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**MASTS Renewable Energy Forum**  
**Undergraduate Summer Internships 2017**

**Marine Mammals in Scottish Waters**

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## Introduction

The coastal waters around Scotland are home to many species of marine mammal, such as harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncatus*). They are small cetaceans belonging to the Odontocetes (toothed whales) who explore their environment using sound waves, known as echolocation. Dolphins and porpoises emit echolocation whistles for communication, and clicks for locating and catching prey. Odontocetes are sensitive to underwater noise pollution generated from the construction of offshore wind farms.

The increasing size and number of offshore wind developments around Scotland provide greater potential risks to marine mammals and the surrounding environment<sup>1, 2</sup>. Marine mammals are most heavily impacted during the construction phase where pile driving of the seabed produces loud noise, which can travel long distances underwater and cause disruption over a large area<sup>1, 3, 4</sup>. For Odontocetes sound exposure can interfere with echolocation and communication calls, cause hearing damage, and result in avoidance behaviours as animals move away from the sound source<sup>1, 4, 5</sup>.

Harbour porpoise and bottlenose dolphins are protected under Annex II and IV of the EU Habitats Directive (92/43/EEC), and are classed as European Protected Species (EPS)<sup>1</sup>. Therefore, for any new offshore development that may put animals at risk, an EPS licence is required which is regulated by Marine Scotland Science.

MSS are responsible for planning, licensing, and providing advice for offshore renewable projects along the coast of Scotland. Their key aim is to investigate the effects of underwater noise from construction of offshore wind farms on marine mammals. Dolphin and porpoise populations along the east coast of Scotland are monitored by MSS as part of the **East Coast Marine Mammal Acoustic Study (ECOMMAS)**.

The ECOMMAS project started in 2013 and uses acoustic recorders to detect echolocation clicks to measure population abundance and distribution at 30 sites across the east coast, from St Abbs to Latheron.

Information collected on habitat use by bottlenose dolphins and harbour porpoises is important for understanding the impacts of offshore marine industry on their behavior.

## Objectives

The objectives of this internship project are:

- Process data collected from the ECOMMAS project from 2013 to 2016, in order to describe the distribution and abundance of bottlenose dolphins and harbour porpoises along the Scottish east coast, based on encounter rates at each site.

- Handle, manage and summarise the ECOMMAS dataset so it is useful and understandable to internal and external stakeholders, and to members of the public.
- Exploration of media to visually present and interpret the data for web-based publication and production of a topic sheet, and for use in conferences and community outreach events.

The outcomes of this project will contribute to the consultation and understanding of offshore planning and licensing for Marine Scotland Science, in regards to marine mammal protection.

## Methods

### *ECOMMAS Project*

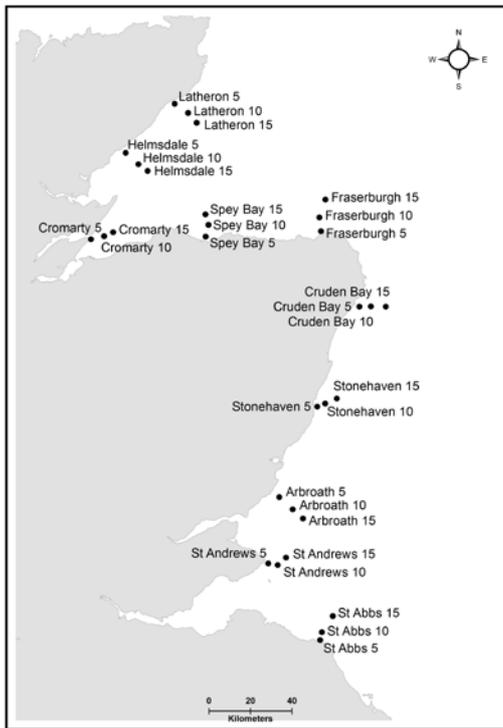
Passive acoustic monitors (PAM), known as C-PODs and SM2Ms, are deployed by boat each year by MS. They are moored at 30 sites across 10 locations along the east coast of Scotland (Figure 1). The PAM buoys are moored in groups of 3, each with increasing distances from the shore of 5, 10 and 15 km.

C-PODs detect and count echolocation clicks of dolphins and porpoises, which provides information on their presence and absence at each site. SM2Ms record all underwater noise. PAM methods are favourable as unlike visual surveys, cetacean clicks can be detected with minimal effort and in conditions unsuitable for observation, such as adverse weather conditions or overnight.

The C-PODs are deployed in the spring where they stay throughout the summer, having a battery life of ~ 4 months. In the late summer/autumn the C-PODs are recovered and prepared for re-deployment the following spring. In 2015 and 2016 C-PODs were re-deployed during the late summer/autumn cruise for a second 4 month period until mid-November.

When recovered the acoustic recordings are downloaded, processed and added onto the current dataset.

The ECOMMAS project has been in operation since 2013, and in 2017 PAMs were deployed for the 5<sup>th</sup> year.



**Figure 1.** Map showing locations of 30 PAMs moored along the east coast of Scotland, as part of the ECOMMAS project.

### *Management and Exploration of the ECOMMAS Dataset*

Within the raw dataset, data was available per day per year for all 30 sites from 2013 to 2016. Data was present in **detection-positive days (DPD)** (Detection of echolocation clicks per day) and **detection-positive hours (DPH)** (Number of hours echolocation clicks are detected per day) for both bottlenose dolphin and harbour porpoise. Data had also been collected in detection-positive minutes (DPM) but DPD and DPH were deemed more appropriate.

Using Microsoft Office Excel 14 the median DPH was calculated for each site and year, for both species, to indicate which sites are used most frequently. For dolphins and porpoises at each site and year, the number of DPD were calculated as a proportion of total days recorded by the C-PODs. Again, to give an indication of site usage.

The cleansed dataset will be published online on the Marine Scotland Data Portal and made available for download as a .csv file with full public access. The data will also be transformed for visual display on the National Marine Plan interactive map (NMPi).

### *Mapping and Visual Presentation of Data*

Results were mapped to show site usage and distribution of dolphin and porpoise for each year simultaneously, and to allow species comparison.

Overall, it was determined to focus on median DPH for harbour porpoise as there is greater variability in DPH throughout each year. There is low variability in bottlenose dolphin median DPH, so proportion of DPD was deemed representative of the distribution patterns observed.

Two maps were created for the production of a topic sheet, showing the averaged DPD for 2013-2016 for both dolphin and porpoise. Average DPD for each site was shown as pie charts of the proportion of DPD, of the total number of days recorded over the 4 years. The same pie chart maps showing proportion of DPD were made for bottlenose dolphin for each year. Graduated colour maps were created for median DPH of harbour porpoise for each site and year. Separate maps for each year and species were necessary as the data points (C-POD locations) overlap, and it allows for comparison between years.

All maps were created using ArcMap 10.3 and were exported as .JPEG images to be downloaded from the Marine Scotland Information ECOMMAS web page, and included within a topic sheet.

#### *Production of ECOMMAS Topic Sheet and Web Page*

A previous topic sheet already exists for the ECOMMAS project, but a new topic sheet was required to update on the progress of ECOMMAS. A web page was created for Marine Scotland Information to link with the dataset on the Marine Scotland Data Portal, when published.

The aim of both outputs was to provide details of the project and a summary of the main outcomes and distribution patterns observed so far. Content for the topic sheet and web page were written at a level to suit the target audience, and are awaiting publication\*.

## **Results**

### *Harbour Porpoise*

Overall, results follow similar distribution patterns for 2013 to 2016, as can be seen in Figure 2. Harbour porpoises are detected most days at most sites and have a high proportion of DPD, especially in comparison to bottlenose dolphins.

Median DPH are high for the majority of locations. Sites with greatest porpoise presence were Fraserburgh 5, 10, and 15, Spey Bay 15, and Arbroath 5 and 10. Fraserburgh 5, 10 and 15 had the highest recorded median DPH, with each year having a minimum of 15 median DPH per day.

*\*Topic sheet and web page not included within report as awaiting final publication from Marine Scotland Science.*

Sites with low median DPH per day, for all years, were Cromarty 5, 10 and 15, Spey Bay 5 and 10 and St Andrews 5. Helmsdale 5 and Stonehaven 10 had low detection rates in 2014 and 2016, respectively.

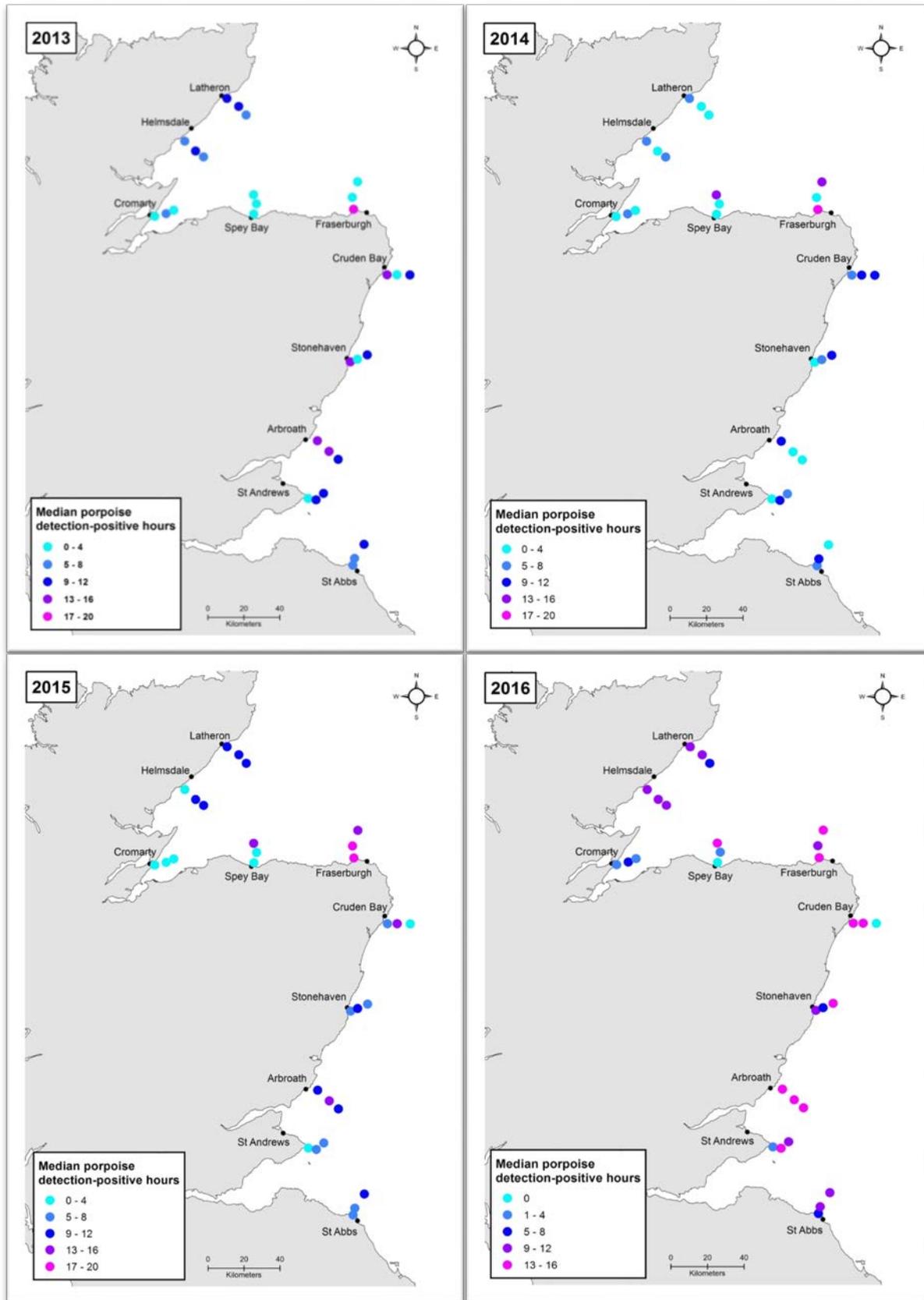
Cromarty 5, 10 and 15 tended to have the lowest detection rates and regularly recorded median DPH of 0 to 5 hours per day.

### *Bottlenose Dolphin*

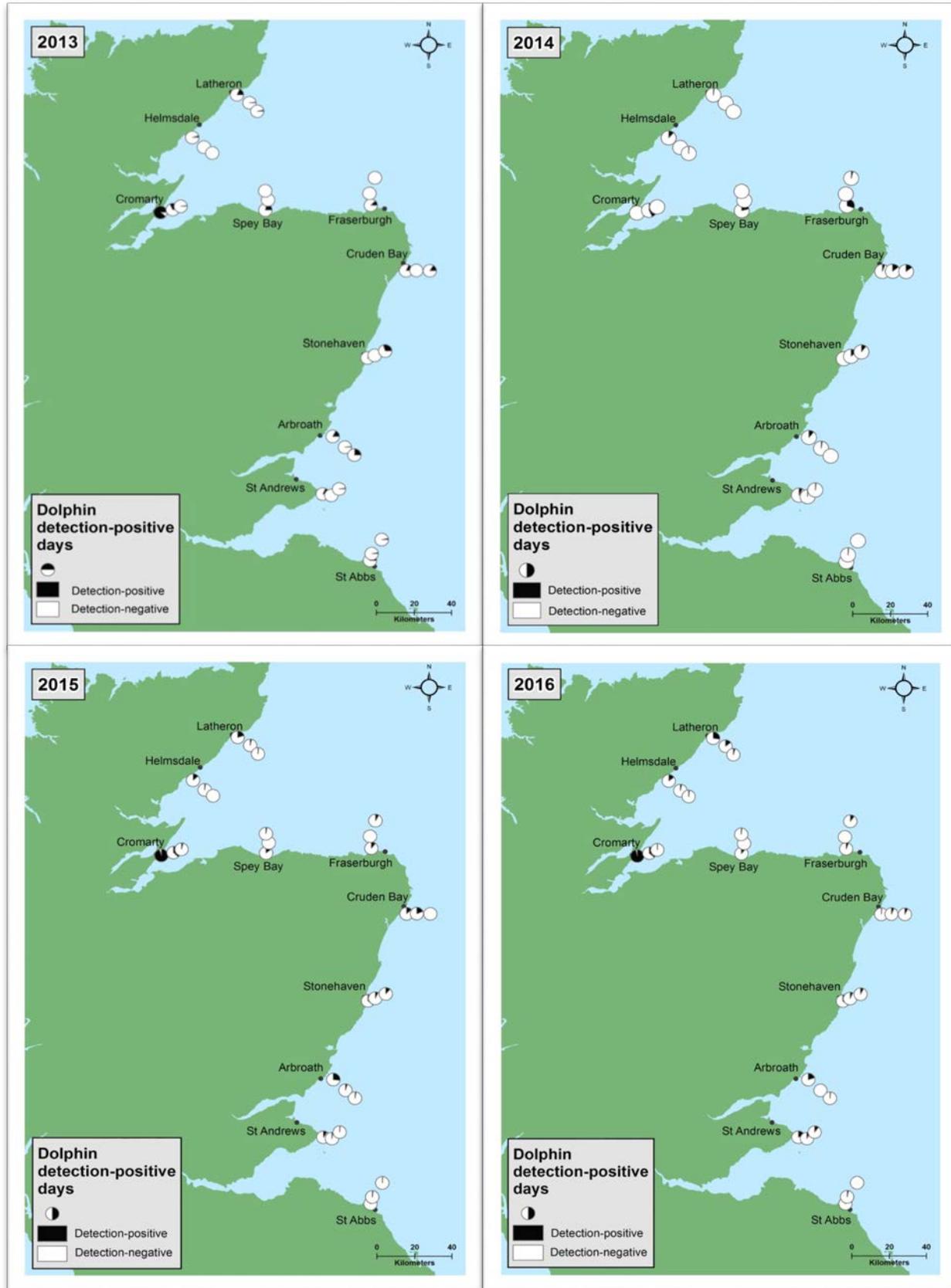
Distribution patterns of bottlenose dolphins are similar for all 4 years, as shown in Figure 3. Generally, the proportion of DPD for dolphin was much lower than porpoise across the majority of sites. Cromarty 5, 10 and 15 had the highest proportion of DPD for all years.

Median DPH per day was also much lower than porpoise, being 0 for most locations. However, all sites at Cromarty were an exception and had the highest detection rates of 1 to 4 median DPH per day. 2016 showed the highest dolphin detection rates with a median DPH of 4 hours per day at Cromarty 5.

All sites with greatest daily detection rates of bottlenose dolphins had very low daily detection rates of harbour porpoise.



**Figure 2.** Median detection-positive hours of harbour porpoise (*Phocoena phocoena*) at PAM locations along the east coast of Scotland from 2013 to 2016.



**Figure 3.** Proportion of detection-positive days of bottlenose dolphin (*Tursiops truncatus*) at PAM locations along the east coast of Scotland from 2013 to 2016.

## Conclusions and Recommendations

### *Conclusions*

The harbour porpoise is the most abundant small cetacean species along the east coast of Scotland, with a large population size and wide distribution <sup>6</sup>. This has been shown within the results of this project, with porpoises being detected most days at most sites from 2013 to 2016.

Sites with low median porpoise DPH and proportion of DPD are mostly inshore coastal sites as porpoises prefer offshore waters. Locations where porpoise are absent have high dolphin presence, such as in Cromarty and Helmsdale which lie within the inner Moray Firth. The inner Moray Firth is a designated Special Area of Conservation (SAC) for the protected population of bottlenose dolphins, which are resident to the Moray Firth and Scottish east coast <sup>7</sup>.

Distribution patterns shown in Figures 2 and 3 suggest limited interactions between bottlenose dolphins and harbour porpoises. Species avoidance may occur as a result of niche overlap as both species occupy similar habitat, which may result in competition for space and some prey species. Research has found shared species of fish within the diet of dolphins and porpoises <sup>8</sup>. The absence of harbour porpoise in the inner Moray Firth SAC may also be related to the high occurrence of bottlenose dolphins. Violent interactions do occur between the two species, with bottlenose dolphins known to attack and kill harbour porpoises <sup>9</sup>.

### *Recommendations and Final Remarks*

Analysis of the dataset on a monthly scale may be beneficial to identify any trends in abundance, distribution and habitat usage on a seasonal basis. It may allow insight into whether dolphins and porpoises utilise different sites at different times of the year, depending on variance in productivity, food, depth or topography between sites.

To continue engagement with stakeholders and the general public, it would be favourable to review and analyse the data regularly, in order to provide updates on progress and any interesting outcomes from the ECOMMAS project.

Outcomes from this project will contribute towards understanding the impacts of offshore marine industry on the ecology and behavior of dolphins and porpoises. The results will be beneficial to Marine Scotland Science when advising upcoming renewable projects on efforts to minimise the risk and disturbance to marine mammals along the east coast of Scotland.

### *Acknowledgements*

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