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Response to and effects of electromagnetic fields in elasmobranch embryonic development

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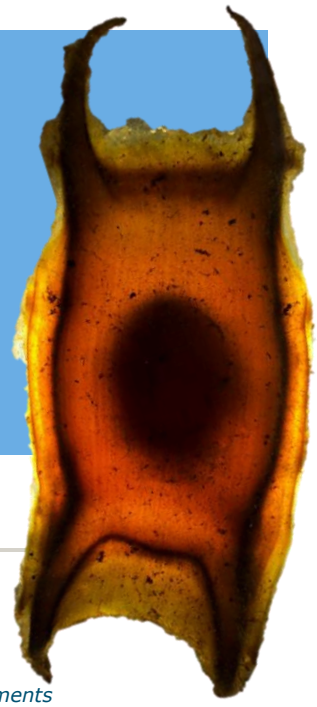


Background

- **Submarine power cables**, transporting sustainable energy from offshore farms, generate **electromagnetic fields** (EMFs) [1] and **elasmobranchs** are known to be particularly **sensitive** to these fields [2].
- **Breeding grounds** and **cable routes overlap** [3][4], potentially creating continuous EMF exposure during **embryogenesis**.
- It is unknown if and how EMF exposure impacts the embryo's **development** and/or **survival**.

Objective

Determine the **impact** of **EMFs** on the **embryogenic development, EMF sensitivity** and **survival** of elasmobranch embryos

Introduction

Effects on elasmobranchs by EMFs generated by submarine power cables are not fully understood. However, electroreception is known to be active early in development, detectable by a 'freeze response' of the embryo [5]. The ventilatory activity of multiple species was significantly reduced when exposed to electric field stimuli. Suitable monitoring techniques are needed to investigate this further.

Methods

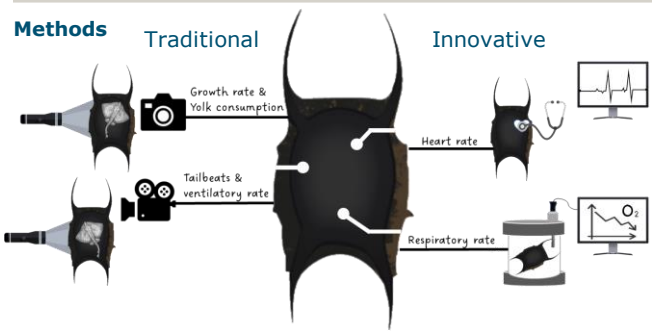


Figure 1. Monitoring techniques and measured parameters for elasmobranch embryos. The candling technique measures growth rate, yolk consumption, tail beat frequency and ventilatory rate. Respiration rates are measured using (micro)sensors and heart rate sensors are tested.

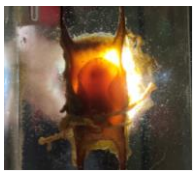


Figure 2 Candling technique

Figure 3 Respiration chambers

Figure 4 Fiber optic microsensor in ray egg

Results monitoring techniques

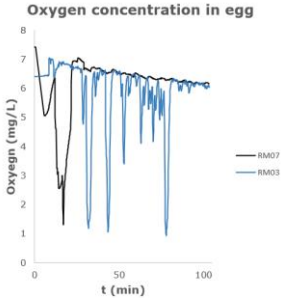
Heart rate measurements

- Test heart rate sensor for chicken eggs managed to retrieve a cardiac signal

Ventilation rate and tailbeat measurements

- Tailbeat frequency and ventilation were detectable with a candling technique using a light pad instead of the traditional bright flashlight
- Ventilation stops/not detectable during freeze responses

Oxygen measurements



- Microsensors can measure oxygen concentration within the egg case
- Oxygen drops after handling eggs
- Large individual variation which might indicate different coping styles associated in relation to stressors
- Movement of the embryo within the egg case resulted in an oxygen peak registered by the sensor
- General oxygen consumption circa 0,7 mg/l/h in last development stage

Figure 5. Oxygen concentration (mg/L) measured inside the egg case with a microsensor for two spotted ray (*Raja montagui*) embryos over a period of 100 minutes.

Conclusions

- Pilot trials give a **first impression** of the **respiration** rate, **heart** rate, **ventilation** rate and **tailbeat** frequency of small spotted ray embryos.
- More trials will be done on **lesser spotted dogfish** embryos to find the **most suitable techniques** considering labour, costs, and data abundance.
- The **presence of EMF** emitted by monitoring **equipment** can have an effect and must be minimalized.

References

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