Marine Mammal Scientific Support Research Programme MMSS/001/11

MR 7.1.2 Report

The density and behaviour of marine mammals in tidal rapids

Executive Summary

Harbour porpoises (*Phocoena phocoena*) are one of Europe's most common cetaceans and they are protected under European law. The current expansion of the tidal energy industry has highlighted concerns about anthropogenic activity in tidal habitats, particularly whether deployed turbines may pose a collision risk to animals. However, the ecological significance of tidal habitats for harbour porpoise is poorly understood and little data exists to inform on the potential risk that tidal turbines may pose. One key metric that needs to be measured to inform on this risk is the depth distribution of animals, for example, if harbour porpoises spend the majority of their time at the surface in tidal habitats then collision risk with deeper turbines will be very low. This report details the results of a three year project to develop, test and survey with a system capable of accurately determining the position of harbour porpoises underwater.

Determining the dive depths of animals is difficult. Tags are a possibility, however, there are no tagging programmes in the UK and the likelihood any one tagged animal would spend a significant time in tidal areas may be small. Passive acoustic monitoring (PAM) is a methodology which can detect the presence, classify the species and localise the position of animals, by listening to their vocalisations. Harbour porpoise use high frequency echolocation clicks almost continually for orientation, prey detection, navigation and social interactions, making them ideal candidates for studies using PAM. However, in order to achieve the accurate underwater tracking required to determine a depth distribution, a large dispersed array of multiple underwater receivers (hydrophones) is required.

Deploying such an array in a tidal habitat is difficult. Fixed structures would be inordinately expensive to deploy in areas with up to 8.5 knots of current and therefore a drifting hydrophone array was developed. The array consisted of 10-12 hydrophones, deployed between 3-45m underwater, from a small research vessel. The practical considerations for such a system are numerous; the array must be quickly recoverable and deployable, any movement underwater must be measured precisely and the delicate electronics used must be sufficiently rugged to remain operational in the particularly harsh environmental conditions present in tidal rips.

In addition to these considerations there are general issues with PAM. Porpoise have narrow beam profiles and hence are easy to miss if facing away from the hydrophone array. Noise and multiple animals clicking at the same time can also be problematic. Many of these issues were overcome by utilising new localisation and tracking methods developed during the project, however, difficulties remain in the fact that usually only fragments of tracks, rather than entire dive profiles, are detected. For the purposes of determining a depth distribution this information is adequate. However, it makes studies on the fine scale behaviour of animals more challenging.

Six tidal sites were surveyed over three years. Over 8514GB and 234 hours of data were collected resulting in 5210 tracks of animals. These were used to create depth distributions for each dive site. Two sites, Corryvreckan/the Great Race and Kyle Rhea contained by far the highest number of detected porpoise vocalisations per hour. Both sites are comparatively deep and porpoises had remarkably similar depth distributions during the day with animals spending 75% of time in the upper 38-40m of the water column. Kyle Rhea was the only site surveyed at night and showed a shift in the depth distribution, with animals spending more time in shallow waters.

The data summarised here provide the first substantial general dataset on porpoise depth distributions and underwater behaviour in tidal rapids. Given that virtually no data existed before, the data presented here can be used to improve collision risk estimates. However, the variation between sites evident in this dataset emphasises the importance of collecting data on a site by site basis.

The continual development of hardware, open source accessible software and PAM localisation methods during this project mean that a methodology now exists to determine depth distributions of harbour porpoises in tidal sites. However, this only forms a subset of the data required to inform on the ecological significance of such an area. Further work needs to focus on combining fine scale tracking of animals with visual/acoustic surveys and long term data recorders.