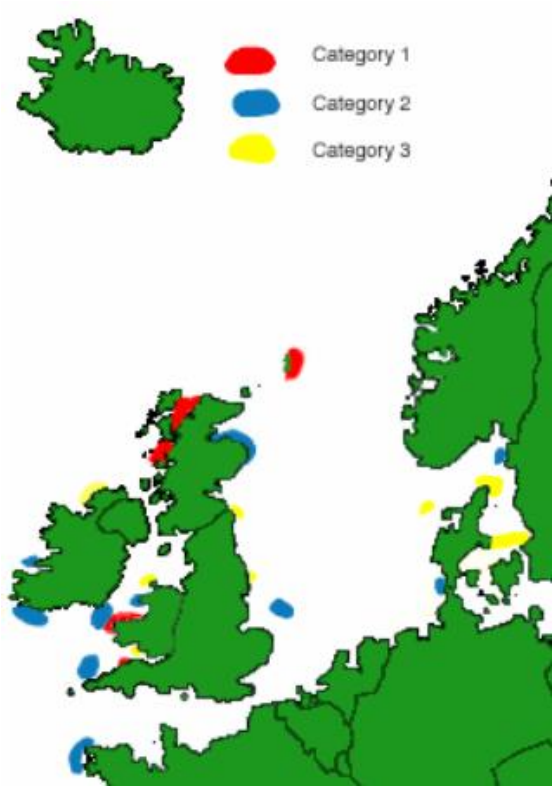

Figure 9: Map showing primary harbour porpoise areas (from Evans and Wang. 2008).

- *Category 1: porpoises have been recorded over several years, with a presence in every month of the year*
- *Category 2: locations where porpoises have been recorded over several years, with a presence generally recorded in most months of the year*
- *Category 3: porpoises have been recorded over several years, with a presence in at least three months of the year*

Additional management tools which would complement MPA management plans would also need to be utilised in areas where there is cetacean activity but which have not been designated as a MPA.

4.3.1 Use of acoustic deterrent devices as a management tool

The incidental catch of marine mammals in fishing gears, especially static nets, is one of the greatest immediate threats to marine mammals throughout the world; the death toll from fishing nets far exceeds the deliberate take of marine mammals (Reeves et al., 1996, Hodgson et al., 2007). Although MPAs, such as Special Areas of Conservation, may manage some activities that are considered a threat to cetacean populations, there are two failings in their designation;

1. In all SACs currently designated within the UK, set net fishing is still allowed, but there is insufficient evidence at present to determine whether or not it is having a significant adverse effect on cetacean populations.

2. As stated in the above sections, cetaceans with a wide-ranging distribution will be affected by threats and activities carried out outside of the boundaries of an MPA.

Therefore it is vitally important for decision makers to consider the impact of fishing on cetaceans. Pingers are acoustic deterrent devices which may alert cetaceans to the presence of a net or drive them away

from its location and hopefully reduce their risk of accidental entanglement in the net, which is termed 'bycatch'. It is known that small cetaceans such as harbour porpoises (*Phocoena phocoena*), common dolphins (*Delphinus delphis*) and bottlenose dolphins (*Tursiops truncatus)* are able to 'see' nets acoustically when echolocating at a short distance from the net. Pingers may be 'alerting' and work by inducing silent animals to echolocate and 'see' the nets, or they may be 'aversive' and cause cetaceans to move away from the source of the pings, thus reducing their chances of entanglement.

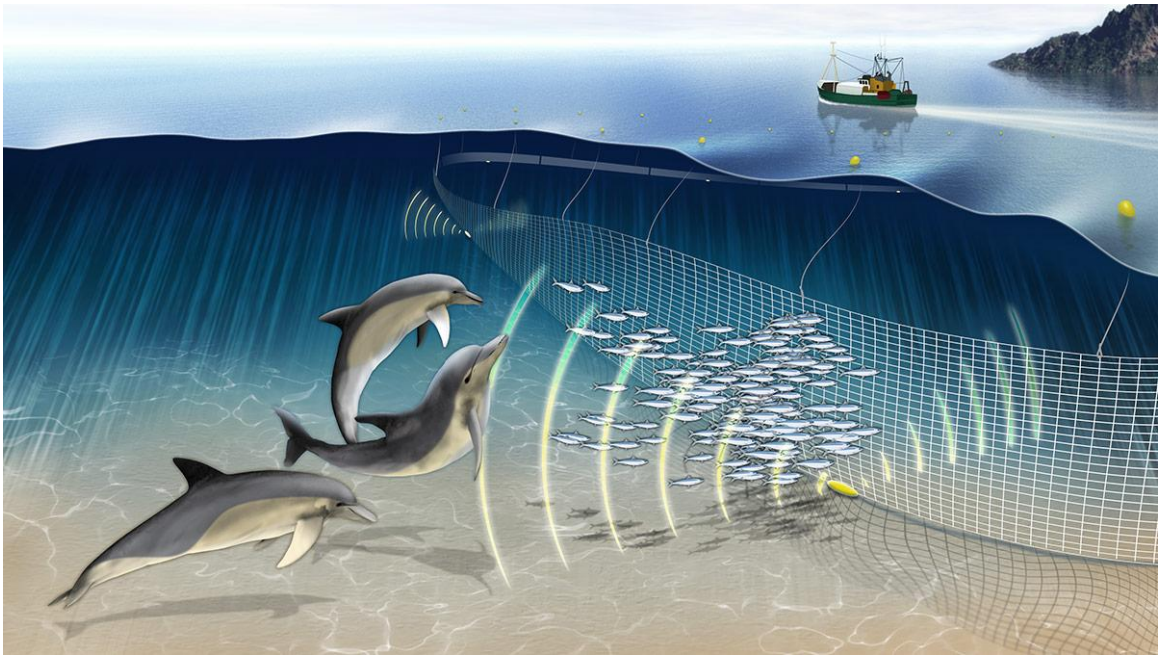

Figure 10: *Illustration of how a pinger works. Image designed by Andy McLaughlin at www.tcistudio.co.uk.*

Field studies with acoustic pingers on set gillnets have shown reductions in bycatch of harbour porpoise in a bottom set gillnet fishery (Kraus et al., 1997, Trippel., 1999) and of common dolphins in a drift net fishery (Barlow and Cameron. 2003), plus a reduction in interaction between bottlenose dolphins and a gillnet fishery for Spanish mackerel (Waples etc al. 2013). Evidence of some degree of habituation has been seen in a number of studies (Cox et al. 2001) which have used visual or acoustic methods to study how close porpoises come to the pinger. However, there is also evidence of persisting long-term effects of pingers in fisheries trials, so the exact nature and significance of possible habituation is not clear. For dolphins, the picture of pinger efficacy is much less clear than for harbour porpoise, with stronger evidence of habituation and concern over 'dinner-bell' effects, as dolphins, unlike porpoises, are known to actively take fish from nets in some locations.

Successful trials of pingers contributed to the European Union Council Regulation No 812/2004 that made use of acoustic deterrents mandatory in certain sea areas on vessels larger than 12m in length using

static bottom set fishing nets. However, regulation 812/2004 imposes no direct action to reduce cetacean bycatch on vessels of less than 12m, but does require appropriate monitoring of their bycatch.

The English Channel supports a plethora of marine life which is recognised by the diverse fisheries in practice in the area. Net activity is highest in the eastern Channel for the English fleet and in the Gulf of St Malo off the French coast. Monitoring of Channel fisheries has indicated that there has been a slight increase in netting activity over the years, with high levels of activity being recorded in 2006 and 2007 (MMO website).

The Channel supports 14 species of cetacean, and is recognised as a region of national importance with regard to cetacean abundance and diversity. Of specific conservation importance in Cornwall are our small, but well-recognised, resident group of inshore bottlenose dolphins, which has shown a decline in the average observed group size over the last 17 years to levels at which the loss of any individual could have a significant impact on the survival potential of this group (Wood, C. J. 1998).

The co-existence of a large number of fishing vessels deploying gillnets in waters with nationally important cetacean populations leads to problematic bycatch. Globally, there is extensive evidence that cetacean bycatch occurs in many areas where gill or tangle net fisheries occur within cetacean habitat (Perrin et al., 1994).

Image 15: Porpoise removed from gillnet. Photo by Environment Agency.

The mandatory requirement announced by Defra in June 2013, for use of pingers on over-12m vessels under their obligations to European regulation No 812/2004, is a positive step towards cetacean conservation which The Wildlife Trusts support fully. However, this regulation does nothing to control cetacean bycatch by vessels less than 12m long. Cornwall Wildlife Trust's research between 2008 and

2013 has therefore focused on deterrent devices that are compliant with the EU regulation and would be effective at reducing cetacean activity around nets used inshore (Hardy et al, 2012).

Cornwall Wildlife Trust's research aimed to find a suitable pinger that was both effective and practical as an inshore bycatch mitigation device. Following trials and assessments of various pingers between 2008 and 2011, a new device called the Banana Pinger was developed which has been designed to overcome all the known issues with alternative pingers on the market. It has been developed by Fishtek Ltd., based in Devon, and Chelonia Ltd. in Cornwall as a direct result of previous work in the Cornish fishery.

In 2012, CWT initiated an investigation into the Banana Pinger which consisted of two trials:

1. Cycling pinger trial – to investigate behavioural effects of the Banana Pinger on porpoise and dolphins in the immediate area, such as possible long-term displacement and the rate and degree of potential habituation of the animals to the pinger.

2. Use in a fishery – to test the effectiveness of this device at deterring cetaceans from inshore set nets and assess their practicality in a normal commercial fishery setting.

Image 16: Banana Pinger designed by Fishtek Ltd. Photo by Cornwall Wildlife Trust.

As a result of our work, it was concluded that the Banana Pinger is suitable for deployment in an inshore set net fishery and shows a strong 'pinger effect' that can be expected to translate into a greatly reduced porpoise bycatch. It also gives confidence that habituation or long-term displacement is not a problem. There is also strong evidence of a response by dolphins as well as porpoise to the Banana Pinger, displayed in the cycling pinger trials.

By minimising the number of cetaceans accidentally caught in fishing nets, effective pingers would reduce one of the main threats to the survival of these highly valued and nationally protected species. Cornwall Wildlife Trust therefore recommends that Banana Pingers should be considered as a tool in protecting cetaceans within our UK waters where set net fishing activity is high.

4.3.2 Reducing chemical pollution

Adopting an integrated approach to reduce chemical pollution reaching the marine ecosystem has a huge potential to reduce the instance of chemical pollution in inshore waters. The Cornwall Wildlife Trust and other individuals and organisations have been working to address this issue in recent years by working with waterway management organisations, land owners and terrestrial conservationists to improve water quality which has a positive impact on inshore waters as a whole. Cornwall's conservation and management organisations have also developed excellent communication channels and protocols to ensure a swift and comprehensive response to pollution incidents around the Cornwall and Devon coast. This communication network helps to speed up any necessary clean-up and wildlife rescue operations. Coupled with tighter regulations on the use and disposal of potentially contaminating chemicals, and the increased potential to prosecute polluters where appropriate, the impact of chemical pollution in the marine environment can be reduced. However, this is a hugely complex issue where pollution is not often seen and only the environmental consequences are visible, by which time it may be too late to determine the source.

Restrictions on the use of disposable plastics by the general public, such as the recently announced levy on disposable plastic bags in England, will help to reduce the instance of marine litter which has been increasing significantly in recent years. Such schemes have been well received and successful in other parts of the UK and Europe, for example Wales and Ireland, and have brought to light the issue of plastic pollution and marine litter into the public domain.

4.3.3 Codes of Conduct as tools to mitigate disturbance

It has been established that consistent disturbance of cetacean species can have detrimental impacts on the individual as well as the population, leading to chronic stress, site displacement and in some cases physical damage or death from boat strike. At present it is an offence to deliberately cause disturbance to European Protected Species, which includes all species of cetacean under the Conservation Regulations 1994 and Offshore Marine Conservation Regulations 2007 (JNCC, 2008). However, there is need to translate these regulations into a workable management tool. The establishment, promotion and policing of a comprehensive code of conduct both for public boat users and commercial boat operators can be a useful tool for the mitigation of disturbance of cetacean species.

Image 16: Common dolphin bow-riding boat following Code of Conduct. Photo by Annabelle Lowe.

Chronic acoustic disturbance has a potential to become a significant threat to inshore populations of bottlenose dolphin and harbour porpoise. The cumulative effect of noise such as boat traffic, commercial construction and military activity has been suggested to have both long and short term effects on cetacean species, though little is known of the true extent of the consequences of anthropological noise pollution to cetaceans (WDCS, 2004). Regulation and monitoring of the noise level for such human activities within areas which have significant cetacean activity would help reduce the more severe impact of noise pollution on inshore cetacean populations.

It is therefore critical in any assessment of an area for protection that the relative importance of these fixed and fluid environmental characteristics be investigated (Hooker et al. 1999).

V. Conclusions and recommendations

Image 17: Harbour porpoise. Photo by Niki Clear.

This report demonstrates several methods of cetacean monitoring and recording that, if implemented on a wider scale, will better inform future conservation strategy for these species. Cornwall Wildlife Trust's Seaquest Netsafe project provided much-needed data on the distribution and behaviour of cetaceans in inshore waters off Cornwall and the Isles of Scilly, as well as establishing a sustainable network of volunteer sightings recorders to continue to collect effort-based data through land-based surveys. However, this work highlighted the requirement of a range of methods to be used to successfully monitor cetacean populations. Visual and acoustic monitoring provided a large quantity of data for the project and each has their own specific value. However, when reviewing the results it becomes clear that visual surveys are unable to match the acoustic monitoring for gaining a holistic view of cetacean activity in a given area, although data from visual surveys did show that there is still a place for this type of monitoring to ground truth acoustic data as well as provide support information. The visual sighting scheme also raised a huge amount of awareness which has proved important in the conservation of a species, while the acoustic methods were more effective in collecting the quantities of data necessary for reliable analysis. Visual surveys are therefore valuable for cetacean monitoring but should always be used as a complementing methodology to acoustic monitoring. Photo-identification has also proved essential in understanding the distribution and movements of cetaceans populating our UK coastline. The monitoring of stranded

specimens such as goes on in Cornwall via the Marine Strandings Network is highly valuable for more detailed study of these elusive animals.

When a cetacean population is thoroughly researched and understood via appropriate monitoring and research, MPA designation is undoubtedly an extremely powerful conservation tool when that species has a small home range, is a migratory species with very clearly defined breeding/feeding areas, or if the threats faced are localised and appropriate management can be put in place to counteract those threats (JNCC 2011 report). However, it is essential for these sites to be supported by schemes or plans which will deal with the complex interaction of different management issues so that cetacean populations are maintained, significant disturbance to cetaceans is avoided, and the key habitats of cetaceans are preserved.

Spatial conservation planning is complicated by the highly mobile nature of marine megafauna: however, these animals are important components of the marine environment and understanding their distribution is a first step toward their inclusion into ecosystem management plans. Where a species ranges widely and threats also cover a wide geographic area, then the value of an MPA is questionable. While the Special Areas of Conservation in Cardigan Bay and the Moray Firth make some contribution to securing favourable conservation status for the bottlenose dolphin, wider measures are also necessary to support the conservation of these animals outside of the SAC boundaries. Such measures are detailed in the UK Biodiversity Species Action Plan for small dolphin species and should be referred to by regulatory bodies and authorities to ensure the best protection for cetaceans in UK waters.

Our recommendations for broad cetacean conservation based on our experience and research are:

1. Create a monitoring network to gather visual data as well as using passive acoustic devices, such as C-PODs, around the coast, starting in areas with high cetacean activity (Wales, West Scotland, Bristol Channel and South West Coast of UK). Where there are high incidences of cetacean strandings it is recommended to collect data from such animals using standardised protocols such as those developed by CWT MSN.

    a. The acoustic monitoring undertaken via the Seaquest Netsafe project provided valuable data on the habitats used and areas of importance to cetacean species around the Cornish coast, and showed that historical data from visual sightings alone cannot be relied upon when setting management measures for the conservation of small cetacean species. A nationwide acoustic monitoring programme would be beneficial in identifying more accurate cetacean distribution and thus aid cetacean conservation management decisions.

    b. One of the first steps towards this network of acoustic monitoring should be to ensure that all environmental impact assessments submitted through the planning process (of large projects such

as renewable energy installations) should include a period of acoustic monitoring to gain a true understanding of the cetacean use of the area concerned, and therefore better inform potential measures to mitigate any disturbance. Such data must be made available for wider use, for example through the Local Records Centres and the NBN gateway.

2. Marine Protected Areas can be a useful management tool for the conservation of small cetaceans but at present the boundaries cannot be changed to reflect the mobile behaviour of some cetacean populations. Legislation governing such MPAs should be changed to enable flexible boundaries and revisions to be made where necessary for the ongoing protection of the cetacean species concerned.

3. Ensure that cetaceans and appropriate management measures are included within the UK Marine Conservation Zone network.

    a. Currently, no cetacean species have been included as features within the newly designated MCZ sites in England, despite research to support these proposals where there is high activity of specific species. It is recommended that cetacean species should be included as features in the new MCZ designations where evidence suggests such conservation management would be appropriate.

4. Pingers should be promoted and used, under a voluntary agreement, by all vessels using bottom set nets.

    a. Cornwall Wildlife Trust's pinger trials have demonstrated that pingers are both effective in the reduction of cetacean bycatch in set net fishing gear and practical for use by fishermen.

    b. To encourage voluntary uptake of pingers, effort should go into raising awareness of vessels using pingers as being 'dolphin friendly' and promote these vessels as using sustainable practices.

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PANACHE

Protected Area Network Across the Channel Ecosystem

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

The project's five objectives:

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

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

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

Les cinq objectifs du projet :

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

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

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