New tools to assess the effects of magnetic fields from power cables on marine fauna

- Luana Albert – PhD thesis (2019-2022)

Context | As the desire to exploit **marine renewable energies** is growing, **offshore construction projects are** multiplying worldwide. The electricity produced is transfered to the coast by a network of **underwater power cables** that are generally buried in the sediment. The latter emit high intensity alternative (AC) or direct (DC) current **magnetic fields,** whose potential effects on marine fauna are still poorly understood. Yet, many marine organisms use the **Earth's magnetic field** to guide their short and long-range movements.

Objectives | The present PhD project explored the short-term **behavioral responses** of marine **benthic organisms** to magnetic fields similar to those of power cables. According to a **multi-model approach,** exposures were carried out in a controlled environment in the **thornback ray** *Raja clavata*, the **velvet crab** *Necora puber*, the **blue mussel** *Mytilus edulis* and the **razor clam** *Ensis magnus*.

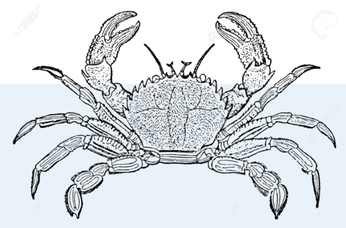
Materials & Methods | Artificial magnetic fields were produced by a custom-made device, named the *Magnotron (central figure),* based on the principle of **Helmholtz coils**, with computer monitoring allowing the control of the generated intensities.

Thornback ray
Raja clavata

Risk factors : benthic predator, magneto-sensitive

Experimental exposure : uniform **450 µT DC/AC** magnetic fields, 1 hour, independant measurement focal sampling.

Aim : assess potential behavioral alterations in the form of quantitative or qualitative changes in **activity budgets.**

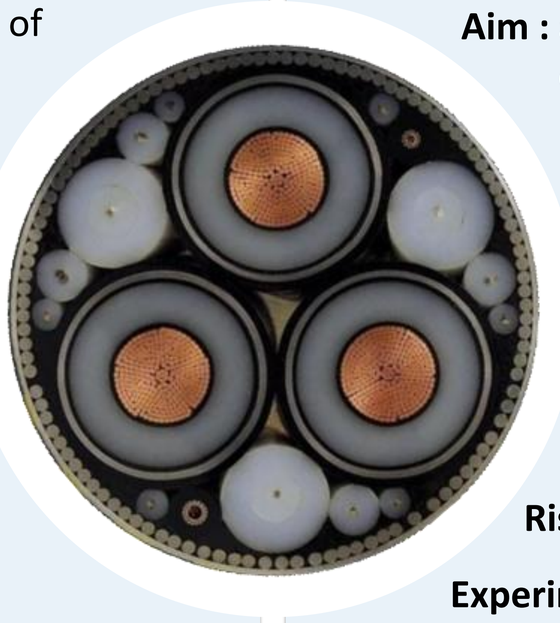


Velvet crab
Necora puber

Risk factors : benthic predator, attracted to artificial hard substrates such as cables protective structures.

Experimental exposure : gradient magnetic field of **70 - 304 µT DC/AC,** 30 minutes, independant measurement focal sampling.

Aim : assess potential **attraction or repulsion** responses effects on **feeding** and **sheltering** behaviors.



Blue mussel
Mytilus edulis

Risk factors : major colonizer of artificial hard substrates, engineer species, key stone species for benthic-pelagic coupling.

Experimental exposure : uniform **300 µT DC** magnetic field, 6 hours, repeated measurements (control and then treatment on a batch of 5 mussels).

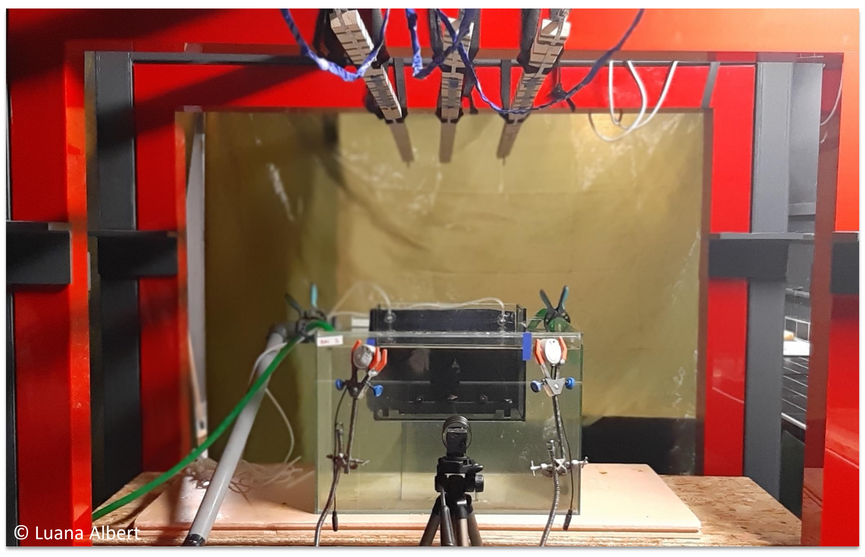
Aim : assess potential alteration of **filtering activity** and **filtration rate.**

Razor clam
Ensis magnus

Risk factors : endogenous species, high living depth

Experimental exposure : uniform **300 µT DC** magnetic field, 5 days, independant mesurements

Aim : assess potential alteration of **the bioturbation activity** (sediment reworking and bio-irrigation processes)



Conclusion | The magnetron is a **polyvalent** tool**,** well-suited to the study of small to mid-size species that allows the emissions of both gradient (Figures above) and uniform magnetic fields. Overall, exposures to magnetic fields **did not cause significant behavioral changes** in any of the four species. Present work is the first to evaluate **magneto-sensitivity** in **bivalve mollusks** and provides valuable foundations for future research. It is now necessary to evaluate the effects of **medium and long-term exposures** and to carry out ***in situ*** behavioral measurements with real energized power cables to account for environmental variations.

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