Using Individual-based Models to De-risk the Consenting Process for the Environmental Effects of Marine Renewables Developments: adaptation of SAFESIMM software

Report on modelling of animal movement workshop

Centre for Research into Ecological and Environmental Modelling

University of St Andrews

26th & 27th September 2012

Attendees:

Ian Davies (Marine Scotland), Kate Grellier (Natural Power), Nancy Maclean (Natural Power), Karen Hall (SNH), Karen Hall (JNCC), Kelly Macleod (JNCC), Stephanie King (SMRU Ltd), Carol Sparling (SMRU Ltd), Brett Marmo (Xi Engineering), Enrico Pirotta (University of Aberdeen), Paul Thompson (University of Aberdeen), Kate Rossington (HR Wallingford), Dorian Houser (National Marine Mammal Foundation), Jacob Nabe-Neilson (University of Aarhus), Jonas Teilman (University of Aarhus), Peter Theobald (National Physics Laboratory), Caroline Carter (SNH), Paul Lepper (Loughborough University), Colin Schofield (BAE Systems), Charles Paxton (CREEM), Dina Sadykova (CREEM), Stacy DeRuiter (CREEM), Carl Donovan (CREEM), John Harwood (CREEM), Rob Schick (CREEM), Len Thomas (CREEM), Catriona Harris (CREEM) Saana Isujunno (SMRU), Esther Jones (SMRU), Jason Matthiopolous (SMRU), Bernie McConnell (SMRU), Theoni Photopolou (SMRU), Filipa Samarra (SMRU), Paul Wensveen (SMRU)

Background:

In 2005, St Andrews University developed a statistical algorithm (known as SAFESIMM) for evaluating the risks to marine mammals from loud sound sources, such as sonars. It consists of a computer simulation of marine mammal behaviour and distribution, together with associated databases on marine mammal biology and

abundance. Its capabilities are currently being expanded to allow assessment of risks to marine mammals associated with the construction of marine wind farms and the operation of marine turbines. However, a number of issues relating to its application, and the application of similar algorithms that rely on individual-based modelling, to the impact of marine renewables on marine mammals and migratory fish need to be discussed and addressed by the community. The intention of this workshop was to bring together representatives of the marine renewables industry, organisations that provide complementary systems (particularly sound propagation models and individual-based movement models) and experts in the modelling of the movement and behaviour of large marine organisms to share expertise and establish a common ground for future assessments.

Day 1:

Five presentations were made describing the efforts of different groups in modelling animal movement (marine mammals and fish) for the purposes of assessing the impact of sound (Carl Donovan, Dorian Houser, Paul Lepper, Jacob Nabe-Neilson, Kate Rossington). Reassuringly there were many similarities across the approaches adopted and similar problems, such as how best to deal with responsive movement to sound, had been encountered by the different research groups.

Following the presentations and related discussion, we held a series of break-out discussion sessions. The following topics were discussed and everyone had the opportunity to participate in up to four sessions:

- Energetic components in animal models.
- Modelling of long-term movement and behaviour
- Do we need to model movement in three dimensions?
- Modelling of animal responses to sound
- Extending marine mammal models to migratory fish
- Developing dose-response relationships

It was agreed that all of these topics are areas in which we need to make progress over both the short term and longer term. Each group discussed possible short-

term solutions but many of the discussions led to more long term solutions in the form of lists of priorities for future research and funding as a result of identifying gaps in current knowledge. These will be expanded upon in the research report written as part of this project. It was discussed that we should also assess the data already available to validate the current models before the next round of environmental assessments for marine renewables developments.

Day 2:

Five presentations were made relating to the main input data types for models such as SAFESIMM – sound propagation models and animal density models (Peter Theobald, Colin Schofield, Charles Paxton, Esther Jones, Bernie McConnell). John Harwood and Carl Donovan then gave an overview of hearing thresholds, hearing weightings and dose-response functions for gathering metrics on injury and disturbance, and described the way in which they are used within SAFESIMM.

Following the presentations and related discussion we held a series of discussion sessions. Numbers were sufficiently low to enable everyone to remain as one group to discuss the following topics:

- Integration/modelling of animal thresholds – dose response curves (should these be probabilistic or thresholds), weightings via auditory hearing thresholds or M-weighting. What are the relative merits and which ought to be used?
- Multiple sound sources and evolution of sound fields through time – can we agree on a standardised approach for providing sound-fields for use in impact assessments?
- Integrating sound field and animal density data. Limitations of sound-field models. Resolution and interpolation. 3D-modelling & 2D-modelling. What is the best approach for integration with an animal risk model?

It was agreed that there are inefficiencies in the way that assessments are currently conducted because multiple contractors, who don't necessarily understand each other's requirements, are often involved in these. Either standards need to be prescribed for data provision to models (which may be difficult in a competitive market) or developers need to be more aware of possible mismatches in data

provision and requirements between contractors. It was felt that risk models should define the inputs they require (data formats, resolution, etc.) and data providers should try to adhere to these requirements wherever possible. Ideally data manipulation (e.g. reformatting) should be done by data providers to limit the possibility that non-experts may introduce errors.

A recurring theme throughout discussions was the need for much of the work carried out so far on models such as SAFESIMM to be published in the peer-reviewed literature so that developers and regulators understand the models, their sensitivities and assumptions. Examples include the sensitivity of output to the use of dose-response functions rather than thresholds for both physical and behavioural responses, the consequences of modelling animal movement in 2D rather than 3D, and the consequences of the way in which the movement of fleeing animals is modelled.

Workshop outcomes:

An immediate outcome from the workshop was the recommendation that the funds originally set aside to allow development of a generic approach for integrating the different models should instead be used to test some of the assumptions and sensitivities of the current version of SAFESIMM and to write a document for publication in the peer-reviewed literature that describes the approach used by SAFESIMM and similar algorithms, and their sensitivities.

Follow-up visits will be made to some of the data providers to allow further exchange of information regarding data requirements and data availability, with the aim of reducing some of the inefficiencies experienced by many in the most recent round of assessments.