PASSIVE ACOUSTIC MONITORING OF SMALL CETACEANS IN THE ISLES OF SCILLY

A CONTRIBUTION TOWARDS MERiFIC WORK PACKAGES 3.3.1 – 3.3.4

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Executive summary

This report was compiled as part of the Marine Energy in Far Peripheral and Island Communities (MERiFIC) project. The MERiFIC project seeks to advance the adoption of marine energy across two regions of Cornwall and Finistère by developing 'toolkits' of methodologies and best practice, that will in turn, facilitate the development of sustainable marine renewable energy extraction in similar communities.

Marine Renewable Energy Installations (MREIs) have the potential to make significant contribution to energy supplies. However, their construction, operation and subsequent decommissioning in marine ecosystems may bring associated impacts (potentially positive and negative) to marine species and habitats. Cetaceans have been identified as a species group that may be affected. As such, to facilitate best practice in the development of MREIs, where negative effects are minimised and positive effects are promoted, it is necessary to quantify species distribution and relative abundance, both spatially and temporally, over seasonal and annual time scales.

Here we use autonomous passive acoustic monitoring devices (C-PODS) deployed in coastal water locations of the Isles of Scilly, Cornwall, England, to monitor and subsequently describe, spatial and temporal occurrence of cetacean species in geographically remote locations through autumn and winter months; areas that would likely otherwise be inaccessible to traditional survey methods.

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Introduction

This report was compiled as part of the Marine Energy in Far Peripheral and Island Communities (MERiFIC) project. The MERiFIC project seeks to advance the adoption of marine energy across two regions of Cornwall and Finistère; more specifically, the island communities of the Isles of Scilly and le Parc Naturel Marin d’Iroise. By doing so, MERiFIC aims to develop 'toolkits' of methodologies and best practice that will facilitate the development of sustainable marine renewable energy extraction in similar communities.

Background & Objectives

Marine Renewable Energy Installations (MREIs) have the potential to make a significant contribution to world energy supplies. However, their placement in the marine ecosystem may bring associated impacts to marine species, and their environment, during construction, operation and decommissioning phases; both above and below water. These impacts may be acoustic disturbance, displacement/barrier effects, collision/entanglement risks, habitat alteration or changes to water flow or turbidity; however, the possible effects on marine species are difficult to quantify (Inger *et al.* 2009; Witt *et al.* 2012). Cetaceans are one group of marine species that may be negatively impacted by noise in the marine environment; this may be particularly so as cetaceans use underwater echolocation to navigate and to detect prey species. A number of studies have reported negative impacts to cetaceans from MREIs, particularly during the construction phase (Carstensen *et al.* 2006, Thompson *et al.* 2010, Brandt *et al.* 2011, Teilmann & Carstensen 2012).

To facilitate ecologically sustainable practice in the development of MREIs it is necessary to quantify species present, both spatially and temporally, over seasonal and annual time scales. This may then allow appropriate siting of MREIs in relation to environmental resources at the same time as accounting for species presence. Establishing species spatial and temporal occurrence may also enable identification of potential threats and help formulate relevant mitigation strategies if required.

Recording the presence of cetaceans has traditionally been achieved using visual surveys (*e.g.* Leeney *et al.* 2012). However, cetaceans spend comparatively little time at the surface; visual surveys are also dependent on sea state and prevailing visibility. As such visual census techniques afford only a limited glimpse of their distribution and may only provide an appropriate survey technique for smaller cetacean species, such as harbour porpoise (*Phocena phocena*), when the sea is calm (generally during the summer). Therefore, the resulting data provide limited insight on the seasonal presence of cetaceans in coastal habitats and may significantly under-record species when environmental conditions may be at their most limiting.

The most common small cetacean species in UK coastal waters are the harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*) and common dolphin (*Delphinus delphis*). Other occasional species are white-beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutes*) and Risso's dolphin (*Grampus griseus*). Under the European Union Habitats Directive all cetaceans are classed as European Protected Species; this directive also extends to give addition protection to harbour porpoise and bottlenose dolphin within Special Areas of Conservation (SACs). Within UK waters, cetaceans are further protected under the Wildlife and Countryside Act 1981 and are also listed as UK Biodiversity Action Plan priority marine species. It is therefore essential that spatial and temporal distributions of these species are quantified when considering the siting of MREI infrastructure.

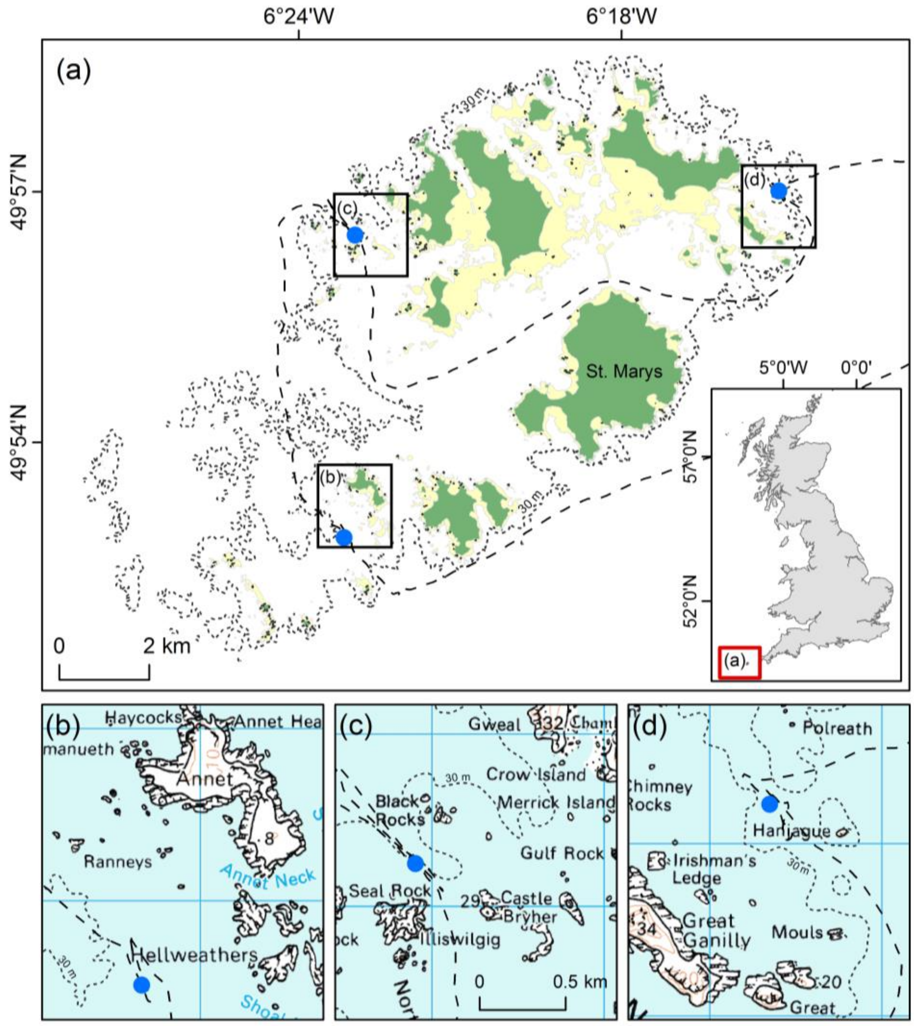
The C-POD (www.chelonia.co.uk) is an autonomous passive acoustic monitoring/recording device that is able to record the characteristic high-frequency clicks made by porpoises and dolphins. It is able to operate in depths of up to *ca.* 200 m, for up to 200 days without servicing. The device includes an omni-directional hydrophone allowing for a detection range for harbour porpoises of approximately 400 m and up to 1000 m for dolphin species. The associated C-POD analysis software (CPOD.exe: www.chelonia.co.uk) enables detection of echolocation clicks and trains and also allows for differentiation between porpoise and dolphin species, but not within dolphin species.

Here we use autonomous passive acoustic monitoring devices (C-PODS) deployed in coastal water locations of the Isles of Scilly, off southwest Cornwall, England, to continuously monitor the occurrence of cetacean species in remote locations through autumn and winter months; areas that would likely otherwise be inaccessible to traditional survey methods.

Methodology

C-PODS were deployed on 2nd October 2011 at three locations to the south, west and east of the Isles of Scilly main islands (Fig. 1). These locations were: Annet (N 49° 53.1' W 006° 22.4'), Castle Bryher, Northern Rocks (N 49° 56.7' W

006° 22.8') and Great Ganilly, Eastern Isles (N 49° 57.5' W 006° 14.9') (all coordinates degrees and decimal minutes: WGS84). C-PODS were located in water depths of approximately 30 m, and between 2 to 5 m from the seabed at chart datum (lowest astronomical tide). Ground tackle consisted of a single rope running along the seabed between two anchor chains, from which lines rose to a single marker buoys at the surface. C-PODs were attached to the line running along the seabed approximately 25 m from either of the anchor chains and floated vertically in the water column.



OS Landranger Map / Scale Colour Raster [TIFF (LZW compressed)], Scale: 1:50,000, Tile: SV80, Updated January 2006, Ordnance Survey, GB. Using: EDINA Digimap Ordnance Survey Service, <http://edina.ac.uk/digimap>, Downloaded: Febuary 2009
Map not to be used for navigational purposes. Do not reproduce in any form without the explicit permission of data owners (University of Exeter).

Fig. 1. C-POD detection array for the Isles of Scilly, deployed 2nd October 2011. Study area (a) Isles of Scilly showing locations of C-POD deployments (blue circles) at (b) Annet, (c) Castle Bryher and (d) Great Gannily. In (a) land above Mean High Water is drawn in green, drying areas at chart datum (lowest astronomical tide) are drawn in yellow. In all parts deployment vessel track is drawn as a long dashed black line, 30 m isobath drawn as a short dashed black line and labelled. Parts (b), (c) and (d) are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator.

Results

C-PODs acoustically monitored for the presence of cetaceans for a total of *n* = 448 days; Annet *n* = 98 d, Castle Bryher *n* = 204 d and Great Ganilly *n* = 146 d. The C-POD at Annet stopped monitoring on 8th January 2012 and the C-POD at Great Ganilly on 25th February 2012; the C-POD at Castle Bryher continued monitoring up to the time that it was switched off and retrieved on 20th April 2012.

The majority of echolocation clicks and trains were identified as being narrow band high frequency and therefore associated with the occurrence of harbour porpoise. There were very few dolphin detections (Fig. 2).

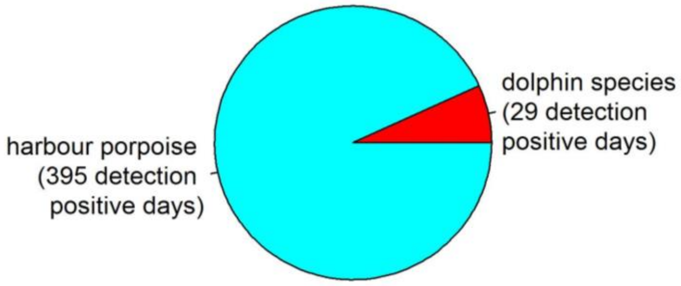


Fig. 2. Cetacean species echolocation trains expressed as detection positive days for all C-POD deployments. A day was categorised as positive if an animal was detected as being present within that 24 hour period, irrespective of the length of time of the detection. Detection positive days were apportioned by harbour porpoise and dolphin species.

There was some variation among sites. Annet received the greatest total duration of detections in any one day (12 minutes) and had the highest averaged daily detection rate (1.5 cumulative train detection minutes day^{-1}). Castle Bryher had the greatest number of detection positive days but the least consistent time-series of detections (detection positive days *n* = 154; 77% of days operational *n* = 201); whereas Great Ganilly had the most consistent time-series of detections (detection positive days *n* = 146; 100% of days operational *n* = 146) with the greatest cumulative total of detections (210 minutes) (Fig. 3).

There was evidence for a shift in monthly detection patterns among sites (Fig. 4). At both Castle Bryher and Great Gannily daily detection rates increased October to February, and then declined in March and April at Castle Bryher; data were not available for Great Gannily. Conversely, at Annet, daily detection rates decreased October to January; data were not available for February to March. This may reflect a shift in habitat preference for harbour porpoise during winter months; the deployment site at Annet had an open west/southwest aspect and would be vulnerable to Atlantic storms driven from this direction. In contrast, Castle Bryher and Great Gannily are afforded some protection by exposed rocky reefs and small islands chains. Seasonality in detection patterns have similarly been observed in C-POD deployments made on the North and South mainland coast of Cornwall and from the analysis of incidentally collected sightings and strandings data (Pikesley *et al.* 2012).

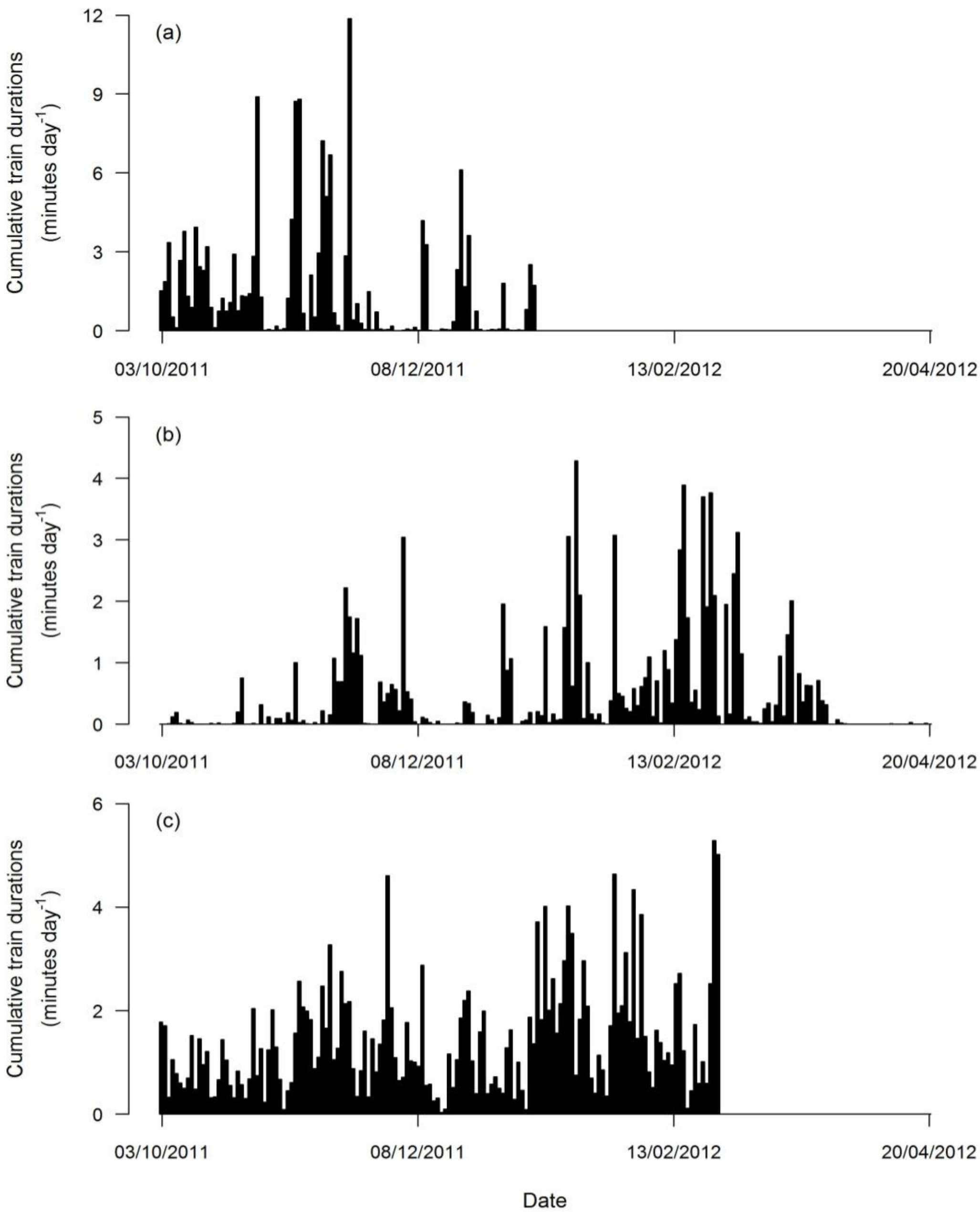


Fig. 3 Daily harbour porpoise cumulative train durations (minutes day^{-1}). For (a) Annet n = 98 d, (b) Castle Bryher n = 204 d and (c) Great Ganilly n = 146 d.

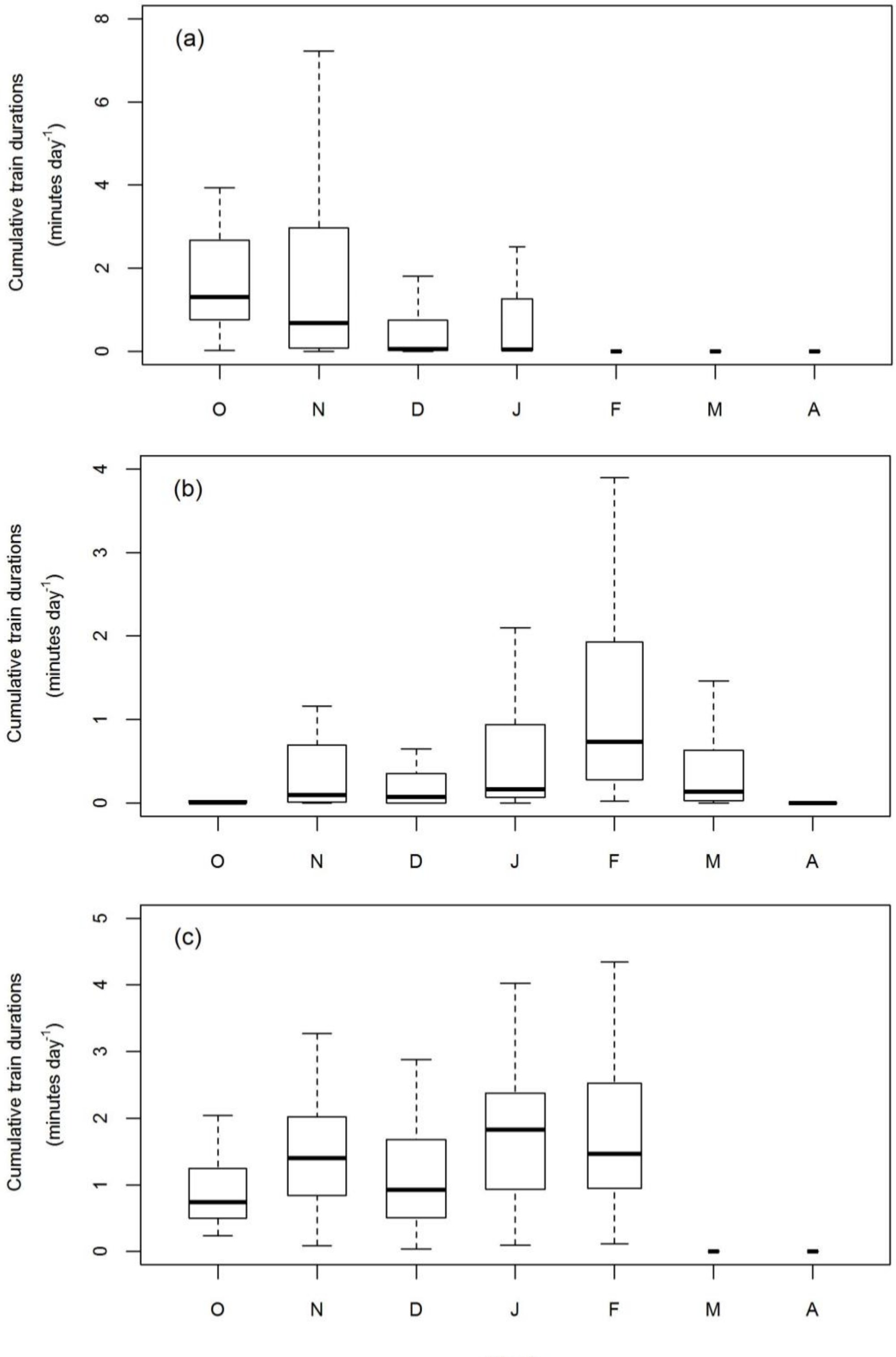


Fig. 4 Monthly harbour porpoise cumulative train durations (minutes day^{-1}). For (a) Annet, (b) Castle Bryher and (c) Great Ganilly. Box shows median and inter-quartile ranges. Box widths are proportional to the square-roots of the number of observations in the box, outliers are not drawn. No data available for Annet February to March or Great Gannily March and April.

Conclusion

With this study we demonstrate that autonomous passive acoustic monitoring devices have utility in continuously monitoring and recording the presence of cetacean species in coastal water locations of Island communities.

The Isles of Scilly has demanding marine environments; being exposed to the north-east Atlantic makes the deployment and maintenance of autonomous marine recording equipment challenging. The Island's nearshore bathymetry, with shallow waters, numerous reef features and areas of intense tidal activity further exacerbates this challenge. This makes site selection for deployments challenging and in light of the knowledge gained from this study future site selection could be improved upon.

While monitoring occurred over a comparatively short period (approx 4-6 months) some interesting seasonal and spatial patterns in habitat use emerged, with concordance between Isles of Scilly detection patterns and those observed from the nearby mainland coast; these would benefit from further investigation. For future continuous monitoring it would be appropriate to fully train deployment and retrieval capability by contracting local boat owners to frequently service and maintain equipment (every 2 months is optimal). The use of multiple units across the Isles of Scilly and with two units at some sites will also provide a degree of redundancy in data collection, particularly in situations where devices may fail or are lost.

Given the highly sensitive nature of the Isles of Scilly habitats (SSSIs, SACs etc.) the monitoring method employed in this study would seem a useful way to map out areas of high relative cetacean abundance. The remoteness of these locations and the potential prevailing adverse environmental conditions would significantly hamper traditional monitoring and surveying techniques, and would undoubtedly be financially restrictive. Embedding these environmental monitoring capabilities at a local and regional level may be critical to the growth of the renewable energy sector, particularly as the need for the identification of appropriate sites continues, and also to help facilitate the ecologically sustainable development of MREI infrastructure.

Acknowledgments

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