**DHI CASE STORY**

ASSESSING NOISE-RELATED IMPACTS ON MARINE MAMMALS

Developing a Dynamic Risk Assessment Model for Acoustic Disturbance

For companies like Statoil that conduct oil and gas exploration, we help them ensure that noise from their work does not harm marine mammals. Current noise risk assessment models assume that marine mammals are stationary. However, marine mammals move around their environment. As such, Statoil asked us to develop a risk assessment model that took this into account. Using our MIKE by DHI software, we created a Dynamic Risk Assessment Model for Acoustic Disturbance (DRAMAD) using the Chukchi Sea as the demonstration area. DRAMAD gives Statoil more accurate results than current noise risk assessment models on the large scale noise-related impacts on seals as well as bowhead and beluga whales. It also enables Statoil to convey environmental awareness to the local communities in the area.

AGENT-BASED MODELLING

We developed the Dynamic Risk Assessment Model for Acoustic Disturbance (DRAMAD), which models the movements of marine mammals before, during and after noise exposure. The effect of noise on marine mammals is an important environmental issue. Up until now, noise assessments have applied a concept that assumes whales and seals are stationary. As such, sound levels were calculated for different distances from the activity. The estimation of the number of animals affected was therefore based on the assumption of non-moving animals.
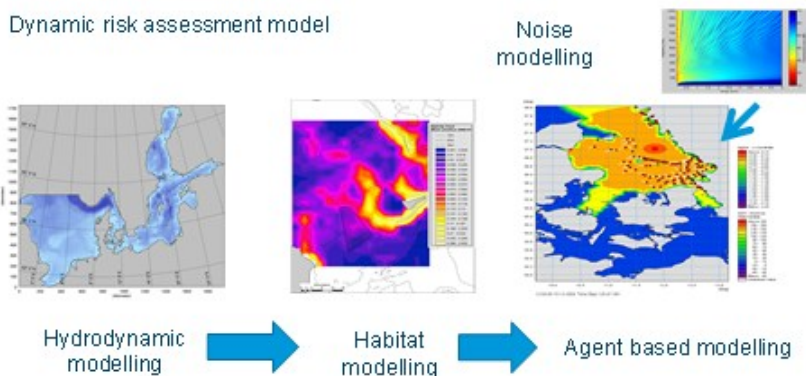
DRAMAD comprehensively combines all of our modelling strands © DHI

SUMMARY

CLIENT
Statoil

CHALLENGE
- Difficulty in accurately assessing noise-related impacts on marine mammals
- Uncertainty about cumulative impacts of noise in large project areas
- Possible delays in consent being granted for individual projects

SOLUTION
A dynamic risk assessment model that assesses noise-related impacts of acoustic disturbances

VALUE
- Enabling of large-scale risk assessments for new project areas, such as concession blocks for the exploration and production industry
- Improved identification of periods when or areas where impacts on marine mammals could be high
- Increase in the amount of information used for exploration campaign planning and decision making
- Provision of support for the project approval process

LOCATION / COUNTRY
Chukchi Sea

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However, whales, dolphins and porpoises constantly move in response to the environment. In addition, they can also react strongly to sound. Therefore, traditional risk assessments can lead to unrealistic results.

To address this, we developed agent-based modelling to look at sound impacts. We utilised the experience of a marine mammal biologist (who was also the project manager), combined with the expertise of environmental modellers. Unlike previous noise-related impact assessment methods, our approach is based on the movements of marine mammals, making DRAMAD the risk assessment tool of the future.

DRAMAD can assess sound risks to whale ecotypes like the hump-back whale. Photo: iStockphoto © miblue5

GROUND-BREAKING RISK ASSESSMENT MODELLING

The Chukchi Sea is a complex and very large area. This made hydrodynamic modelling very challenging. There are also huge gaps in the understanding of cetacean movements and noise-related impacts. We therefore had to predict movements based on known data from other areas or other species.

We utilised all three of our modelling strands to develop the ground-breaking DRAMAD. First, we modelled the hydrodynamics of the Chukchi Sea using our MIKE by DHI software. Next, we extracted environmental variables that could influence the movements of the six species studied:

• bowhead whales

• beluga whales

• bearded seals

• ringed seals

• spotted seals

• walruses

Then, we investigated the relationship between the variables and movement patterns of the whales and seals.

By doing this, we could predict areas of high importance within the Chukchi Sea. This process is called habitat modelling. Finally, we used agent-based modelling to predict the movements of individual marine mammals. We could then model reactions to extracted variables and sound.

To support our work, we validated all our hydrodynamic and habitat models. We did this by comparing empirical data – including measurements of currents and densities of marine mammals – with our model results. There are also a number of new field studies related to whale reactions to sound in a variety of places. This will help the expansion of our database of agent-based models.

DRAMAD'S EXTENSIVE BENEFITS

DRAMAD gives Statoil more accurate results than current noise risk assessment models on large scale noise-related impacts. It also enables Statoil to convey their environmental awareness to the local communities around Chukchi Sea. Furthermore, DRAMAD can potentially also be used for large scale risk assessments in new license blocks. A variety of scenarios using a number of sound sources can be modelled. This could help identify risky periods or sensitive areas where impacts could be high. DRAMAD will also greatly increase the amount of information for exploration campaign planning and decision making.

In addition, by modelling the environmental field, survey efforts could be much more targeted. This could result in reduced costs for the developers. Moreover, developers can also show regulators that the assessment work has already been done. This could significantly smooth the Environmental Impact Assessment or license-to-operate process. Finally, the models can help communicate results and impacts, as well as further the dialogue with national authorities, NGO's and local stakeholders.

DRAMAD can assess sound risks to whale ecotypes like the killer whale. Photo: iStockphoto © Jannie_nikola

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