Marine Mammal Scientific Support Research Programme MMSS/001/11

MR 7.2.2 Report

Collision risk and impact study: Examination of models for estimating the risk of collisions between seals and tidal turbines

Executive Summary

The rate at which collisions can be expected to occur between marine mammals and tidal energy generation devices is potentially important to both the conservation of these species and the industry. Developers need to identify potential adverse effects of their proposed developments. For seals, this means demonstrating, among other things, that development and operation will not have an adverse effect upon the integrity of any SACs for which seals are a qualifying interest. Seals are seen as a particular problem in this respect because they frequent coastal locations where most tidal turbine developments have been proposed.

The major difficulty in estimating likely rates of collision is the lack of information on how animals will respond to active turbines. It is possible that they will be attracted, increasing their overall risk, though it seems more likely that they will avoid some potential collisions. Without such information, which is likely to be difficult to collect even once there are operational turbines, estimation is limited to encounter rates. Encounter rates are defined as the number of seals per unit time which turbines would strike if seals did not respond to the presence of the device. Those can be rescaled by assuming rates of avoidance, but that process will necessarily be approximate.

This report examines two models that have been proposed for estimating the rate at which seals can be expected to encounter tidal turbine blades. It also summarises a method that has been applied to calculate the risks to riverine fish from passing through hydroelectric power stations. The assumptions and implications of using the methods are discussed.

One approach was developed at SAMS Research Services Ltd (SRSL; Batty *et al*., 2012). It simplifies calculations by simplifying the shape of animals into spheres that would be of equivalent risk and assuming that animals' speeds are independent of their direction relative to the turbine blade. The two versions of that model seem to have errors in the equations they present, but their overall intent is clear.

An alternative approach was a development of the Band model for the risk of birds being struck by wind turbines. That 2012 model assumed the animal's motion was parallel to the axis of rotation of the turbine. Counterintuitively, the model's representation of a "flapping bird" is a more appropriate approximation of a seal than is its "gliding bird" one. The model was broadly similar to the one presented by von Raben for fish passing through a hydroelectric power plant.

The two approaches produce broadly similar results from their different simplifications. Given the greater uncertainty in the animals' responses, either could be used to give an estimate that will be less of an overestimate than simply estimating the number of animals likely to pass through the disc swept by a turbine rotor. If more detailed comparisons, such as between devices, are required, then a better estimate could be made by averaging the risks over an estimate of the likely joint distribution of animal speeds, directions and orientations throughout the tidal cycle.

In practice, the results of any assessments of overall risk are likely to be determined by the assumptions made about animals' ability to avoid collisions. Until data on avoidance rates become available, further refinements of the models of encounter rates may be of limited value.