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Marine Renewable Energy MRE2

Annual Report

Individual Consequences of Tidal Turbine Impacts

Sea Mammal Research Unit
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Executive Summary

Following on from the work of Thompson *et al.* (2015), modifications were made to collision apparatus to reduce the uncertainty surrounding the effective collision speeds of seals with modelled tidal turbine blades.

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1 Introduction

In the absence of any field data, collision risk models currently assume that all collisions between marine mammals and tidal turbines will be fatal. This precautionary assumption is not likely to be true and will lead to over-estimation of mortality rates. Estimated mortality rates are likely to be a serious constraint on turbine deployments and reducing the uncertainty should have the effect of reducing these rate estimates.

1.1 Previous work

Work previously carried out by Thompson *et al.* (2015), described collision trials with grey seal (*Halichoerus grypus*) carcasses using a shaped, rigid bar fixed to the keel of a jet drive boat to simulate the leading edge of a turbine blade. The blade profile chosen represented a section near the tip where it is narrowest/sharpest and therefore most potentially damaging. The boat was driven at, and collided with, a number of previously frozen grey seal carcasses at a range of speeds.

Safety considerations meant that the original simulated turbine blade was fixed to and followed the curvature of the keel. The resulting collisions represented glancing blows to some extent and could not be directly compared to real collisions of the same speed. The position of the blade in the water also varied slightly with vessel speed, changing the angle of attack. Attempts to account for this led to the conclusion that the effective collision speeds were significantly less than the boat speed and introduced some additional uncertainty into the predictions of damage likely to result from specific collision speeds. Accounting for the angle of attack at the point of impact produced estimates of "effective collision speeds" ranging from 1.95 $m.s^{-1}$ to 5.32 $m.s^{-1}$, compared to potential maximum collision speeds of over 12 $m.s^{-1}$.

Detailed x-ray and necropsy examinations suggested that slow speed collisions with the tips of tidal turbines, were unlikely to produce serious or fatal injuries in grey seals and that a significant proportion of potential impacts with tidal turbine blades would not be fatal. However, because the tests were carried out on dead, previously frozen carcasses, the results were limited in their ability to assess soft-tissue damage.

1.2 Current work

The aims of this work are to carry out a series of new collision trials using a straight turbine blade profile to avoid the uncertainty in the effective collision speeds and to assess the true speed of the collisions. Where possible these trials will be carried out on fresh, (not previously frozen) carcasses.

2 Apparatus development and collision trials

To circumvent the issues of impact speed described above, two modifications were made to the collision apparatus. Using the profile of the tip of a typical turbine blade, a one metre long, straight edged ram with that profile was produced. The ram is constructed of solid PVC and fitted into a thick walled aluminium frame (Figure 1a). This is fixed to the boat by means of three support bars made from lengths of thick walled aluminium box section which are pinned to three hard points welded to the keel (Figure 1b).

The ram is fitted to hang from the prow of the boat, tilted back at a slight angle (approx. 10^{o}) to ensure that the collision does not lift the carcass clear of the water but rather drives it down into the water. This is to ensure that the mechanics of the impact are as close as possible to those that would occur in collisions with real turbines. The jet drive boat has been modified by the addition of adjustable trim tabs that allow the driver to adjust the pitch of the boat to keep the desired angle of attack. The angle can then be further adjusted by using different length support bars. The angle of attack will be assessed in the field immediately prior to trials by photographing the boat moving past at the planned collision speeds.

The system can be quickly fitted and removed from the boat and is available for use whenever a sample of seal carcasses is available. Over the past 12 months there were no suitable fresh seal carcasses for use in tests and there was no capacity to store frozen carcasses.

If fresh carcasses become available we intend to hold them in a cold store/chiller for a short period before using them in collision trials. Fresh carcasses are preferred as they are more likely to show signs of soft tissue damage. If immediate tests are impractical, the carcasses will be frozen and held until one or more fresh carcasses become available. A large container freezer has now been installed at the Sea Mammal Research Unit for storage of seal carcasses. We expect to carry out a series of trials through 2016. All the

useable carcasses and the boat will be transported to the sheltered harbour at Ardersier and the collision trials and carcass processing will follow the same protocols used in previous collision tests. If no fresh carcasses become available we aim to carry out a set of trials with previously frozen carcasses during June or July 2016.

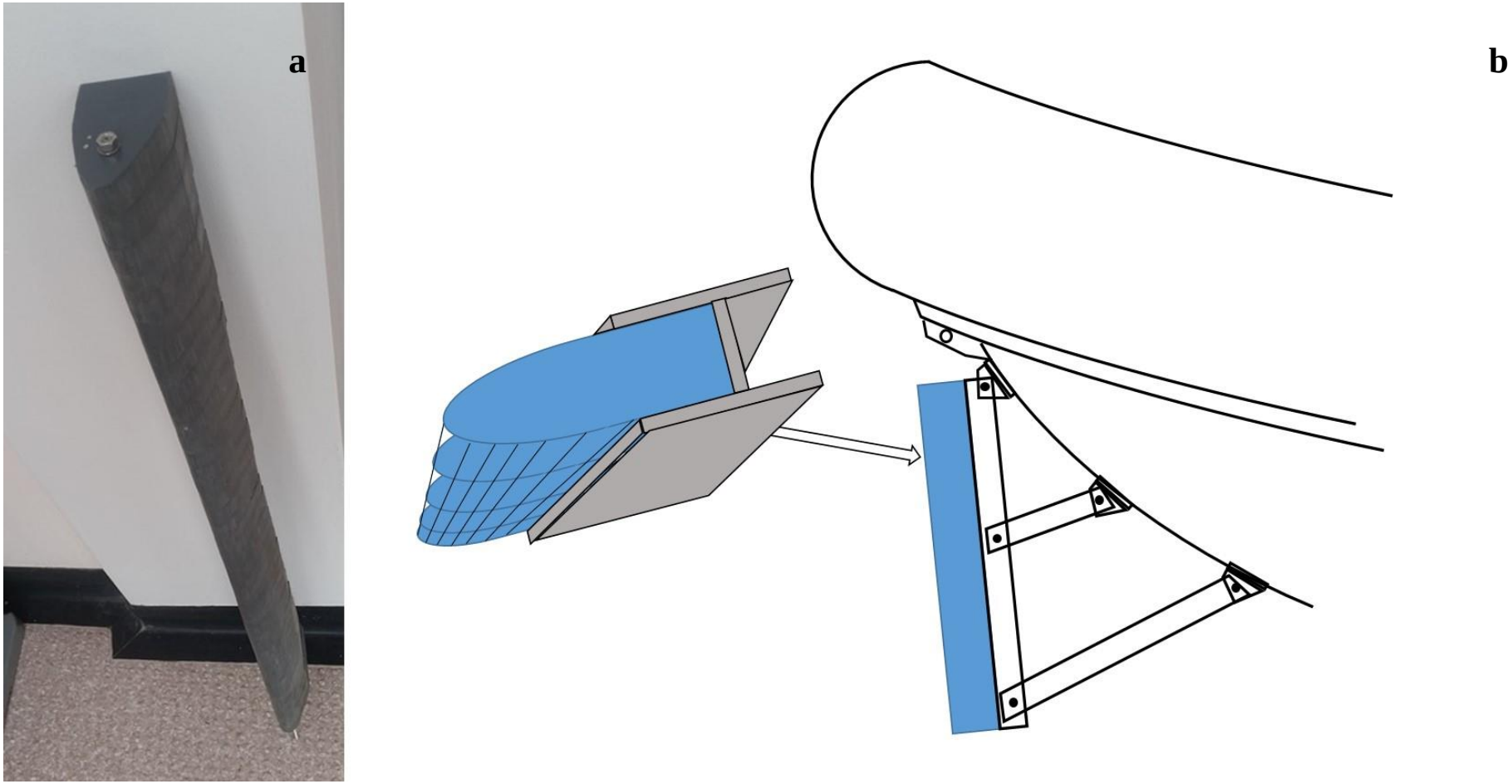

Figure 1. Design of the new collision apparatus showing blade profile (a) and the mounting hardware for the bow of the boat (b).

3 References

Thompson, D., Onoufriou, J., Brownlow A. and Morris, C. 2015. Data based estimates of collision risk: an example based on harbour seal tracking data around a proposed tidal turbine array in the Pentland Firth. *Scottish Natural Heritage Commissioned Report No. 900*.