ERM's Mike Fraser and Steve Mitchell describe how innovative noise propagation modelling was key to assessing the risk of impacting marine fauna in the Statfjord Area and obtaining consent for the survey to proceed.

**Key Issue Noise Disturbance**
A three-dimensional seismic survey is to be carried out in UK and Norwegian waters to explore for hydrocarbons in the southern part of the existing Statfjord licence block. Written consent to undertake the survey is required from the Secretary of State under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001, as amended in 2007, and an application has to be made to DECC to obtain this.

Information regarding environmental issues must be supplied including the effects of underwater noise. Potential disturbance and damage to hearing of whales, dolphins, porpoises and turtles from underwater noise from air guns was a key issue. ERM prepared the necessary EIA justification for Statfjord Licence Group.

**Our Approach**
In line with UK guidelines an environmental study was carried out to identify if any significant impacts are expected to marine species, specifically to determine whether the survey would cause deliberate disturbance or injury/death of marine European Protected Species.

The study provided a description of the proposed survey, the baseline conditions, and an assessment of the potential impacts from planned and accidental events including emissions to air, discharges to sea, the physical presence of the survey vessel and support vessels, and noise generated by vessel engines and air guns. Most potential impacts were identified as not significant but further assessment was needed on underwater noise disturbance.

**Marine Noise Exposure Modelling**
Underwater noise propagation from the seismic air gun array was predicted using ERM's Marine Noise Exposure Model.

The model has been developed to simulate the propagation of sound taking into account the local marine environment including water temperature, salinity, bathymetry, sea bed absorption and the underlying bedrock characteristics, all of which affect the propagation or reflection of sound waves. Sound propagation is modelled down to frequencies of 10Hz to address the hearing range of all the relevant species. After defining the local environment, the model produces transmission loss results for a set of vertical transects through the study area. These are used to compute frequency weighted sound levels as a function of water depth around the noise source.
This process yields instantaneous noise levels. However, in order to consider disturbance and potential damage effects fully, it is necessary to also consider the dose of noise an animal will experience over time. To do this ERM has developed a noise exposure model that sums the noise levels as an animal moves through the water. In this case a swim away model was used, as depicted in the figure above, assuming the animal moves away from the noise source at a given speed at a depth where the noise level is highest. This process allowed a cautious but robust calculation of the noise dose and hence the impact on the various species of animals known to be in the area of the survey activity.

The likelihood of animals being close enough to the noise source to be significantly affected was then estimated from known animal sightings and population data for the area. A suitable seismic survey soft start process was adopted to give sufficient time for animals to move away from the exclusion zone so that the potential for significant effect was minor.

**Outcomes and Lessons learnt**

In keeping with other projects, the noise modelling indicated that noise from seismic operations can potentially lead to impacts over a wide area unless mitigation measures are adopted.

It is important to model the noise impact zone taking into account site specific factors that affect noise propagation so that effects are realistically assessed.

It is also necessary to consider animal movement within the sound field, which affects the accumulated noise exposure and potential for injury.

In order to assess the potential for an offence, the likelihood of animals being sufficiently close to the airgun array must be taken into account. There is inherent uncertainty in this process even if a detailed study of the marine baseline is available.

It was critical for marine biologists and acousticians to work together so that robust assumptions could be made.

With appropriate good practice mitigation consent was given in time for the survey to proceed on schedule.

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