



Accomodate Marines Renewable Energies & Biodiversity (CEMARB)

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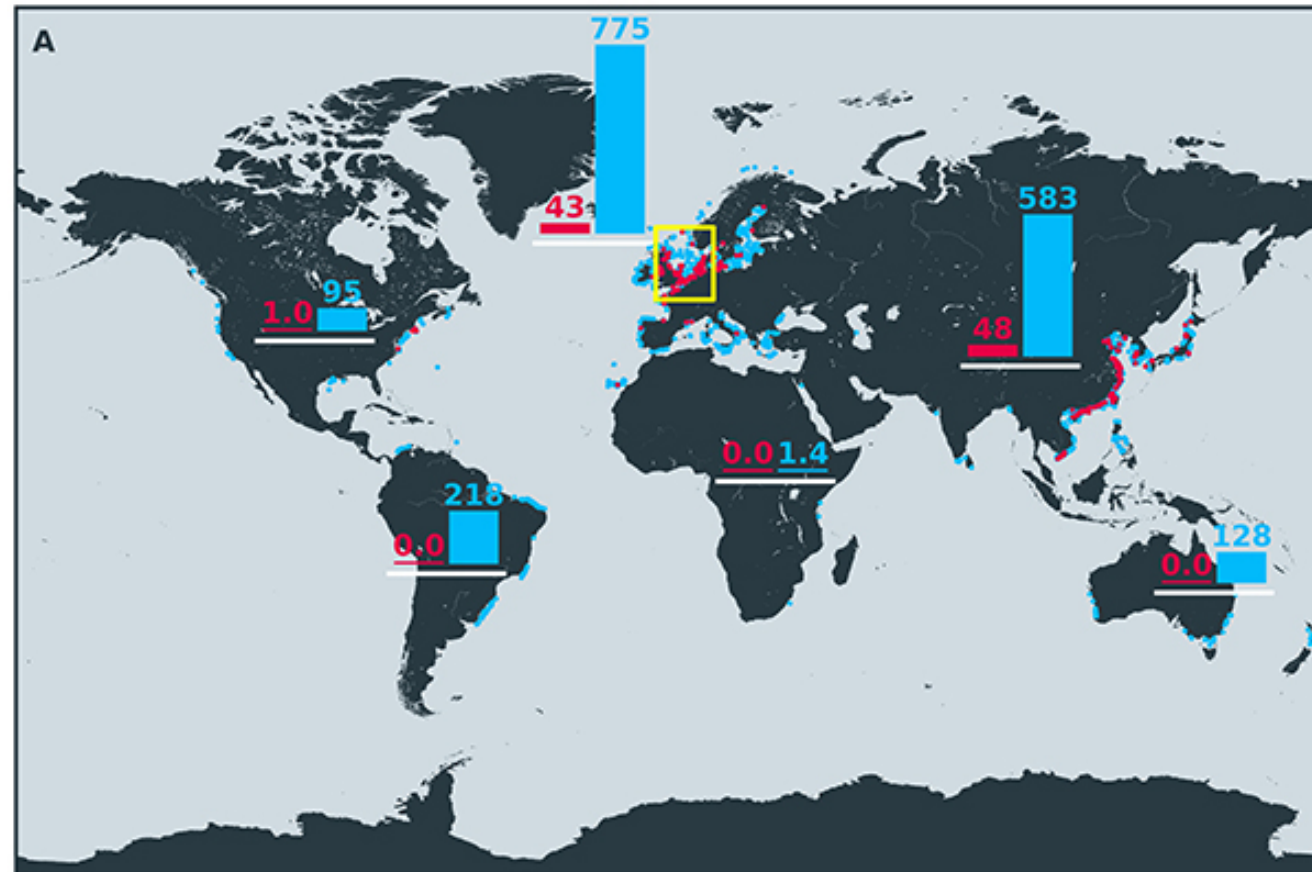
SOUTIENS INSTITUTIONNELS



Context

OFFSHORE WIND FARM DEVELOPMENT

- EU : Objective of 450 GW from offshore wind farms by 2050



Actual (red) and future (blue) energy production capacity (Gigawatts)

Context

OFFSHORE WIND FARM DEVELOPMENT

- EU : Objective of 450 GW from offshore wind farms by 2050
- France : Objective of 50 farms in use → 40 GW by 2050

Windfarm



Anchored



Floating

Electrical connection



Under development



Work in progress



In use

Windfarm project locations



2035



2040



2060



Context

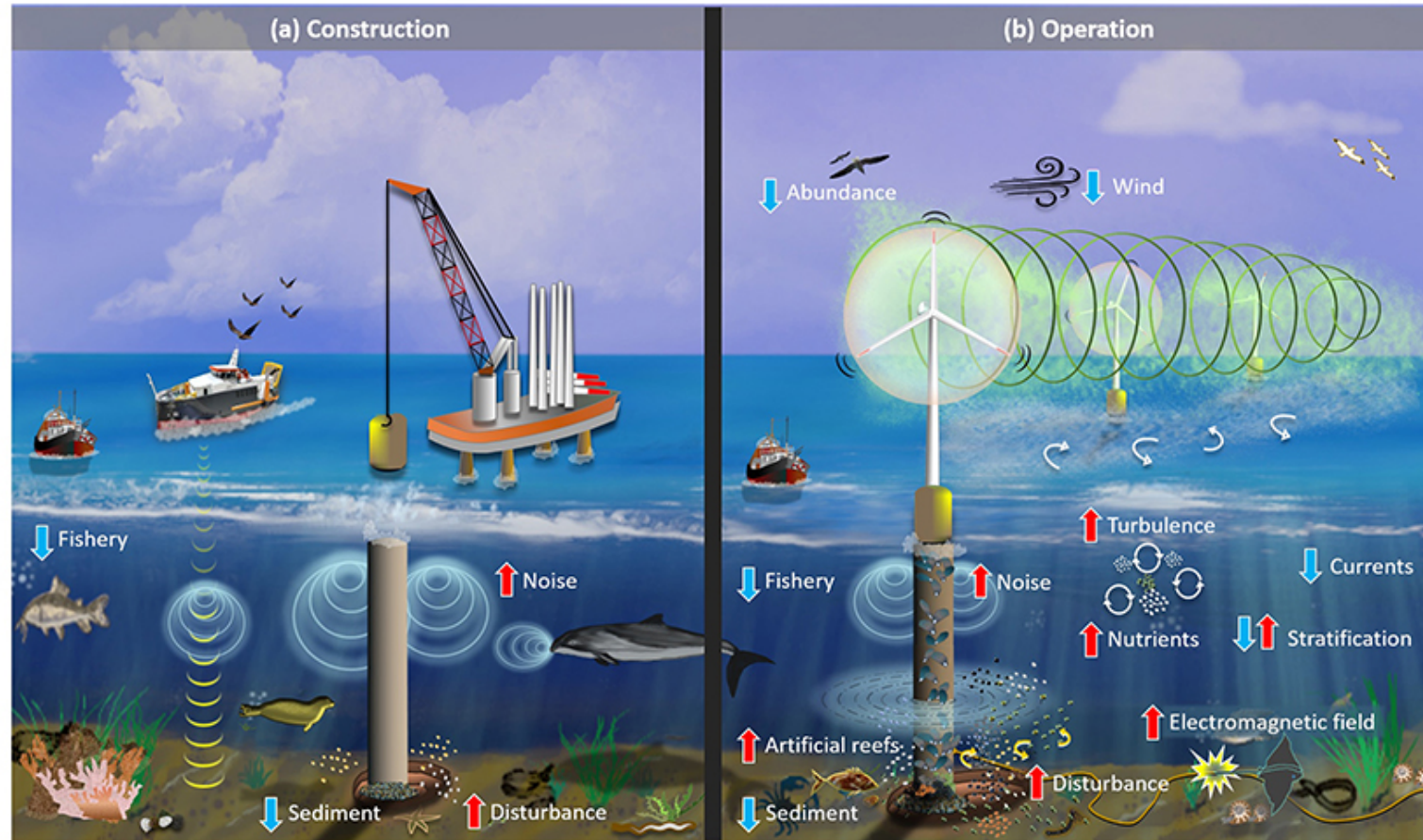
EFFECTS

Positive

- \ fishing activity

Negative

- sound
- vibrations
- resuspension of sediments
- habitat modification



Positive

- \ fishing activity
- recifal effect

Negative

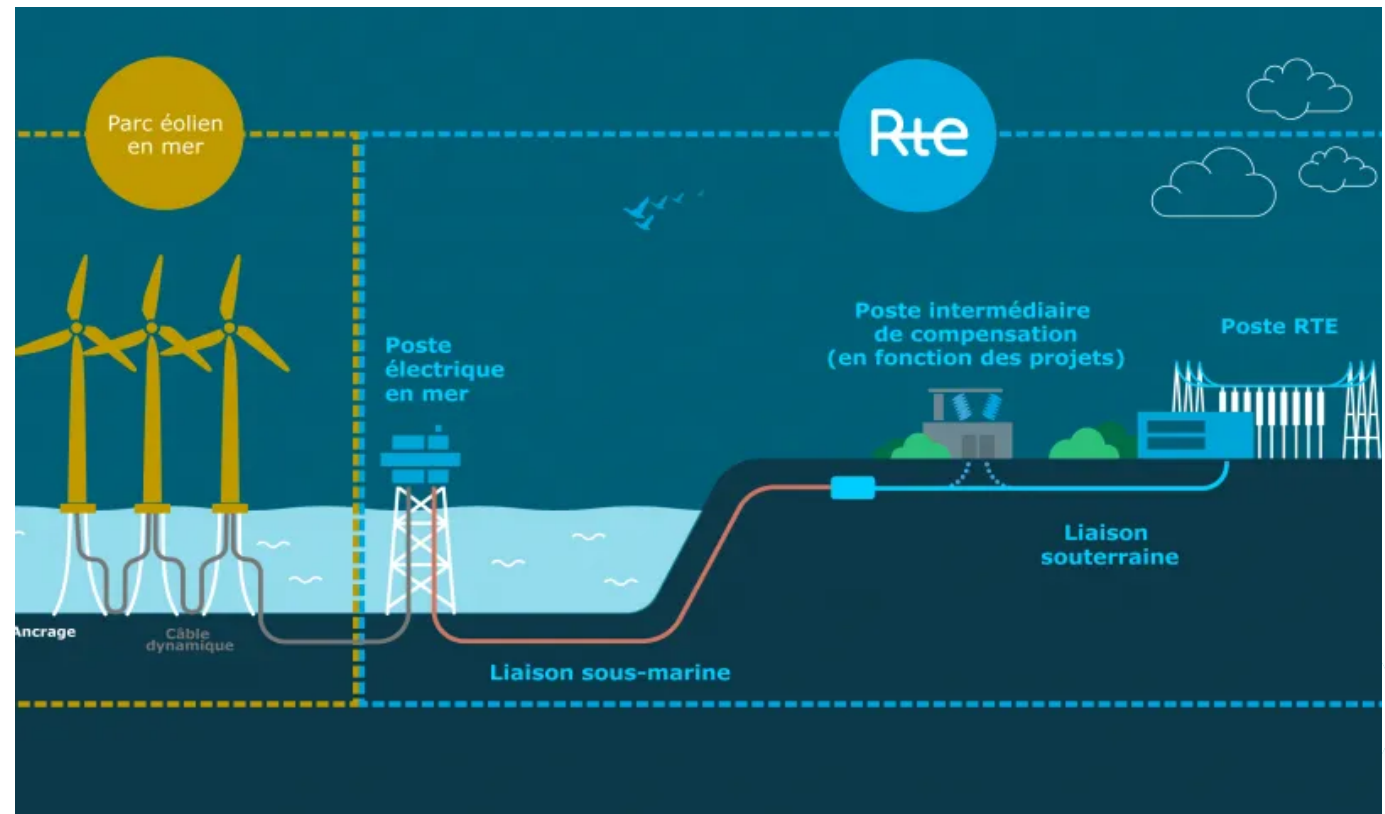
- sound
- ocean circulation
- stratification
- electro magnetic fields

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ELECTRO-MAGNETIC FIELDS

Depending on power and distance to the coast, different electric current are used :

- < 50 km to the coast : Alternatif Current (AC)
- > 50 km to the coast : Direct Current (DC)



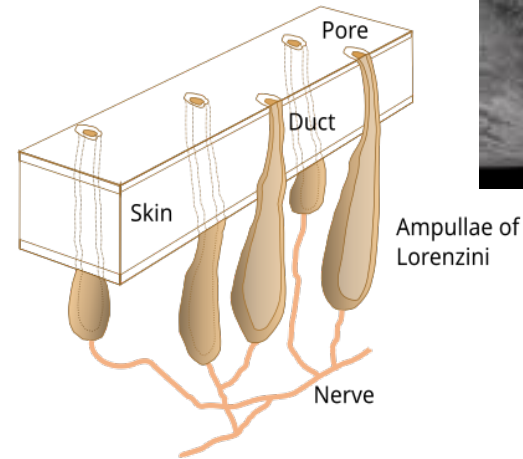
Context

ELECTRO-MAGNETO SENSIBLE SPECIES

Use of electro-magnetic fields to orientate, feed and reproduction



Small spotted catshark
Scyliorhinus canicula





Hypothesis & objectives of the project

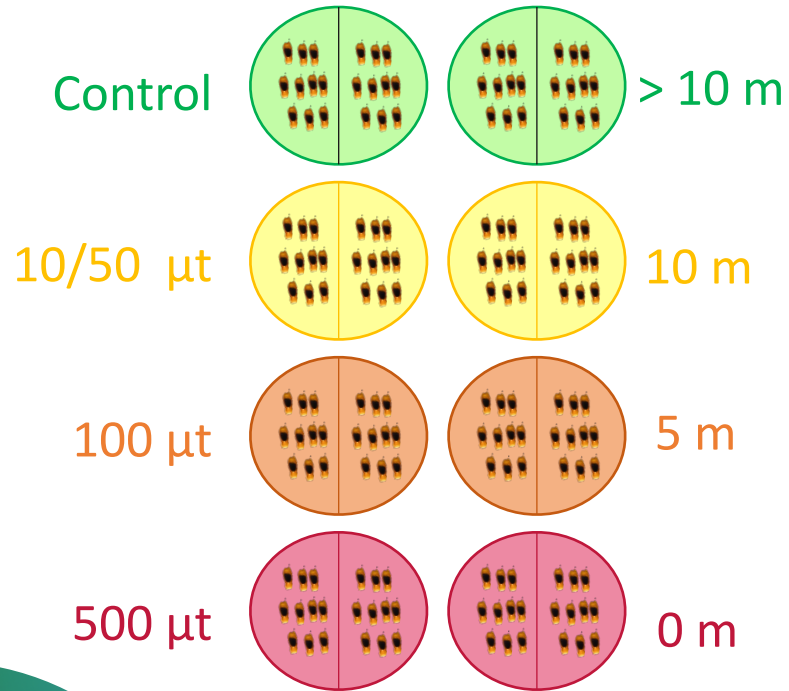
- Offshore wind farms represent favorable habitat for the small-spotted catshark reproduction, benthic elasmobranch, that can lay their eggs near submarine cables with a local amplification of EMF.
- Small-spotted catshark embryos grow in a cap attached to the substrate. If embryos are near a submarine cable, they will be exposed to amplified EMF during the whole embryo stage as well as the beginning of the juvenile phase.

Does chronic exposure to amplified Electromagnetic fields affect (1) survival, (2) growth, (3) metabolism and (4) behaviour in electroreceptive species such as the small-spotted catshark ?

CEMARB experiment



N = 25 eggs / tank
= 50 eggs / condition



Controlled environment

2024: AC
2025: DC



CEMARB experiment

Hatch

21 weeks

77 weeks



Survival

Growth :

- total length
- surface of yolk sac
- development stage



AC

DC

Guillaume Letac (M1)

Survival

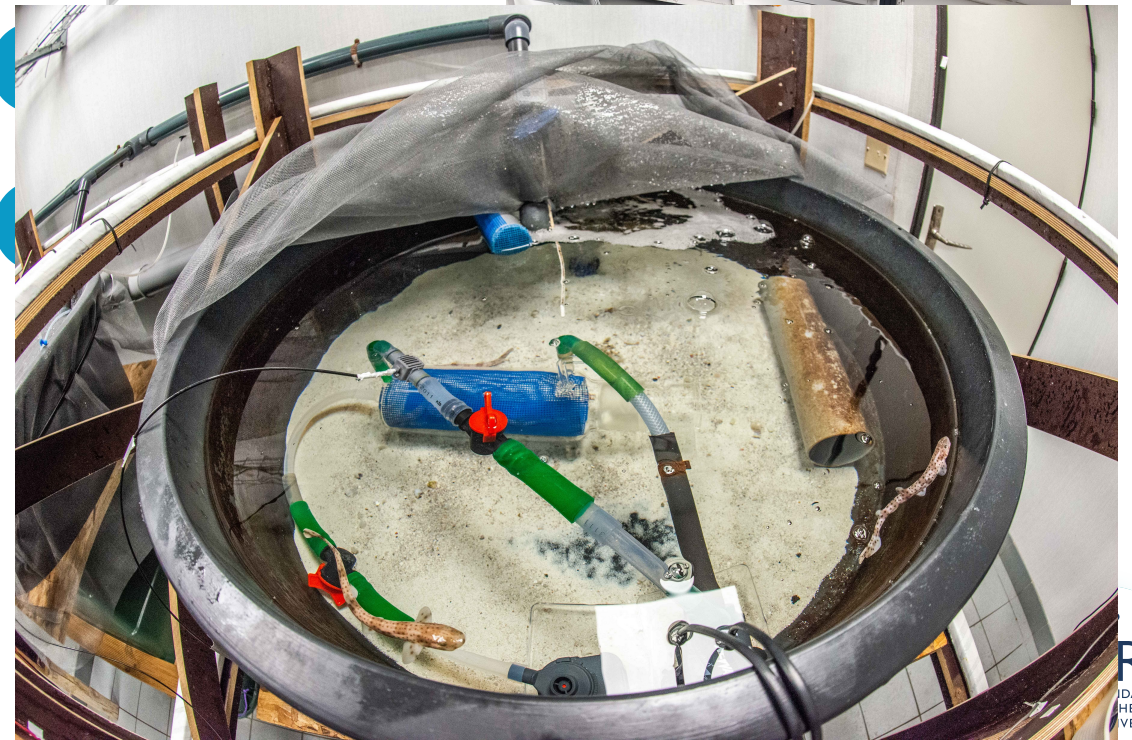
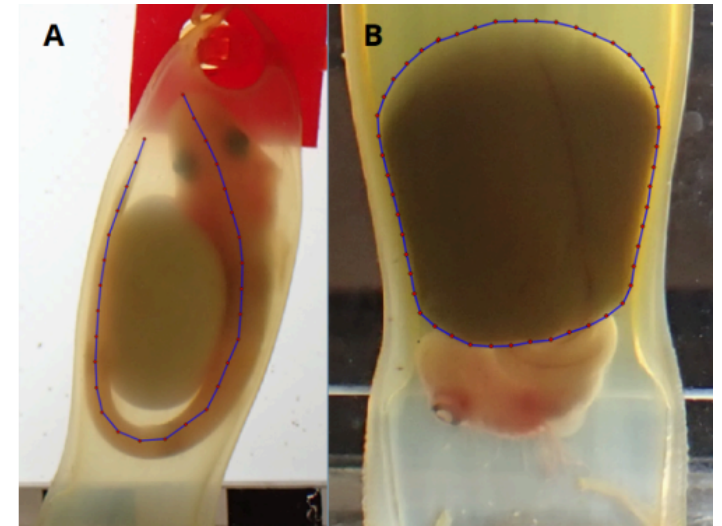
Growth :

- total length
- weigh
- condition index



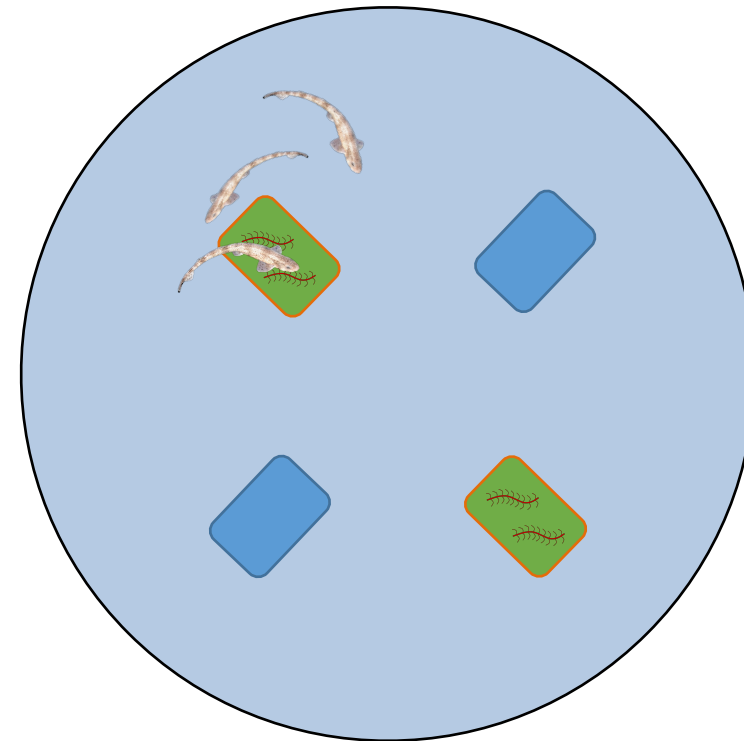
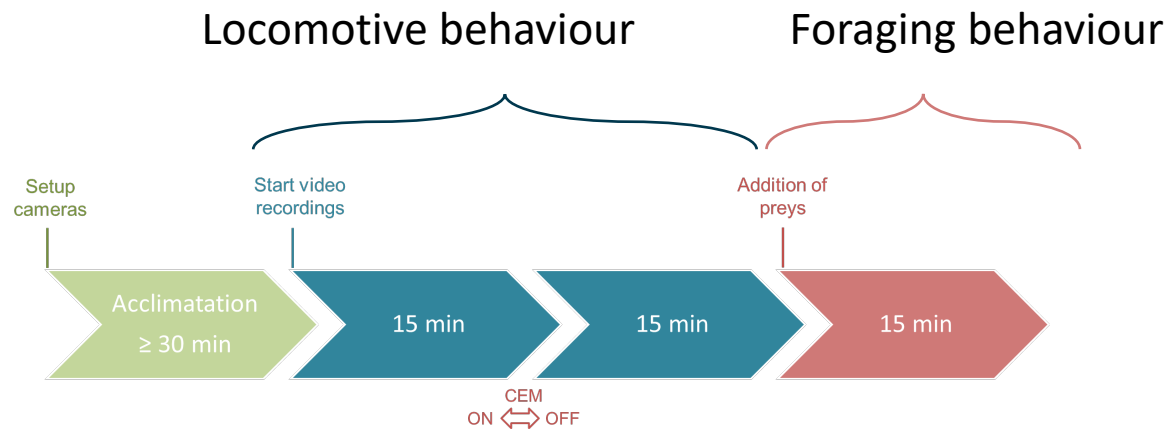
Metabolism

Behaviour



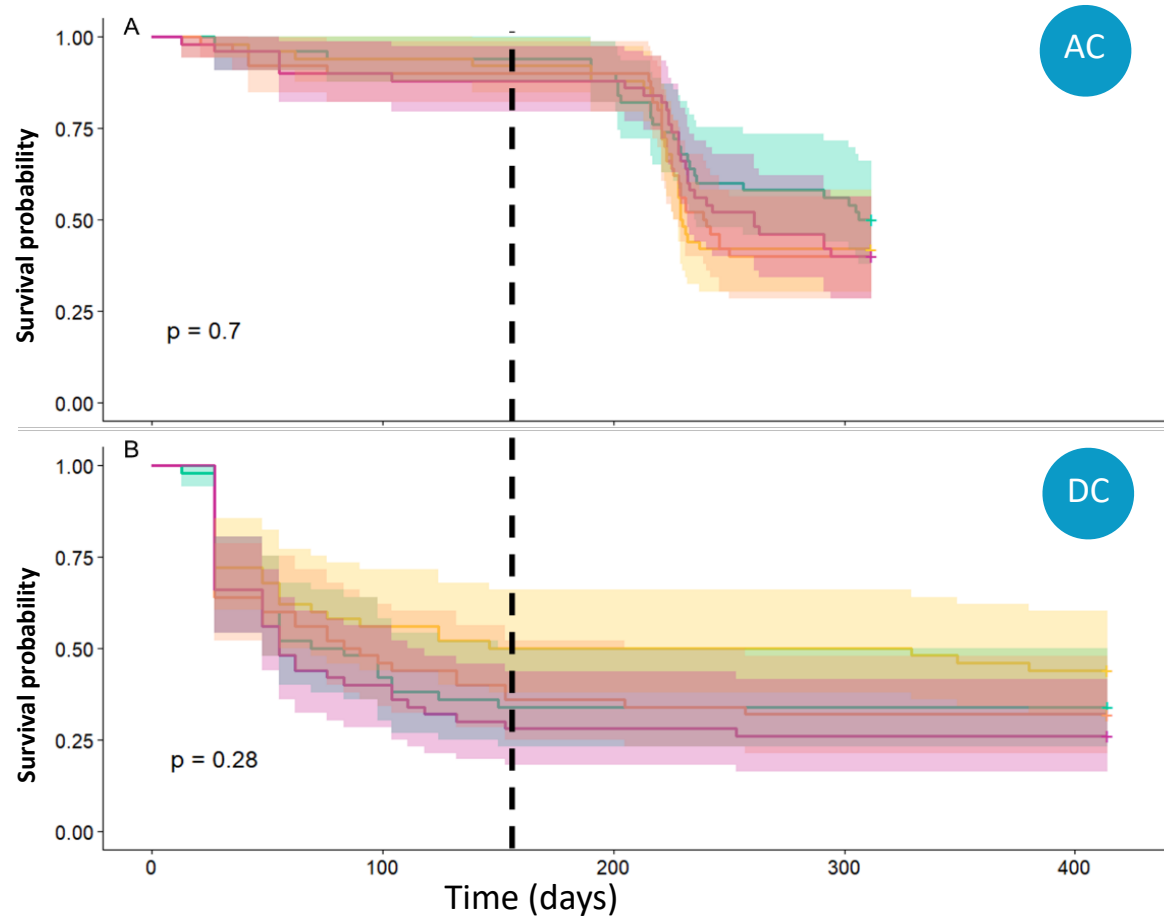
CEMARB experiment

EFFECTS OF AMPLIFIED EMF ON SMALL-SPOTTED CATSHARK BEHAVIOUR



Results

EFFECTS ON SURVIVAL

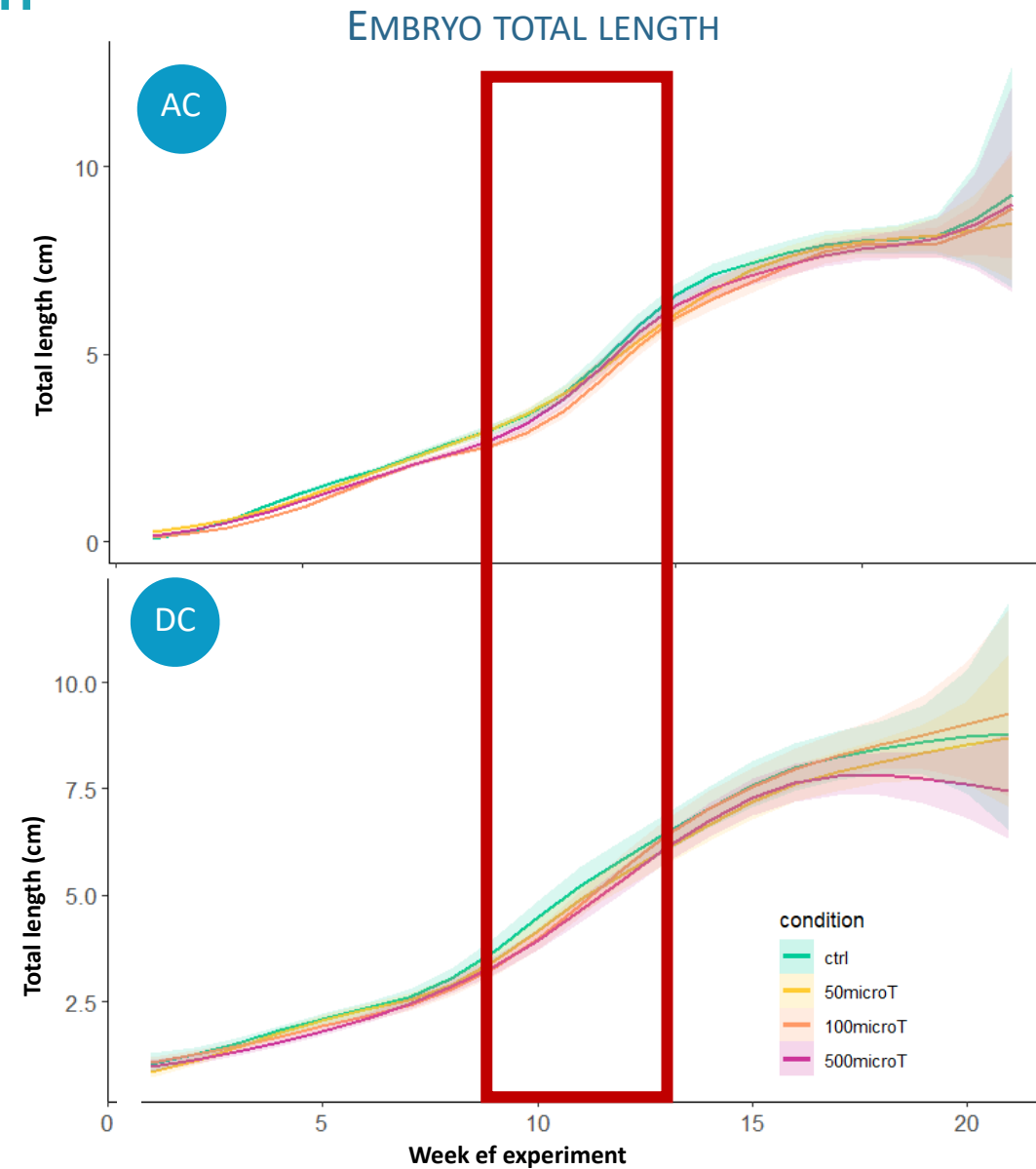


Juvenile survival rate

Condition	AC	DC
Control	66	100
10 / 50 μ t	49	91
100 μ t	42	89
500 μ t	49	94

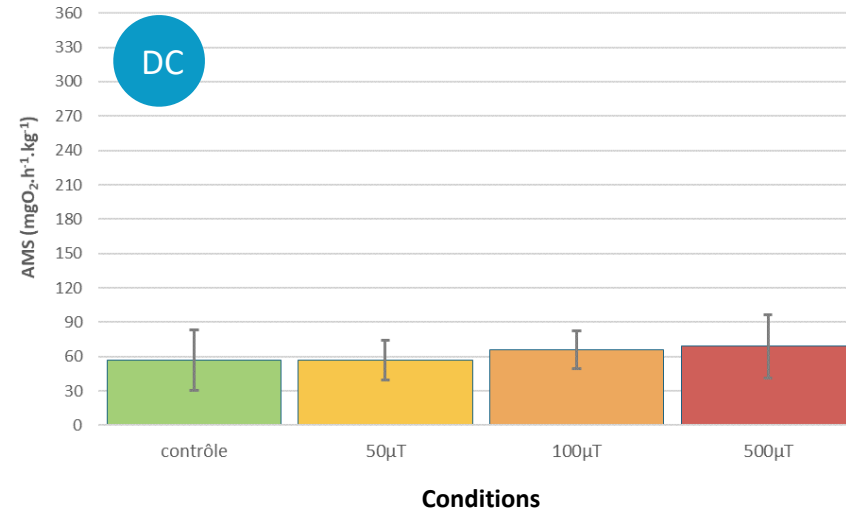
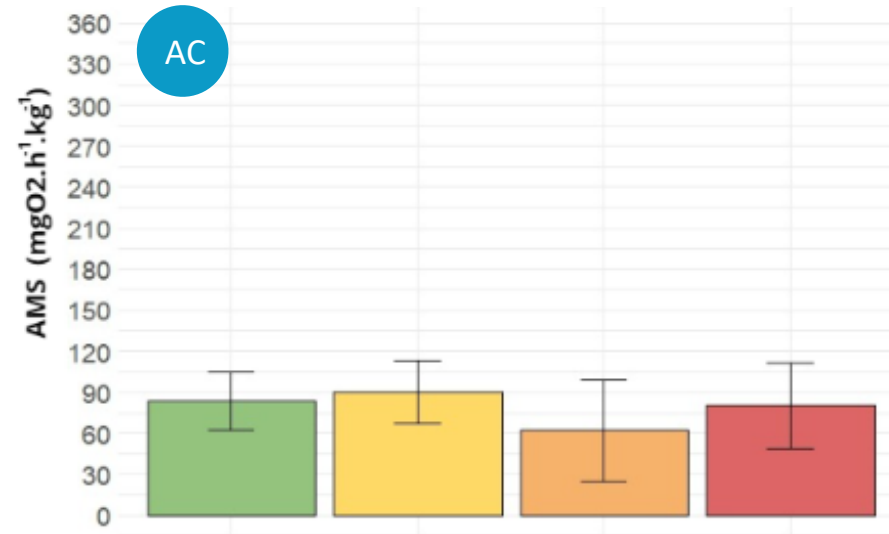
Results

EFFECTS ON GROWTH



Results

EFFECTS ON METABOLISM

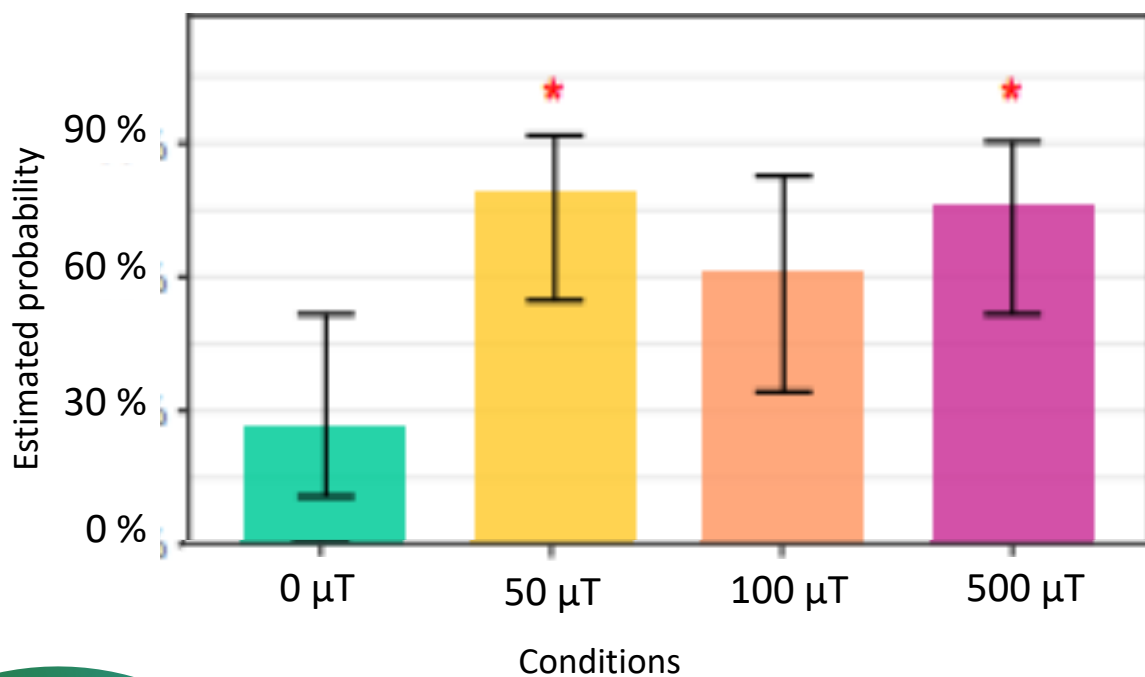




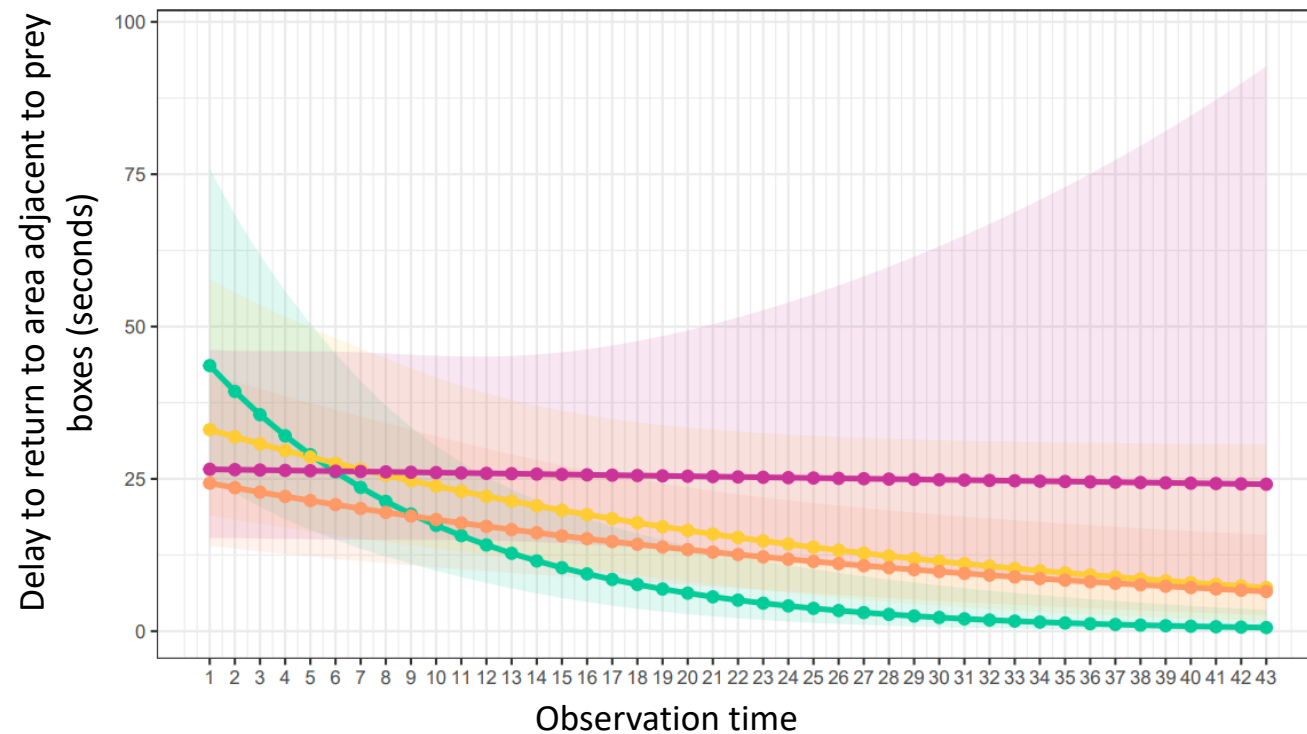
Results

EFFECTS ON BEHAVIOUR

IMMOBILITY



DELAY TO RETURN IN AREA ADJACENT TO PREYS





Key findings

- **NO IMPORTANT EFFECTS OF EMF ON SMALL-SPOTTED CATSHARKS**
- Need to confirm negative tendencies when individuals are exposed to $100 \mu\text{T}$ EMF, which correspond to a 5m distance to a submarine câble.
- **ALTERATION OF LOCOMOTIVE AND FORAGING BEHAVIOURS WHEN INDIVIDUALS DEVELOPPED IN AMPLIFIED EMF**

New knowledge on EMF effect on small-spotted catsharks.



Possible implications on the species ecology, with some behaviour modifications that need to be verified in a natural environment.



Limits & perspectives

- Behavioural observations in EMF using AC were done during the daylight which is out of the activity period of small-spotted catsharks. This reduced possibilities to conclude on the effect of EMF AC on small-spotted catshark behaviour.

To study the effect of EMF on the physiologic stress of small-spotted catsharks



To study the effect of EMF on the reproduction behaviour, in order to validate the hypothesis that small-spotted catsharks can lay eggs in amplified EMF environment.

MESSAGES CLÉS

- 1 | No durable effect of amplified EMF in survival, growth and metabolism of small-spotted catsharks
- 2 | Chronic exposure to amplified EMF affect locomotive behaviour of small-spotted catsharks
- 3 | Chronic exposure to amplified EMF affect foraging behaviour of small-spotted catsharks
- 4 | It is necessary to check if behavioural modifications are reversible or long-lasting effects and whether these effects also occur under natural conditions



