Marine Acoustics Monitoring Project 2016

Summary Report

Report by the Cornwall Wildlife Trust

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Title Page Photo: Mirrored common dolphins playing. Photo Credit: Ross Wheeler

1.0 Executive Summary

Bottlenose dolphins in the coastal waters of SW England are thought to be under threat and potentially in decline. However, this inshore resident population is poorly understood. In order to gain a more thorough understanding of this population the Cornwall Wildlife Trust (CWT) ran the Bottlenose Dolphin Appeal in 2015, and have subsequently set up the SW Bottlenose Dolphin Consortium. This collaborative partnership aims to lead research on this species, to gather and collate existing data on this locally threatened population in order to gain better protection and population management strategies.

As a part of this, a small project was conducted by Seaquest Southwest throughout the summer of 2016 to trial new equipment and to monitor the local bottlenose and common dolphin populations. The project utilised a combination of both acoustic and sightings data collection methods. This monitoring project had three key aims:

1) Gather data on local bottlenose dolphin populations

2) Trial Chelonia Ltd's newest acoustic monitoring device, the 'C-POD-F'

3) Assess the capabilities of the C-POD-F to reliably identify dolphin species through acoustics.

The newest design of passive underwater recording device, the C-POD-F, was supplied by Chelonia Ltd. to be trialled during this project. This POD was deployed in Newquay Bay and monitored by Atlantic Diving Newquay between June and September 2016. During this same time period, effort based land surveys were conducted using CWT's existing Seaquest data collection methodology and opportunistic sightings (mostly boat-based) were recorded.

Sightings of four cetacean species were recorded: bottlenose dolphins, common dolphins, harbour porpoise and Risso's dolphins. Three of these species were also recorded by the C-POD-F (excluding Risso's dolphins). The POD collected high quality acoustic data, however, as to be expected in a trial of new equipment, some small teething issues were highlighted during the deployment. These issues are currently being addressed in the final development stages by Chelonia Ltd, and further trials of the C-POD-F are being conducted in Cornwall and globally.

Through the delivery of this project, valuable data on all of Cornwall's cetacean species has been collected and will feed into larger ongoing projects and databases. We were able to gather data on our local inshore population of bottlenose dolphins which will work towards gaining official recognition for the population as a local, resident population, separate to offshore bottlenose dolphin populations. Additionally, the acoustic data collected is of a high enough quality to enable early development of species specific acoustic identifiers, although further research is required.

2.0 Introduction

Cornwall's bottlenose dolphins (*Tursiops truncatus*) are potentially in decline. Current estimates suggest that the resident population may have halved in numbers since the 1990's, causing them to be at serious risk of local extinction. In order to stop the loss of these majestic creatures from Cornwall's shores, the Cornwall Wildlife Trust launched the Bottlenose Dolphin Appeal in 2015 and have subsequently set up the SW Bottlenose Dolphin Consortium. The purpose of this work was to enable projects to better understand the current status of the resident bottlenose dolphin population and to gather enough information to gain official recognition as a local resident inshore population and thus lobby for better protection.

Funds raised through this appeal have been put towards several projects. The Trust aims to bring together existing data from organisations throughout the South West through the Bottlenose Dolphin Consortium and to continue monitoring the population. Through collation of existing data and ensuring continuous monitoring we hope to build a better picture of the local dolphin population, for example their movements, seasonal behaviours and rate of population change. This acoustic monitoring project was a pilot project to trial equipment and methods of continuous monitoring.

In the summer of 2016, the Trust led a project monitoring bottlenose dolphins via the Seaquest Southwest Project through a combination of both acoustic and sightings data. A passive underwater acoustic monitoring device (supplied by Chelonia Ltd in Mousehole, Cornwall) was deployed off of the Cornish coast and land and boat based sightings records were collected. The project was developed with three key aims:

1) Gather data on local bottlenose dolphin populations

2) Trial Chelonia Ltd's newest design of acoustic monitoring device known as a 'POD'; specifically, we used the C-POD-F

3) Assess the capabilities of the new POD to reliably identify dolphin species through acoustics.

The information gained through the project will be used to inform and evaluate methods of monitoring these elusive creatures and is a step towards building a bigger picture of our very own South West bottlenose dolphin population.

Photo 1: A surfing Bottlenose Dolphin. Photo by George Karbus

3.0 Methods

Our methods briefly comprised of an underwater passive acoustic recording device, or POD, being deployed in Newquay Bay on the north coast of Cornwall by tour boat operator and Trust supporters Atlantic Diving Newquay. To compliment this acoustic data, voluntary surveys utilising the CWT Seaquest Southwest protocols were carried out to provide sighting records of cetaceans (species and abundance) in the area. Further to this, opportunistic boat sightings were recorded by partner organisation, Atlantic Diving Newquay.

Below we will explore what exactly PODs are and how we used them in this project.

3.1 What are PODs?

During this project, we trialled the newest POD design from Chelonia Ltd, the C-POD-F. Together with previous versions, these types of acoustic monitoring instrument designed by Cornwall based Chelonia Ltd. are known as PODs. PODs are passive underwater acoustic recording devices that float in the water column. They do not produce sound themselves and do not actively seek cetacean activity but simply record sounds as they pass by. PODs record the echolocation sounds, clicks and whistles of cetaceans (particularly the toothed whales, dolphins and porpoises) that fall within the frequency and distance ranges of the POD. The PODs also record other sounds, including those of anthropogenic (human) origin such as noise produced by boats or jet skis. Using PODs to research cetaceans enables data to be collected 24 hours a day, something that cannot be done with visual surveys alone, providing a greater insight into the vocalisations used by these animals over a whole range of behaviours including feeding, locating, socialising and sleeping.

The C-POD-F used in this monitoring project can record over a larger range of frequencies than previous versions with a frequency range of 17-220kHz, encompassing the sounds produced by both common and bottlenose dolphins and harbour porpoise. This POD design has a recording range of about 4km in all directions.

Photo 2: A POD up close (left) and a POD deployed underwater (right). Photos by Nick Tregenza

3.1.1 Previous research using PODs

Conservation of cetaceans is in a critical state. One, the Yangtze river dolphin has recently gone extinct and another, the Vaquita, a small porpoise species found only in Mexico, is on the edge of extinction, but much more effort is being made to save it. That is partly because it has been possible to show that it is still in decline despite claims from fisheries and the government that the fishery regulations are adequate. The contrary evidence has come from an array of about 50 C-POD instruments made in Cornwall. The original effort to make this kind of instrument came from the Wildlife Trust's observer program on Cornish and Irish gillnet fishing boats.

Those early instruments, called 'The Bombs' by the fishers, were only able to recognise the sounds made by porpoises, and couldn't reliably exclude boat sonars that made pulses at porpoise frequencies. A lot of development work has produced the C-POD that solved that problem and is good at recognising dolphins as well.

The development of software to distinguish the species is tough, and currently there is no software from any other source that can pick out the trains of clicks made by the animals.

These C-PODs have been used in cetacean research, conservation and projects all over the world. Notable research includes: The Banana Pinger Trial carried out by the Cornwall Wildlife Trust between 2010 and 2013, researching the species range of Maui dolphins (*Cephalorhynchus hectori maui*) in New Zealand and using PODs to detect small changes in population sizes of the Vaquita (*Phocoena sinua*) in Mexico.

The Banana Pinger Trial used C-PODs to assess the effectiveness of an acoustic deterrent (the FishTek Banana Pinger) on reducing harbour porpoise (*Phocoena phocoena*) bycatch in set-net fisheries. C-PODs were used to monitor harbour porpoise activity at the net site and both harbour porpoise and dolphin activity approximately 150m away. The project showed promising results with a reduction in harbour porpoise detection by 82% close to nets using the pinger deterrents.

In New Zealand, PODs have been used to confirm the presence of the endemic Maui dolphins, a subspecies of the Hectors Dolphin (*Cephalorhynchus hectori*) and the smallest known subspecies of dolphin, in areas where they have rarely or never been sighted. Maui dolphins are critically endangered, and knowing the full species range is integral to fully protect the species from harmful fishing practices.

Vaquitas are the world's rarest cetacean, resident only in the Gulf of California, Mexico. Due to its small size and rarity, observation of the species and transect methods of estimating population size are ineffective and do not provide the low confidence intervals required to detect small changes in abundance. By providing 24 hour monitoring for long periods, an array of C-PODs have been able to provide evidence of population declines.

3.1.2 PODs and our Project

The current challenge is to distinguish dolphin species from the qualities of their clicks and click trains. Some acoustic distinctions between species will probably always be impossible but one that would be very valuable is to distinguish bottlenose dolphins from the other smaller species.

Our project trialled the newest POD design, the C-POD-F which has been designed with this in mind. This POD records over greater range of frequencies than previous POD designs, and is therefore able to record several species in one deployment. Previous versions of the POD required the frequency range to be set to the target species. One of the aims of this project was to assess the potential for creating 'acoustic identifiers' for different dolphin species based on the recordings from the C-POD-F. The ability to reliably identify species through acoustic data alone would be beneficial to the field of cetacean research, minimising the man hours required to carry out land or boat surveys as these species are not easily surveyed by eye as they spend much of their time underwater. Acoustic data can also provide more information on the vocalisations produced during different behaviours such as echolocating, feeding, socialising or sleeping, providing an insight into not only the abundance and distribution of a species but also into their behaviours at different times of the day or year and in different locations.

Photo 3: A seawatch has to be undertaken during the day and poor weather conditions can impact sightings (left). The C-POD-F marker buoys (right), the instrument can record cetacean activity 24/7. Photos by: Katie Bellman and Emily Easman

3.2 The Seaquest Southwest Project and sea watch methodology

The CWT Living Seas Seaquest Southwest project has been running for over 20 years and works to collect sightings records on the distribution and abundance of marine megafauna around the Cornish coastline. Through public surveys the project aims to engage the wider public in the amazing marine wildlife on our doorstep and to better understand and conserve these animals. Seaquest Southwest is a citizen science programme and provides training to volunteers on surveying protocols and the identification of marine wildlife.

Seaquest Southwest surveys are an effort based survey designed to collect data on the distribution and abundance of marine megafauna in Cornwall. They use a standardised form to record environmental conditions throughout the survey and every 10 minutes all sightings are recorded, even if that means recording nothing! The first time an individual or group is seen, the exact time is noted and details of the; species, number in the group including the number of juveniles and sex are recorded where possible. Repeat observations of the same group or individual are noted as such.

To collect the sightings records for the acoustic monitoring project, the Seaquest Southwest recording methods and forms were utilised by trained volunteers to record marine mammals, particularly cetacean, sightings at the POD location. However additional information was required from surveys, including details of birds that were seen diving or feeding nearby. This can allow prediction of the prey species (fish) that may be present, influencing the feeding behaviours and vocalisations likely to be displayed by dolphins. Additionally, an outline map of the watch point and POD location was provided where details of direction of travel of cetaceans could be recorded (heading towards/away from/alongside the POD). This aided analysis of acoustic records. During these surveys, it was also important to record 'zeros' in line with Seaquest recording methodology as the POD may record activity from animals that were not seen from land.

Photo 4: A public Seaquest survey event (left); A volunteer surveying at Towan Head (right). Photos by: Dan Murphy and Caz Waddell

3.3 Project Methods

From June to September a C-POD-F was deployed in Newquay Bay using a weighted line and surface buoy visible from land to demarcate the POD location. The POD was left for weeks at a time and was only removed from its location when the sea state was too rough, leading to poor recording quality and increased risk of loss of equipment.

Simultaneously, effort based surveys (using the Seaquest Southwest recording methods) from land were carried out by dedicated volunteers from the Seaquest Southwest project and the Newquay Marine Group (supporters of the Seaquest Southwest project) from Towan Headland. Additionally, ad hoc boat sightings were recorded by boat tour operator and project supporter Atlantic Diving Newquay.

One of our key aims was to assess the capabilities of the new POD design to reliably identify species through acoustics. To do this we need to combine acoustic and sightings records to create labelled data. This means we know what species made a specific vocalisation recorded on the POD by identification via sightings data. From this labelled data, we can begin to build an acoustic profile for the species we have recorded. In the long term, this can lead to changes in the way marine mammals are monitored. Acoustic monitoring is less intensive than visual surveying, requiring less human input and effort in time and money, can collect data for 24 hours a day, can provide an insight into the behaviours of these animals and can collect data on species that don't surface regularly.

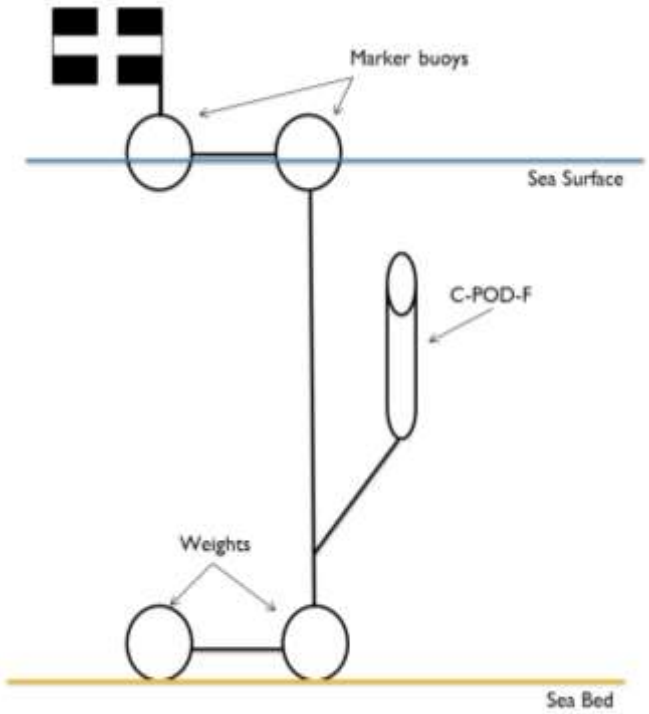

Diagram 1: A basic diagram of the C-POD-F deployment rigging during this project.

4.0 Results

Over the four month period the POD was deployed, we collected 70 individual sightings records from both the land and sea. These sightings included four different cetacean species. Our C-POD-F recorded high quality acoustic data, however there were some teething issues. At some stages of the deployment the POD did not record continuously and had short intervals where no data was recorded. The deployment has also recorded high levels of sediment transport noise due to the relatively shallow deployment and strong tidal currents. Sediment transport noise has the potential to impact cetacean echolocation as the noise levels can be at a much higher level and similar frequency of the echoes they need to listen for.

4.1 Sightings Data

Volunteers recorded 70 sightings of four cetacean species and an amazing 391 animals were counted over 25 dates of the 4 month deployment period. The four species included both of our target species: bottlenose dolphins and common dolphins, as well as harbour porpoise which are very hard to spot and identify due to their small size but are actually one of the most common cetaceans in Cornwall and Risso's dolphins (*Grampus griseus*).

There were 10 sightings records of 52 bottlenose dolphins over the POD deployment period. These dolphins were seen in numbers anywhere from one individual sighted (one sighting recorded) up to groups of 10 individuals (three sightings recorded). Some of these sightings are likely to have been repeat sightings of the same animals. Eight of these sightings were recorded by boat, while just two sightings (of groups of 10 and 4 individuals) were recorded during land based surveys. Bottlenose dolphins were sighted from the 25/7/2016 until the 14/9/2016.

Common dolphins were sighted 34 times during the POD deployment period, and 282 animals were recorded. Some of these records are likely to be repeat sightings of the same animals. 24 of these records were from boat sightings, while 10 were from land based surveys. These animals were seen in groups of up to 33 individuals but were also recorded individually (three of 34 sightings). Common dolphins were sighted from the 23/7/2016 until the 23/9/2016.

There were 24 sightings of harbour porpoise, eight records from boat and 16 from land based surveys. These animals were most commonly seen in pairs (10 of 24 records) but were recorded in groups of up to three individuals (five records) and individually (nine records). Harbour porpoise were sighted from the 23/8/2016 until the 8/9/2016.

There was one sightings record of Risso's dolphins. This sighting was recorded by boat on the 29/08/2016. 12 individuals including two calves were recorded to be travelling west away from our POD location.

Photo 6: The four species sighted throughout this project. Bottlenose dolphin (top left), common dolphin (top right), harbour porpoise (bottom left) and Risso's Dolphin (bottom right). Photos by: Dan Murphy (bottlenose dolphin), Ben Porter (common and Risso's dolphin) and Niki Clear (harbour porpoise)

4.2 Acoustic Data

The challenge of distinguishing dolphin species from the qualities of their clicks and click trains is a difficult one. The new C-POD-F, which we trialled in this project is able to capture very fine details of clicks, timing features to a precision of a quarter of a microsecond. Its development has proved much more difficult and prolonged than planned! But it could be really useful for other endangered species once it becomes fully operational.

The work by volunteers watching the sea, and by Chris and Annabelle Lowe deploying a C-POD-F off Newquay has provided data sets that throw light on where things are working and where they are going wrong, aiding in the final developments of a fully operational C-POD-F that can be deployed in projects globally.

During this deployment some issues were highlighted regarding the continuity of records and the level of sediment transport noise recorded, potentially making the identification of any clicks during this time difficult and increasing uncertainty. These small issues are expected in the development of such a precise instrument and this deployment has aided in the identification and rectification of such problems.

5.0 Discussion – What does this mean?

This project was developed with three key aims in mind. Firstly, to gather data on local bottlenose dolphin populations, specifically the resident in-shore population which appears to have displayed a population decline since the 1990's. We were able to successfully deploy a C-POD-F and mobilise volunteers to gather acoustic and sightings records. Four species of cetacean were recorded through visual surveys and three species have been identified in our acoustic records, including our two target species, bottlenose and common dolphins. These records will feed into larger datasets within CWT and the work of the new Bottlenose Dolphin Steering Group.

Our second aim was to trial Chelonia Ltd's newest POD design, the C-POD-F which has been developed to record with higher precision and over a larger range of frequencies. The data we collected using this technology is of very high quality but some small issues were identified. These have been fed back to Chelonia Ltd and are being addressed in the final development of the C-POD-F. Further trials of this POD are currently being undertaken both in Cornwall and abroad in the Amazon in Peru and the sub-Antarctic Kerguelen Islands. The development and eventual commercial distribution of this POD will enable high quality research to be undertaken on cetaceans globally, including working towards more robust monitoring of Cornwall's resident inshore bottlenose dolphin population.

The final aim was to assess the capabilities of the C-POD-F to reliably identify dolphin species through acoustic records, to determine whether acoustic identifiers could be produced. The data collected can be analysed together to create 'labelled data', where sightings records can be used to confirm the identity of the acoustic records. For example, we can say that a click train identified in the acoustic data on a specific date and time is very likely to be from the pod of common dolphins that were sighted in the area at the same date and time. However, to make even the smallest steps in producing these identifiers, many more 'labelled data' are required. What this project has done, is take the first steps in producing reliable acoustic identification of dolphin species using the data collected by the C-POD-F.

The data collected has been partially successful in addressing the project aims and whilst further work is required, our results have helped in the development of acoustic identifiers for dolphin species.

6.0 Next Steps

Acoustic monitoring technologies is an exciting and current field to be a part of. Following on from this trial, we will continue to work closely with Chelonia Ltd to aid in the development of this acoustic technology. Utilising feedback from this and other trials that are being undertaken around the globe, it is hoped that the C-POD-F will soon be available for commercial use. Being able to access such innovative technology will help us move towards gaining a better understanding of our own, local cetacean populations. As we hope to develop species specific acoustic identifiers with this technology, further research is needed to allow the collection of even more sightings and acoustic records to create a more comprehensive library of labelled data.

Acknowledgements

Cornwall Wildlife Trust would like to give a huge thanks to all those who volunteered their time during this project, without whom, this trial could not have happened.

We would also like to extend special thanks to:

- Nick Tregenza of Chelonia Ltd for his generous donation of his newest technology, the C-POD-F;
- Annabelle and Chris Lowe of Atlantic Diving Newquay for their time and enthusiasm throughout this pilot study, for sharing their sightings records and for looking after the POD throughout its deployment;
- Seaquest Southwest volunteers and the folks at Newquay Marine Group for their support and sharing their sightings records throughout the project.

Photo 7: A group of common dolphins. Photo by: Paul Semmens

For more information

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