Electromagnetic fields from subsea power cables: A risk driver for biodiversity changes of offshore wind?

Bjørn Henrik Hansen, Julia Farkas, Bjarne Kvæstad, Stefania Piarulli, Raymond Nepstad & Tor Nordam

Environmental risk factors associated with offshore wind farms

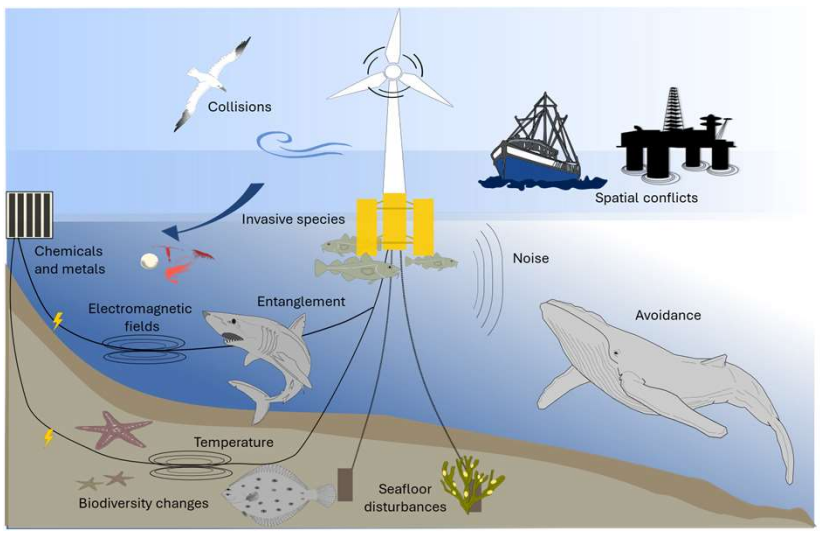

Figure 1: Overview of different OWF-related stressors potentially affecting the marine environment.

A range of biological effects of EMF has been observed in fish

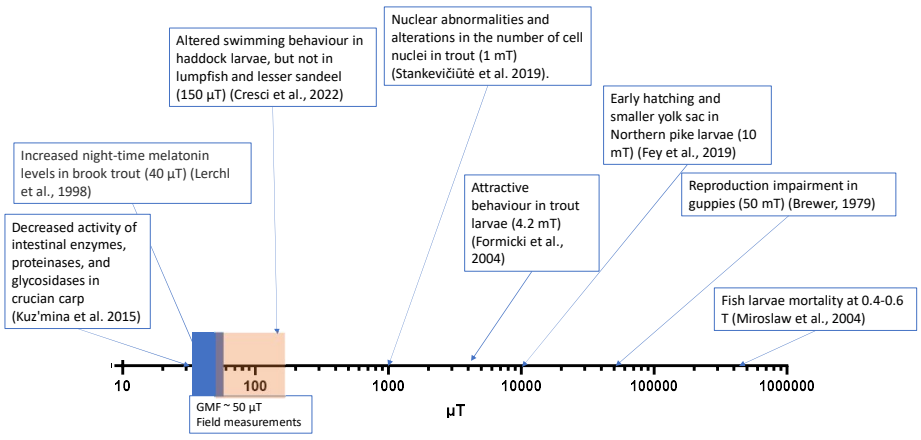

Figure 2: Examples of biological effects observed in fish exposed to B-fields.

Background

- The Norwegian Government wants to allocate 30 GW of offshore wind capacity by 2040.
- Offshore wind farms (OWF) may affect the marine environment in many ways (Fig. 1), and one potential risk factor is the environmental effects of electromagnetic fields emitted from subsea cables.
- OWF utilize subsea power cables for intra-array and export purposes, generating electromagnetic fields (EMF), comprising electric (E-fields) and magnetic fields (B-fields).
- Most studies on effects of EMF has been performed on fish which have displayed a wide range of biological effects (Fig. 2).
- Electroreceptive marine species, like certain sharks and rays, with specialized organs, may be affected by E-fields, impacting their ability to locate prey. B-fields are likely to disrupt geomagnetic cues and navigation in species relying on such cues, altering natural behavior and navigation patterns.
- Potential impacts on marine organisms will depend on field strength, species sensitivity and cable proximity to sensitive habitats. Cable insulation and burial can mitigate environmental impact, with burial being more effective.
- HVDC cables, responsible for transmitting electricity to the onshore grid, are high voltage, cover longer distances, and are seabed-buried.
- Benthic and epi-benthic communities, critical for maintaining the ecosystem functionality, are thus at risk of EMF exposure. Some benthic invertebrates, like lobsters and crabs, are sensitive to B-fields, which causes altered behavior.
- The overall impact on organisms, communities and ecosystems remains poorly understood and studied.

RESEARCH FOCUS: To assess biological effects of EMF on various marine species, aiming to <u>establish biological thresholds for EMF exposure</u>. This research will contribute to <u>evaluating EMF as a potential environmental risk factor</u> for offshore wind installations.

Experimental system assessing effects of EMF on biological systems

SINTEF Ocean developed an experimental system for controlled exposure of marine organisms to B-fields. The system generates B-fields from two coils placed on each side of an exposure arena (60 x 80 cm) so that the B-field direction can be altered. To simulate the dark deep-sea environment, the arena is lit up by IR lights (850 nm). Animal positioning is continuously monitored using a 5 MPx industrial camera with a 4 mm fisheye lens mounted above the arena.

Videos recorded can be used to assess animal behavior; e.g., speed and direction of movement, turn rates, distance travelled, interactions between individuals etc. Small marine organisms can be placed singly or combined within the arena (mesocosm) while subjecting them to realistic magnetic fields from submarine cables.

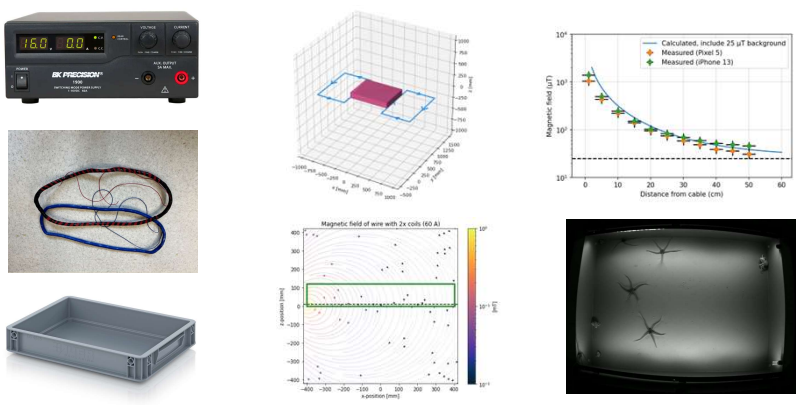

Figure 3: Key components, schematic drawing and validation data.

Figure 4: Examples of marine animals that can be used for experimental exposure to EMF at SINTEF Sealab.

Preliminary results and future plans

The functionality of the system has been tested using six different marine species. Next steps will include acquiring knowledge about the natural behaviors (locomotion, social behavior, feeding behavior, antipredation etc.) and identify key behavioral variables to assess thresholds.

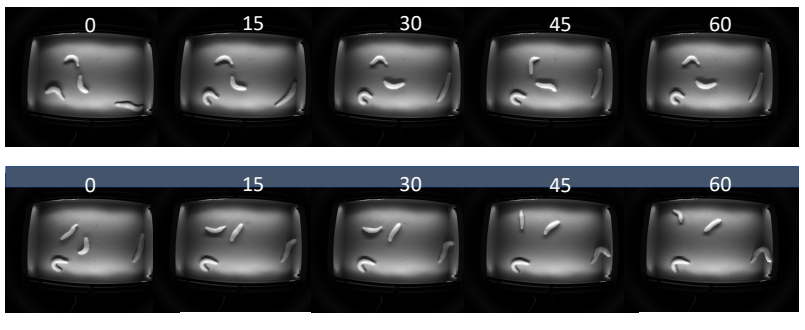

Figure 5: Snapshots of sea cucumber 0-60 min after being introduced to the exposure arena (top), and 0-60 min after being exposed to EMF (from top to bottom of arena).

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