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Movement patterns of seals in tidally energetic sites: implications for renewable energy development

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ABSTRACT

Proposed sites for tidal stream renewable energy extraction tend to occur in discrete locations, usually between islands, around headlands or at the narrow mouths of inlets. Such areas are also frequently used by marine mammals such that the overlap is one of the most pressing issues facing this emerging sector. This paper reports on a tagging study of harbour seals in a tidal channel on the west coast of Scotland and discusses the implications of the movements for tidal energy in such tidal channels.

INTRODUCTION

By their nature, suitable sites for the development of tidal stream renewable energy tend to occur in discrete locations, usually between islands, around headlands or at the narrow mouths of inlets. Such areas are also frequently used by marine mammals such that the overlap is one of the most pressing issues of environmental consenting facing this emerging sector. One major environmental concern derives from the potential for physical injury to marine mammals through direct contact with moving structures of turbines (Hastie et al, 2014). Unfortunately, due to the inherent difficulties of studying marine mammals in such energetic locations, data on marine mammal behaviour in these sites are extremely limited. Limited information on the relative densities of marine mammals in tidal channels exists [1]; however, information on the movements of individual animals are required to fully understand the potential implications of tidal energy.

There now a number of studies that have utilised GPS telemetry devices to study individual seals around the coast of the UK which provide data on movement patterns in these areas [2]. However, the limited battery capacity in the tags used in many of these studies, mean that not all surfacing events produce successful GPS fixes. This has the potential consequence that movement data can be relatively coarse thus limiting its use in measuring movements of seals in relation to fine scale tidally induced features. To circumvent these issues, we carried out a study of the fine scale movements of harbour seals in a tidal channel on the west coast of Scotland (Kyle Rhea) in 2013.

METHODOLOGY

Ten harbour seals were captured on the west side of a narrow tidal channel between the Isle of Skye and the mainland (Kyle Rhea: Figure 1) in April 2013 and GPS tags were glued to fur on the back of the neck. Seals were captured whilst hauled out on intertidal rocks. Once captured the seals were anesthetised with Zoletil® or Ketaset®. The tags were attached to the fur at the back of the neck using Loctite® 422 Instant Adhesive. A series of morphometric measurements and biological samples were also taken at the time of capture.

A telemetry system that combined near real time at sea positioning of seals and data storage with periodic transmission to archival base stations on shore was developed by Pathtrack (http://www.pathtrack.co.uk/). Animal-borne tags captured GPS data which were processed on board using the Fastloc algorithm [3]. UHF telemetry (in the 869.4-869.65MHz frequency band) was used to broadcast these Fastloc data at the first opportunity when at sea. Data were also stored in the tags so that they could be downloaded by UHF to fixed base

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stations when animals had hauled out for a pre-determined period within range of a station.
Three data archiving base stations were placed at vantage points that overlooked nearby haul out sites (Figure 1). These were fully autonomous, being powered by internal batteries charged by solar panels. When seals hauled out for 30 minutes within range of a base station data were transferred from the tags. When the base station signalled that data had been successful transferred the data pointer in the tag would be advanced to a new section of memory, data were never deleted from the tags. Data were downloaded from the base stations periodically either by connecting them to a laptop via USB or by wireless transfer through a hand held mobile wireless receiver.

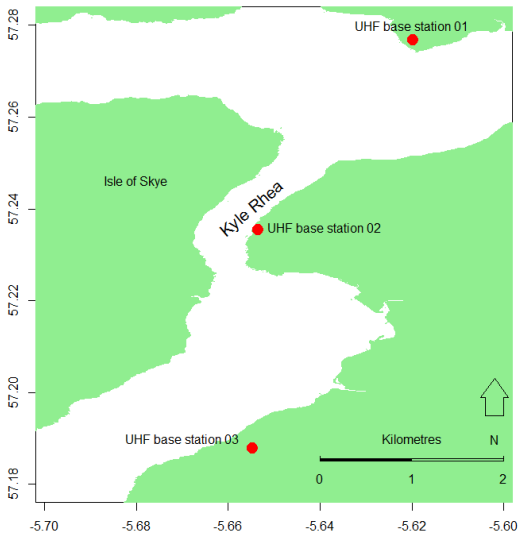

Figure 1 Map of the study area showing the narrow tidal channel (Kyle Rhea) and the locations of the UHF base stations.

The combination of two way communications between the tags and the base stations and multiple methods for retrieving data from base stations and tags resulted in a system that was flexible and adaptable. Two way communications also allowed memory to be reallocated once data had been successfully archived in base stations and for tags to be reprogrammed if necessary.

As part of a controlled exposure experiment to measure the behavioural responses of seals to tidal turbine sounds, a series of playbacks were made to tagged seals during the study. A speaker was lowered to a depth of approximately 1.5 metres below a moored boat in the channel and a series of 6 one-hour playbacks, randomised within a 12 hour period were played.

OBSERVATIONS

Although all of the tagged seals made trips out of the narrow tidal channel (up to approximately 50km from Kyle Rhea), each spent the majority of their time within the channel during the study.

Plot of frequency of intervals between locations recorded by the tags showed that intervals peaked at 175 seconds and that 95% of intervals were less than 477 seconds (Figure 2).

A total of 125 hours of tidal turbine sound playbacks were made on a total of 25 days.

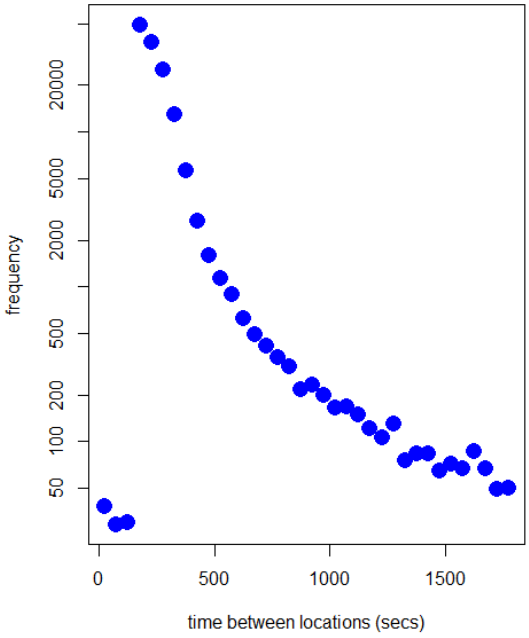

Figure 2: Frequency of the time (seconds) between subsequent locations recorded by the seal tags.

CONCLUSIONS

The telemetry system used in this study proved suitable for studying the fine scale movements of harbour seals in relatively small tidal channel; with 95% of the intervals between locations being less than 477 seconds, this represents a relatively high resolution seal movement dataset. Specifically, given that the mean dive durations of harbour seals are around 4 minutes [4], it seems likely that the majority of surfacings were recorded by the tags (Figure 2).

All of the tagged seals spent a significant proportion of time within the narrow tidal channel; although it is currently unclear how common this pattern in other coastal areas, these results has clear implications for the placement of tidal energy devices and the potential risks to marine mammals.

High resolution telemetry data such as this also provides the basis for an analysis of behavioural responses by seals to the controlled playbacks of tidal turbine sound.

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