A QUICK GUIDE TO THE DATA MAPS

E&P **SOUND & MARINE LIFE** PROGRAMME

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A QUICK GUIDE TO THE DATA MAPS

Sounds in the oceans

Many sounds in our seas are natural, while man-made sounds may result from activities such as shipping and fishing, pile-driving for marine construction, military sonar and seismic surveys for oil & gas exploration.

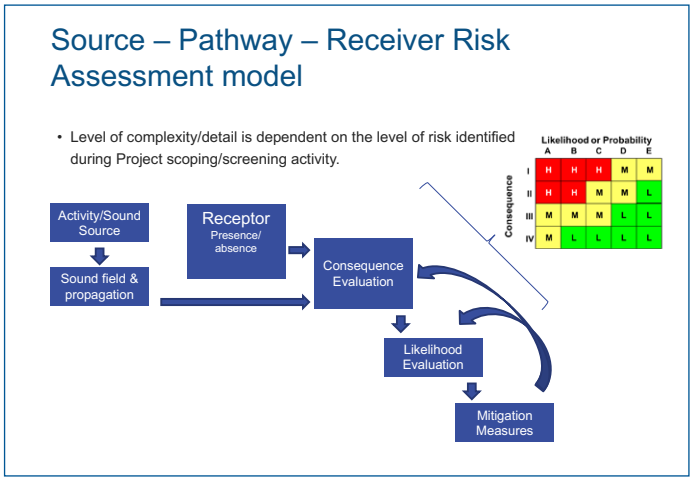
We need to understand the levels of potential risks posed to marine life by sound we create, so we can manage them and restrict risk to acceptable levels. Here we explain how a review of outcomes from research supported by the Sound and Marine Life Joint Industry Programme (JIP) is improving risk assessment for oil & gas exploration and production (E&P) activity.

The E&P environmental risk assessment framework

A commonly adopted method of risk assessment for a proposed activity is to use a matrix to map the likelihood (or probability) of harm and the consequence (or severity) of harm. The first step for environmental risk assessment experts in an E&P exploration team is to carry out a screening exercise to plot the level of risk on a matrix.

The type of assessment required could range from desk-top comparison looking at available literature (low risk), to basic sound assessment compared to marine life hearing sensitivities (medium risk), to complex sound disturbance assessment (high risk). High-risk scenarios may compare potential numbers of individuals of different marine life species that may be exposed to sound to overall population size, to identify risk relative to population status.

The oil & gas sector commonly uses a generic source-pathway-receptor framework to assess risk to marine life, which we can broadly divide into six stages. The initial risk level identified in the screening exercise helps to determine the complexity of assessment needed for these stages.



Where risk is identified as being high following initial project screening, mitigation measures can be used to reduce risk.

The diagram above shows how we may be able to use mitigation measures to reduce the likelihood and/or consequence of an event occurring. In this case, the matrix shows mitigation methods help the risk level to drop from high (red) to low (yellow).

Examples of mitigation measures include a 'soft start' to gradually increase a sound output over time, and visual and acoustic monitoring to shut down operations when marine mammals are observed within an exclusion zone.

Reviewing an in-depth research programme

In 2014, the JIP formed a Risk Assessment Workgroup. This set out to identify what outcomes from the JIP's extensive research programme provided information that could be used in a generic risk assessment process for underwater sound. The workgroup also investigated what additional information could help inform the process (potential knowledge gaps that may be addressed by future research efforts). The JIP has the most extensive industry research programme in this field, with projects in five categories:

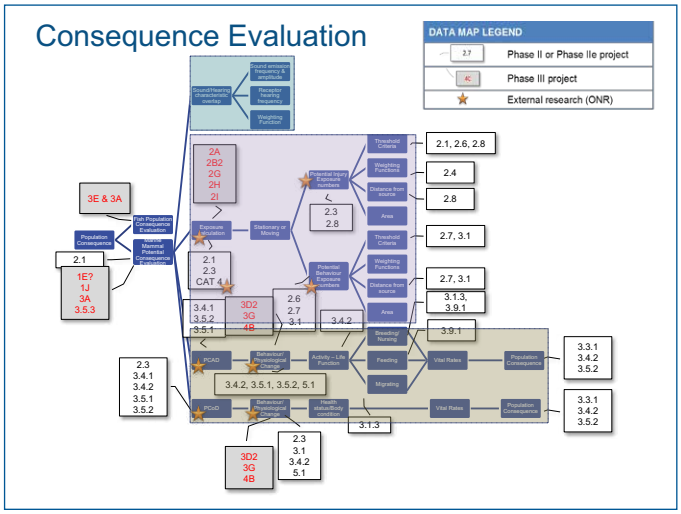
1. Sound source characterisation and propagation
2. Physical and physiological effects and hearing
3. Behavioural reactions and biologically significant events
4. Mitigation and monitoring
5. Research tools

The workgroup's members prepared block diagrams showing the information needs of each element of the risk assessment process for seismic and other E&P activities. They then carried out a mapping exercise to show which JIP projects addressed or satisfied these needs. Six simple block diagrams became detailed data maps. To make the data maps as comprehensive as possible, the workgroup also identified and mapped relevant external research.

What the data maps reveal

Overall, the mapping exercise showed that the outcomes of over 90 per cent of JIP-supported projects that were assessed provide information relevant to the generic risk assessment framework.

Each data map reveals which research projects are relevant to a specific data point on that map. A numbering system details which research category a project falls under, a research theme (where relevant) and the project number. In the consequence evaluation data map below, 2.7 refers to a category 2 project (number 7). This project is about hearing and behavioural responses in turtles.



Information-rich research: project outcomes are relevant to all three shaded areas, which show the levels of assessment complexity based on risk (from top to bottom is low to high risk)

A focus on population consequence

Ideas about best practice for marine risk assessment are constantly evolving. For many years the research focus was on potential acute impacts on animals such as mortality and injury. The subject has since progressed to an evaluation of the significance of behaviourally mediated effects that might lead to a population-level consequence.

Initially this methodology focused on how acoustic disturbance alone might change aspects of marine mammal behaviour. If the effects on behaviour were large enough, the consequence could reach a life function level such as feeding and breeding, and if the effects on life functions were large enough, the consequence could be an effect on vital rates such as survival and reproduction. If those effects were large enough, it could affect the population. This is the Population Consequences of Acoustic Disturbance (PCAD) framework, which was broadened to include any form of disturbance, not just acoustic, under the Population Consequences of Disturbance framework (PCoD).

The workgroup included the key information needs for PCoD/PCAD-based risk assessment on the data maps, with much of the JIP-backed research proving relevant. The JIP research will help establish what behavioural changes (including duration and extent) are likely to lead to a biologically significant effect and which are not.

Learning more about dolphins (case study)

We have much to learn about marine life in relation to sound, but JIP-backed research is significantly aiding our understanding. The JIP funded independent research to improve understanding of potential temporary hearing impacts on bottlenose dolphins from sound sources used during seismic surveys, which help us to study the geology beneath the ocean floor. The study also aimed to differentiate any impacts of this activity from those of other sound sources, such as sonars.

Three dolphins in mesh pens were exposed to ten seismic impulses, each 175-195 dB SEL, separated by ten-second intervals. Researchers observed their reactions and measured small changes in neurological signals produced when an animal hears sound. Based on data from experiments using tonal sounds such as sonars, this was expected to produce a temporary (hearing) threshold shift (TTS). The hearing threshold is the sound level below which an ear is unable to detect sound.

However, the study showed dolphins are relatively insensitive to seismic survey impulses, produced by airguns, which contain little energy at the high frequencies where dolphin hearing is most sensitive. The animals also appeared to 'self-mitigate' by anticipating the next impulse and turning their heads away from the sound source.

Where we need more research

The JIP workgroup identified areas where gaps in our knowledge remain, including:

- the effect of sound on life function (breeding, nursing, feeding and migration) for most/all receptors
- the effect of seismic sound, more generally, on fish
- the effect of environmental conditions in the sound field
- shifting species distribution and the link to wider environmental factors (climate change).

Building on solid foundations

The risk assessment mapping activity is an important development for our research programme and highlights its many achievements. We remain committed to scientific objectivity, requiring that peer-reviewed publications are placed in recognised journals to ensure high-quality output.

Our efforts to protect marine life include aiding development of screening tools such as PAMGuard, passive acoustic monitoring (PAM) software used to monitor marine mammals which is both free and open source. And we are funding an update of the threshold criteria for injury and behavioural disturbance in marine mammals proposed by Southall et al (2007).

For more about JIP-supported research, see www.soundandmarinelife.org/research-categories.aspx

To view other JIP factsheets, see http://gisserver.intertek.com/JIP/dmsJIP.php

ABOUT THE JIP

One of the most extensive environmental industry research programmes bringing together the world's foremost experts across industry, academia and independent research centres.

This fact sheet has been produced by the IOGP E&P Sound and Marine Life Joint Industry Programme (JIP). The JIP was founded in 2005 and supports research to help increase understanding of the potential effect of sound generated by oil and gas exploration and production activity on marine life.

To learn more about the JIP and our research, please visit www.soundandmarinelife.org

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