

Field scale experiments to assess the effects of offshore wind farms on marine organisms

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Spatial & Temporal Factors

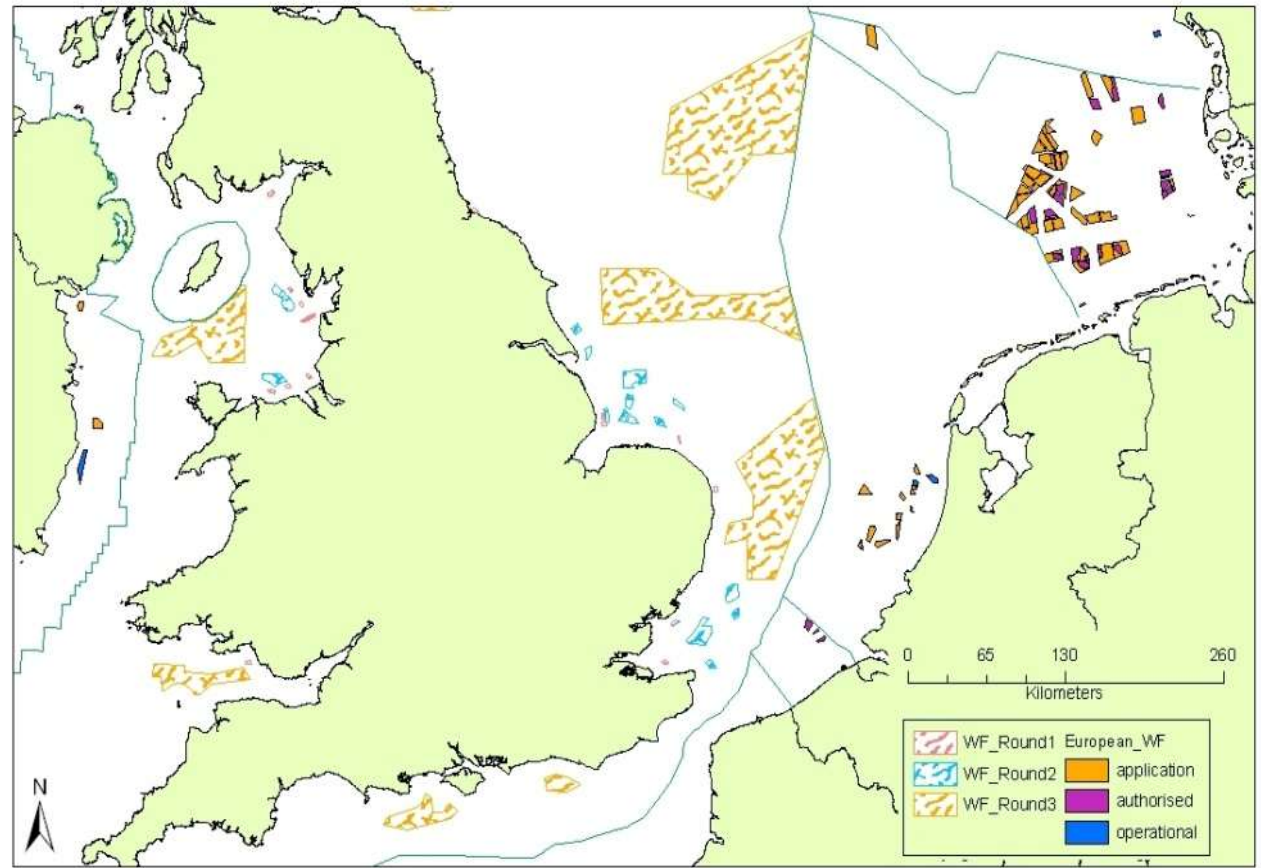
1. Construction (& survey)



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Spatial & Temporal Factors

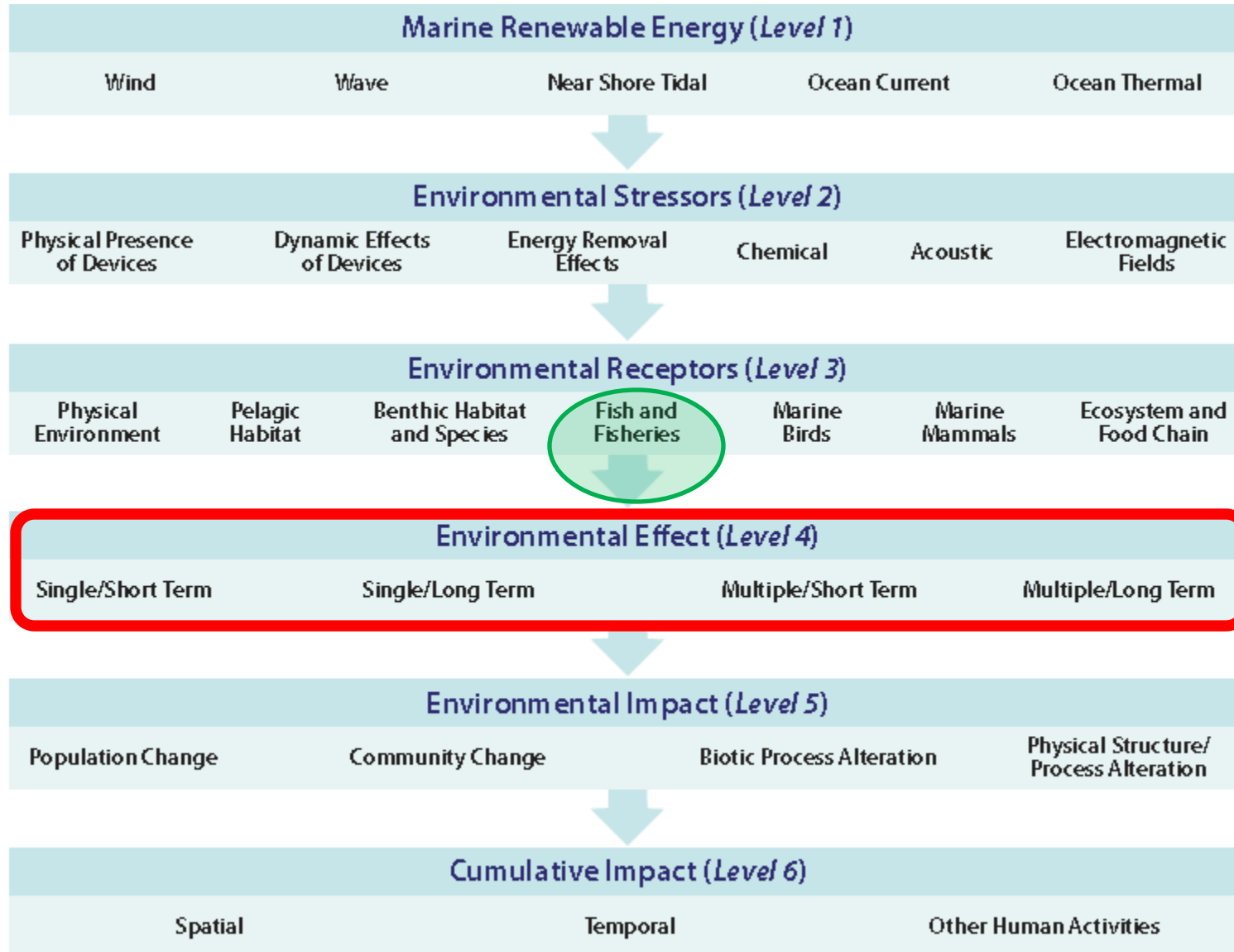
Wind farm locations around the UK and neighbouring areas.



(Adrian Judd, with permission)

Environmental effects framework

(from Boehlert & Gill 2010)



ElectroMagnetic Fields

- Focus - migration behaviour
- behaviour in relation to the cable(s)

Fish (eels & salmonids)



Chelonians (turtles)



Cetaceans (whales & dolphins)



Elasmobranchs (sharks, skates & rays)



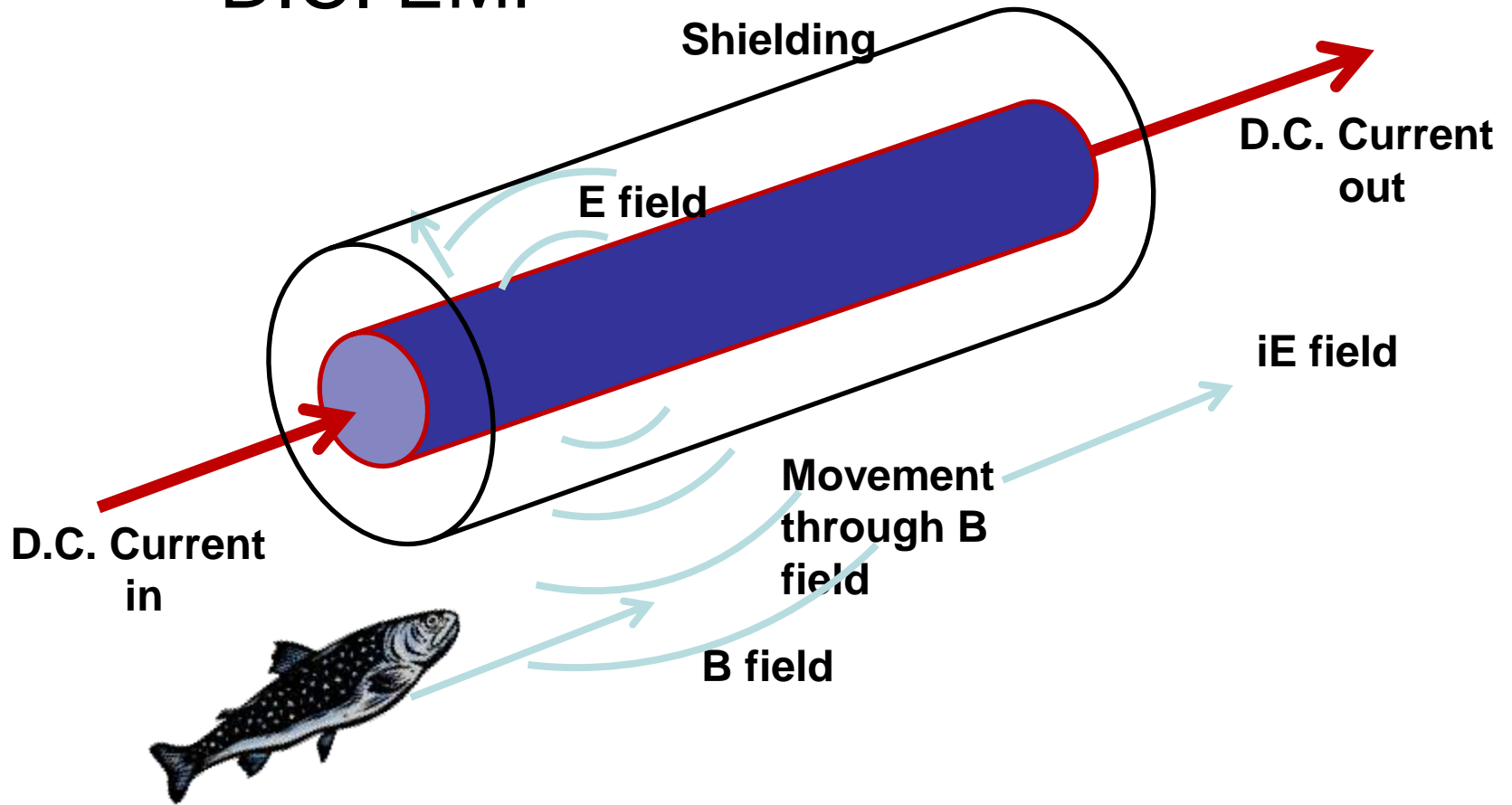
Crustaceans (crabs & lobsters)

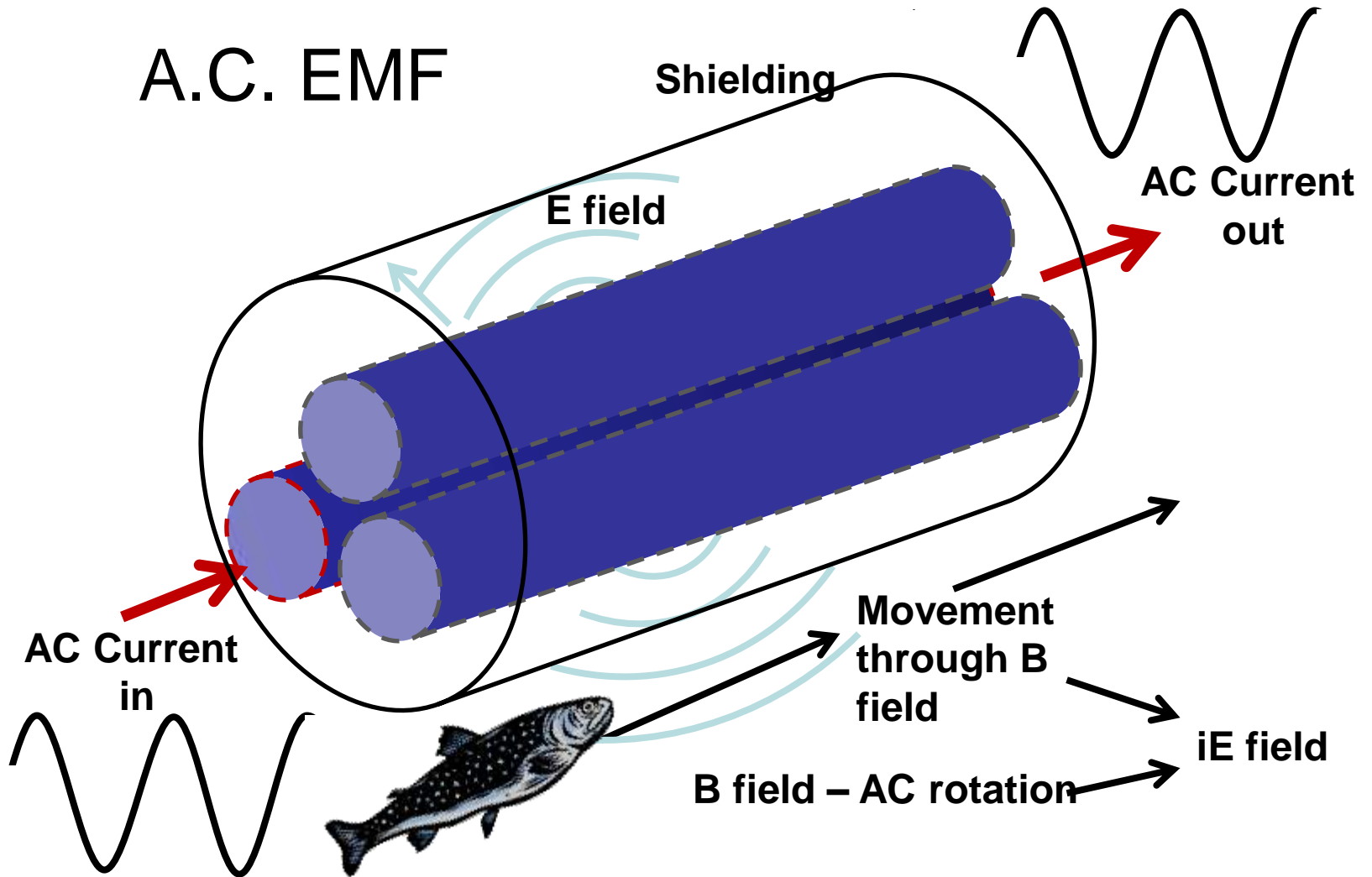


Shark response to E-field

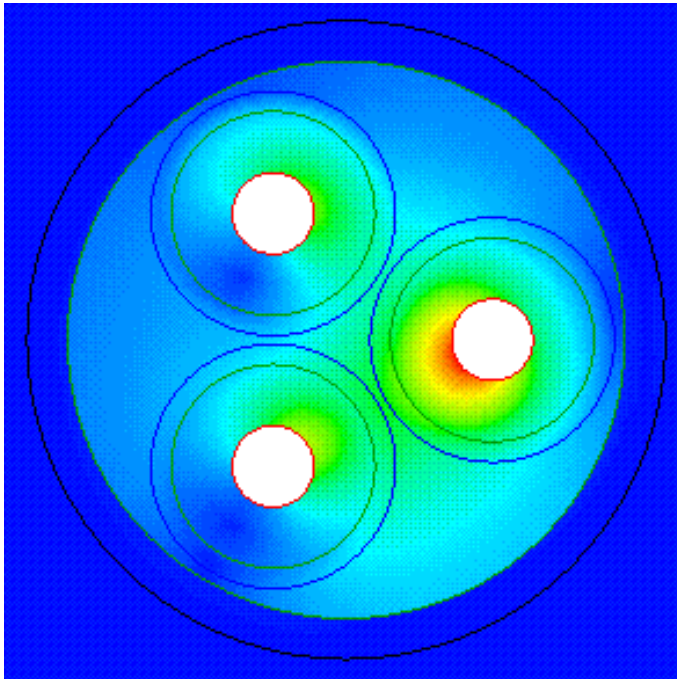


D.C. EMF

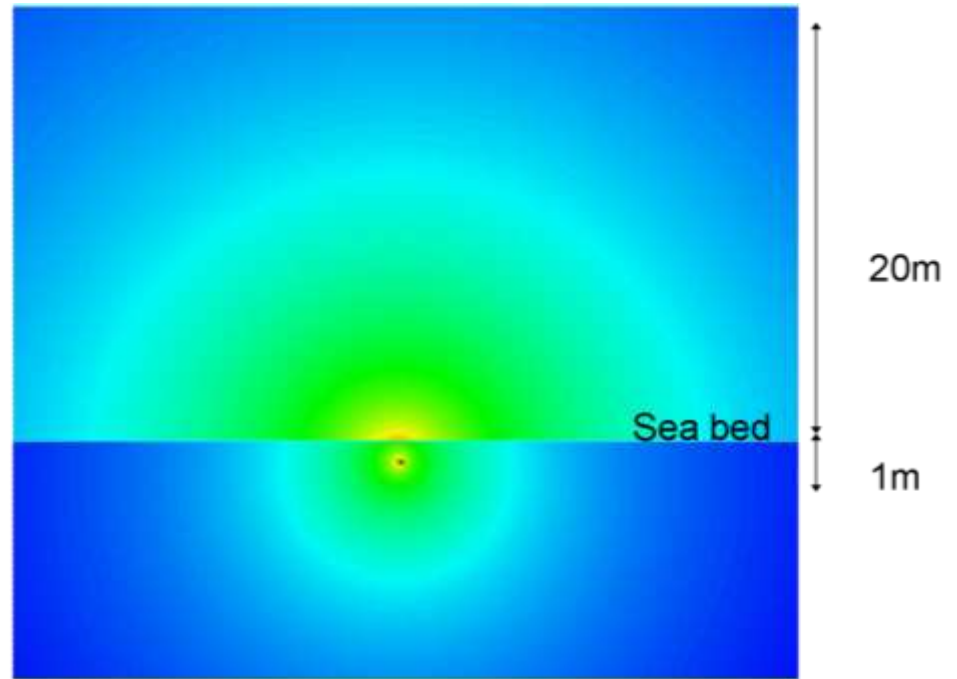




EMF emissions from AC windfarm cables



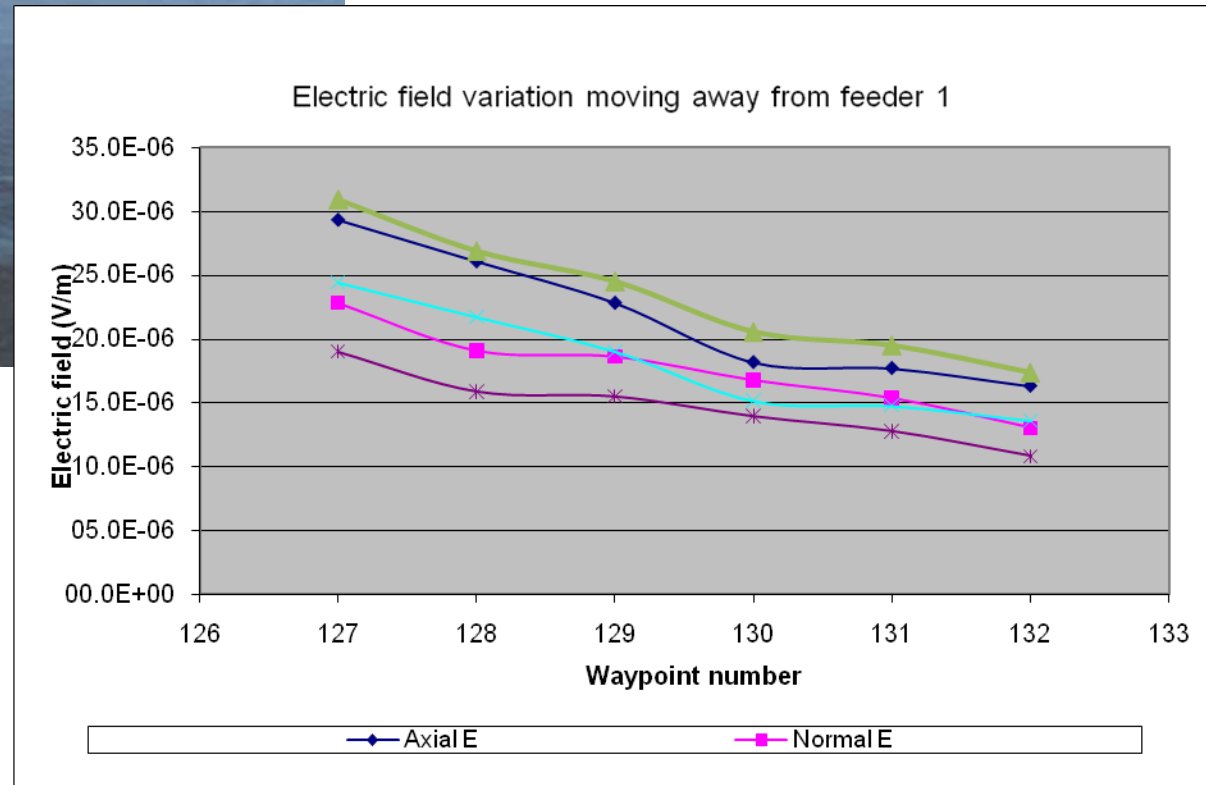
Cable x-section (internal)
Magnetic field



Cable x-section (external)
Induced electric field

- Approximates to E field of $0.9\mu\text{V}/\text{cm}$ (50 Hz) at surface of seabed (ie. within range of detection by EM-sensitive species)

Measured E and B field of operational wind farm cable



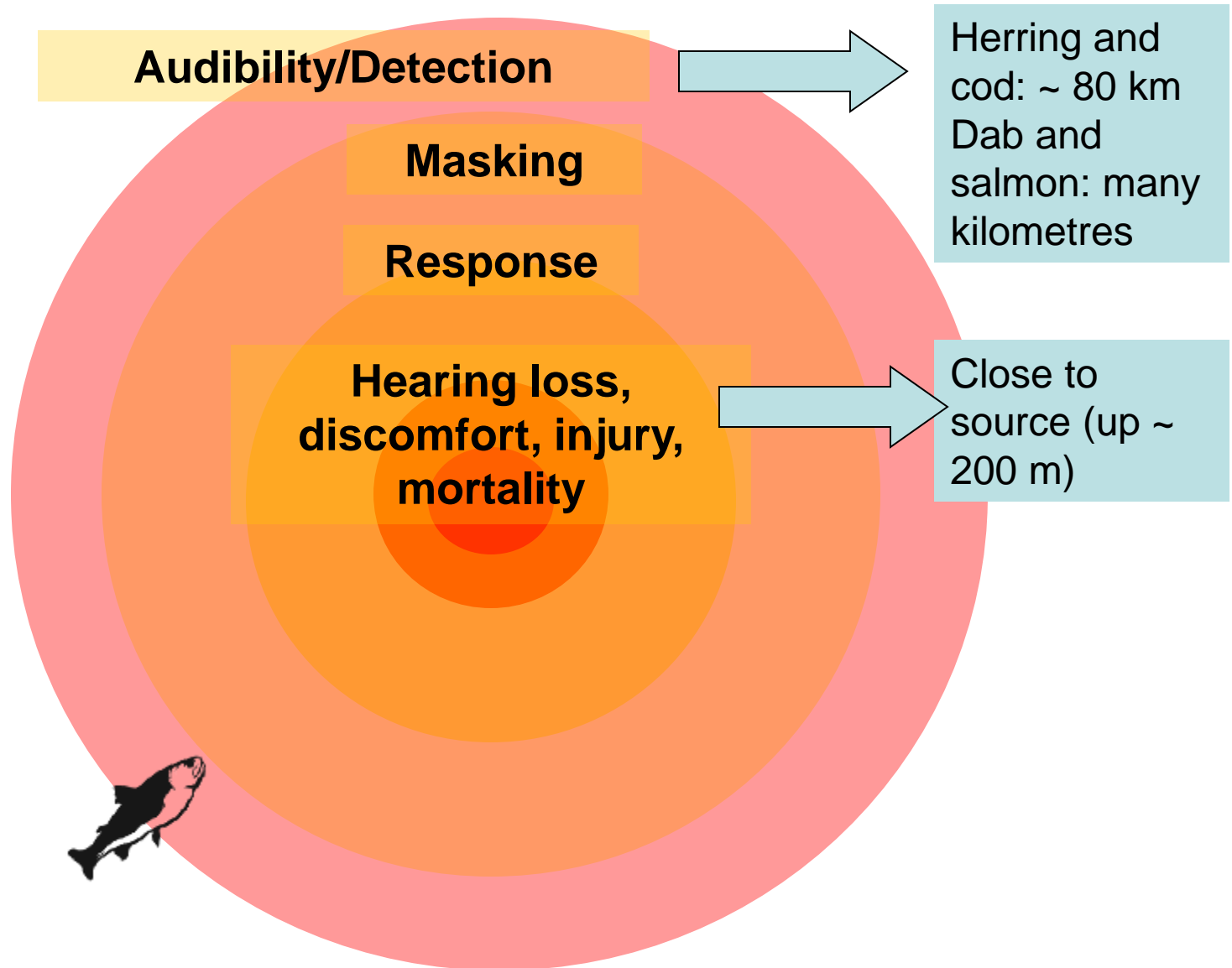
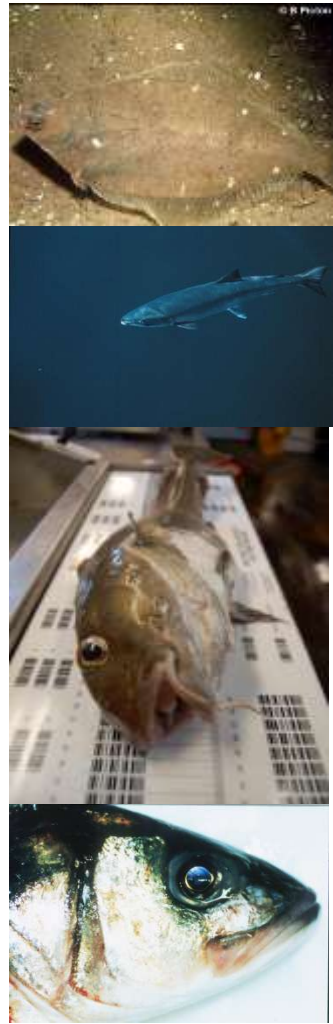
Pile Driving Operations

- Very high sound pressures generated (260 dB re. 1 uPa @ 1m)



from Offshore Windfarm & Environment
Conference 2004, Denmark

Zones of noise influence



(Thomsen et al. 2006))

COWRIE studies

- taking the lab out into the field

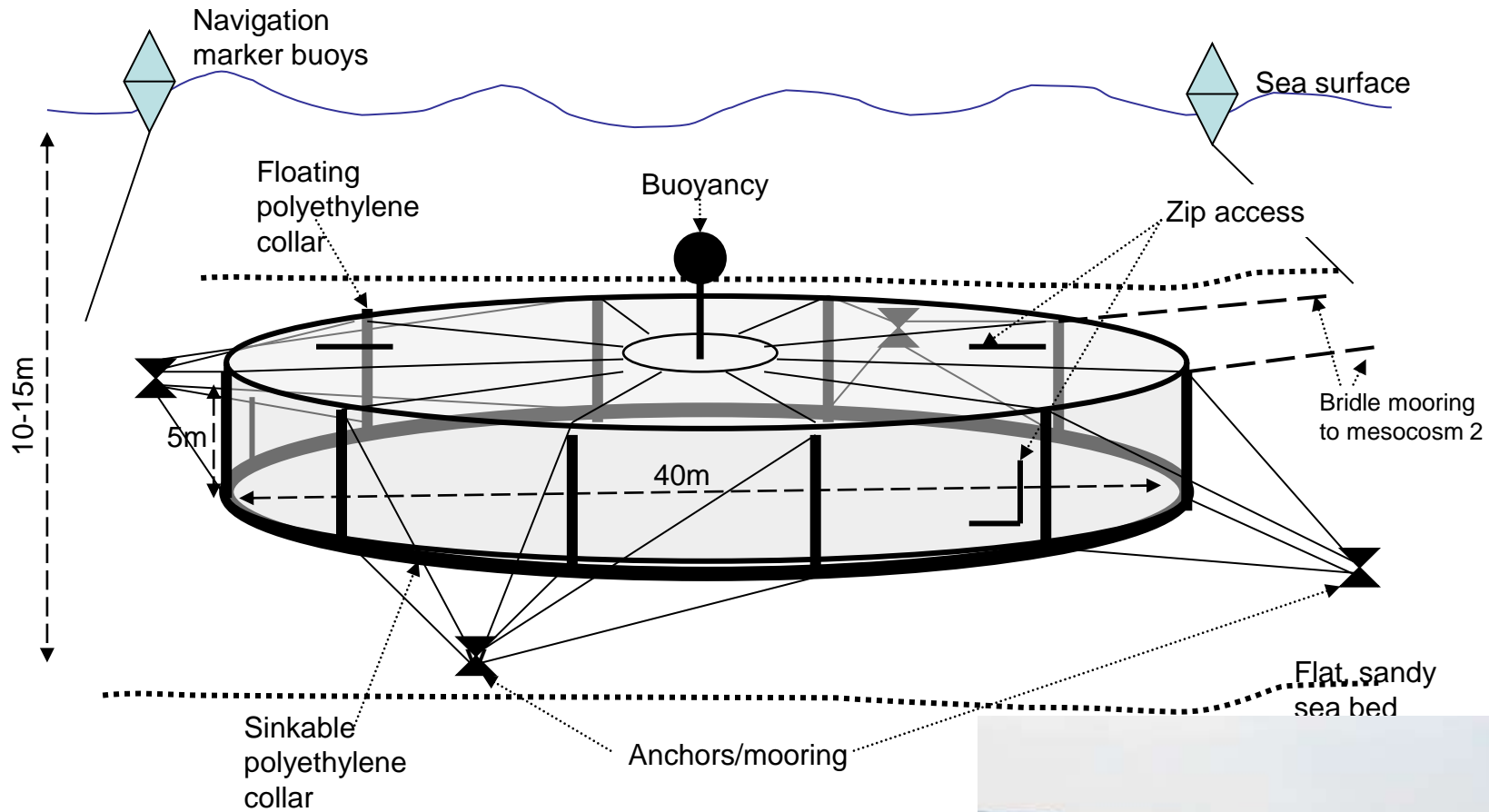
- Specific research question to answer (e.g.)
 - Q. Do electromagnetic sensitive fish respond to EMF emitted by offshore wind farm cables?
 - Q. Does pile driving affect the behaviour of marine fish
 - Mesocosm (large fish pen) based study
 - Focus on semi-realism but study control
 - Remote coastal site away from background EMF & noise
 - Relevant species with different attributes
 - Behavioural study with remote methods



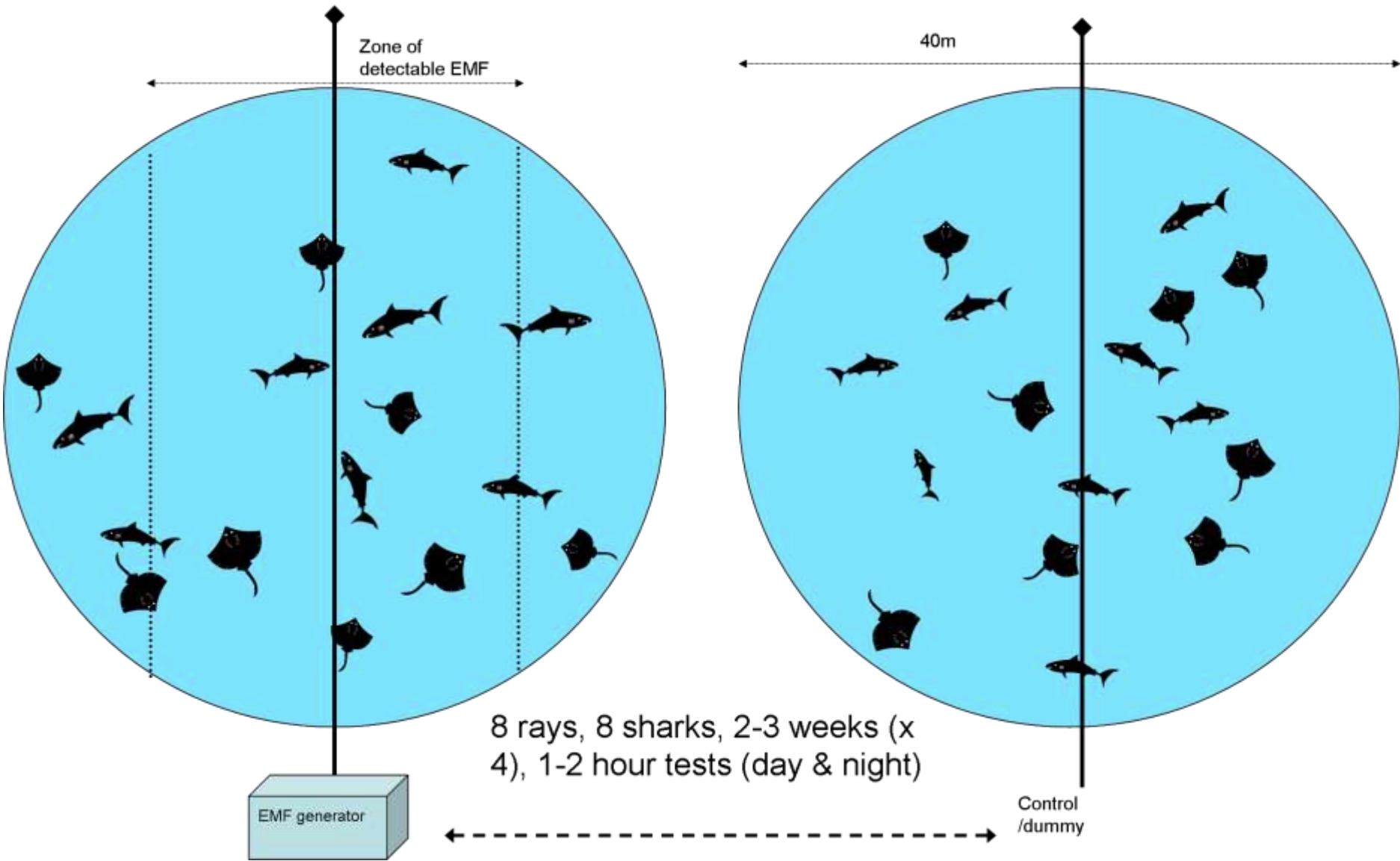
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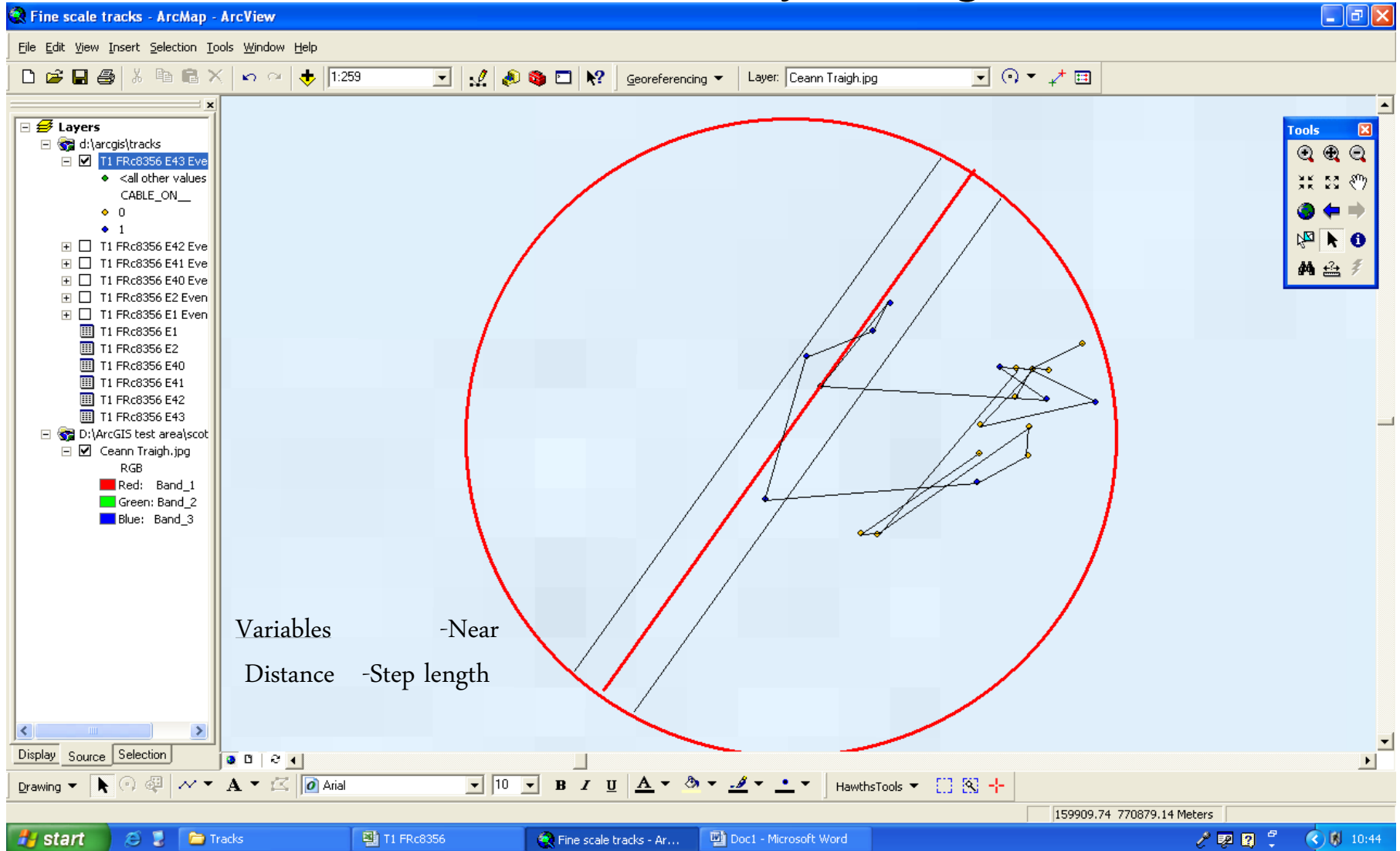
COWRIE Mesocosm studies



Note: not to scale

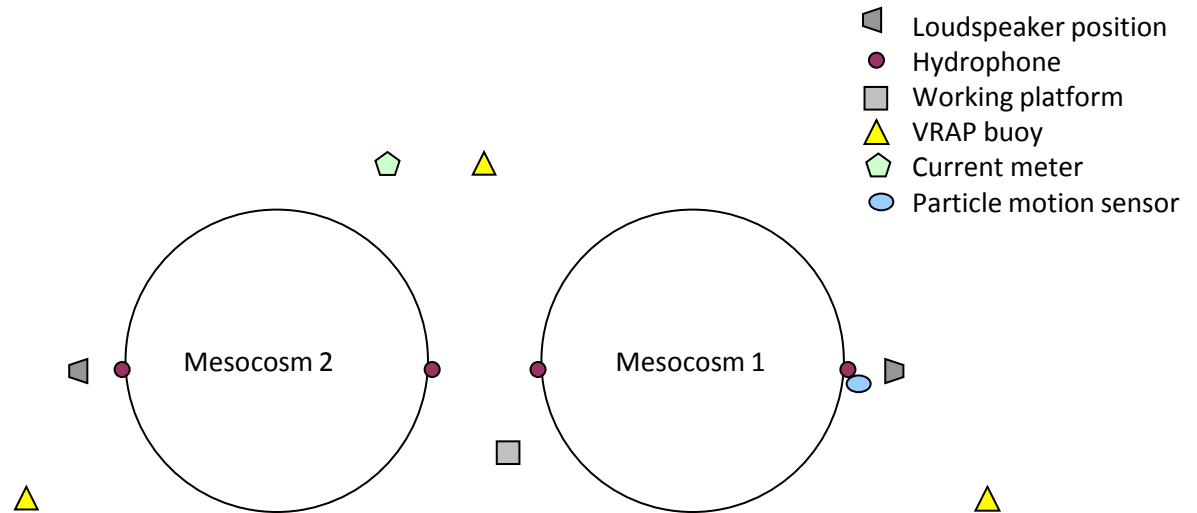
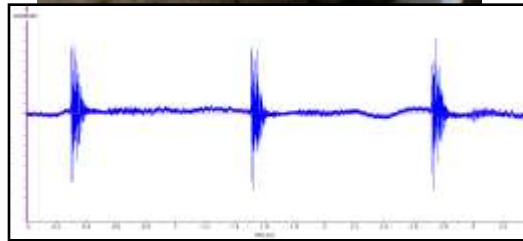


Fine scale movement of ray during 3 hour event



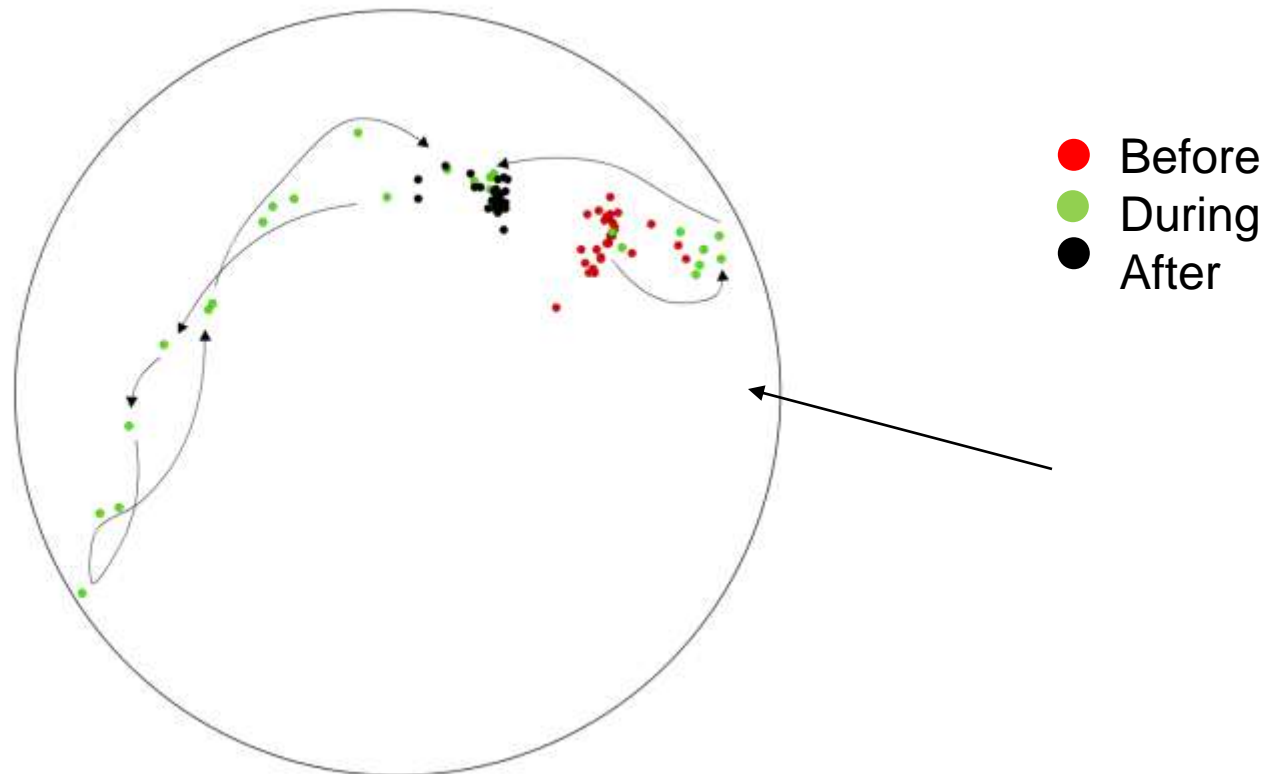
- Benthic catshark non-random distribution more likely in cable zone when energised.

Pile driving study



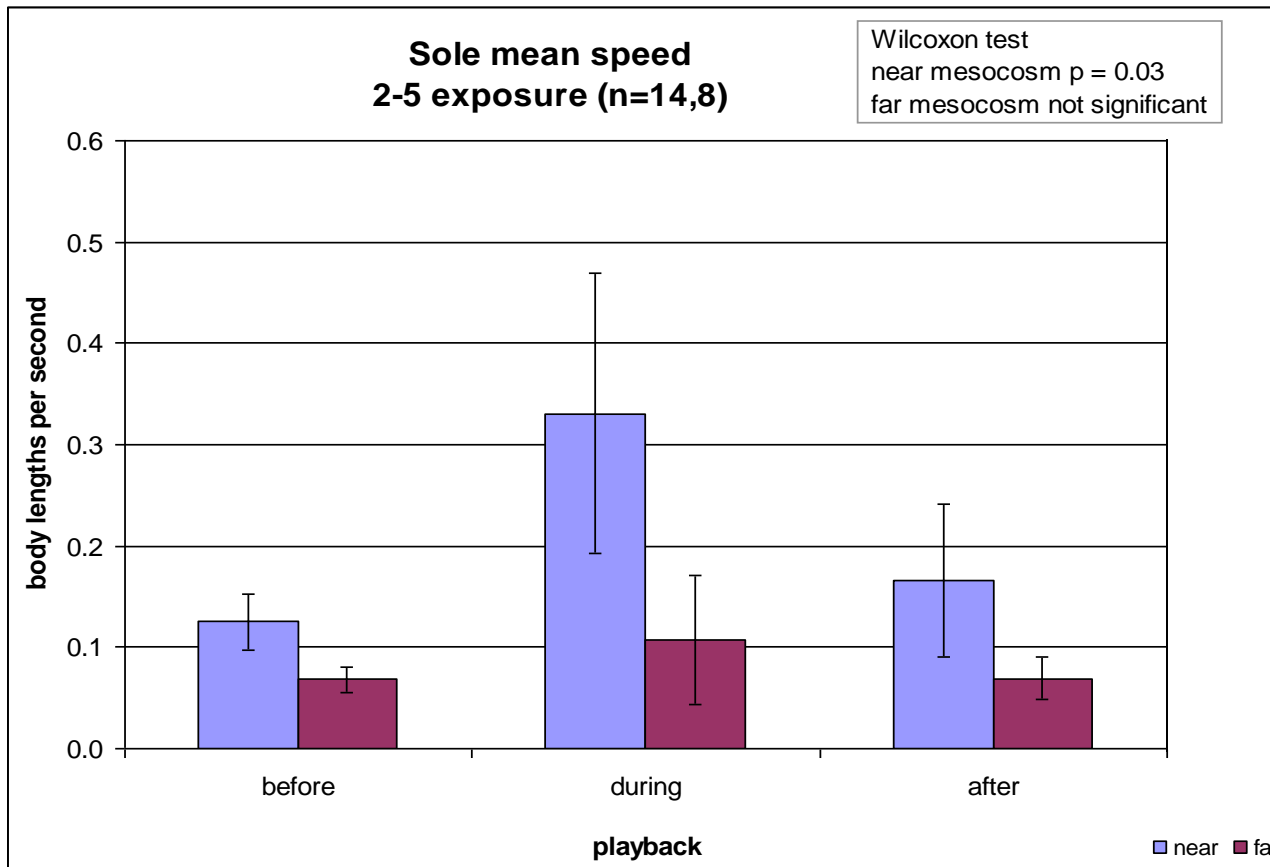
- High quality recordings from real pile driving collected by Itap (2006-2008)
- Playback left or right side (gradient) 20km received sound level
- Trial 10 min playback and 10 min pre- and post playback
- Trial with tagged fish in each mesocosm, 62 trials, 50 Individuals
- Recordings of position, speed and direction of movement of fish every 45-90 secs

Movement response



- ~ 50% of cod and 30% of sole showed movement response

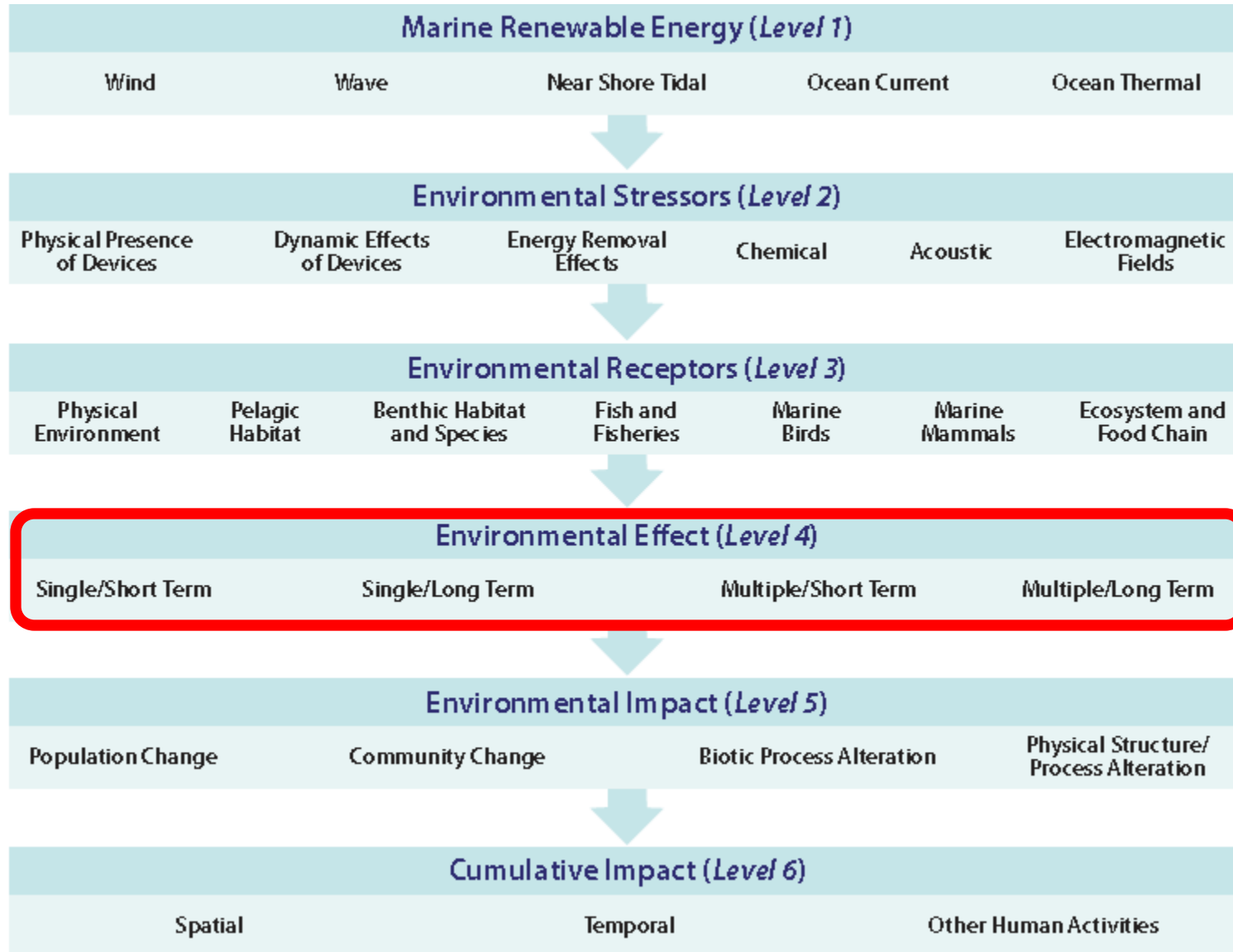
Swimming speed increase in sole



(RL = 144 – 156 dB re 1 μ Pa Peak 6.5×10^{-3} to 8.6×10^{-4} m/s² peak)

Environmental effects framework

(from Boehlert & Gill 2010)



Moving forward

- Investigating potential ecologically relevant interactions between marine organisms and offshore wind energy
- Baseline understanding of the organisms of interest
- Consider effects relating to different phases
 - Installation
 - Operation
 - Decommissioning
- Appropriate spatial scale
- Appropriate temporal scale
- Ecosystem level considerations
- Drivers landscape – policy (eg. EIA & MSFD in EU)
- Relevance to offshore industry, regulators, other stakeholders

Happy to talk further :

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<http://www.cranfield.ac.uk/sas/aboutus/staff/gilla.html>

