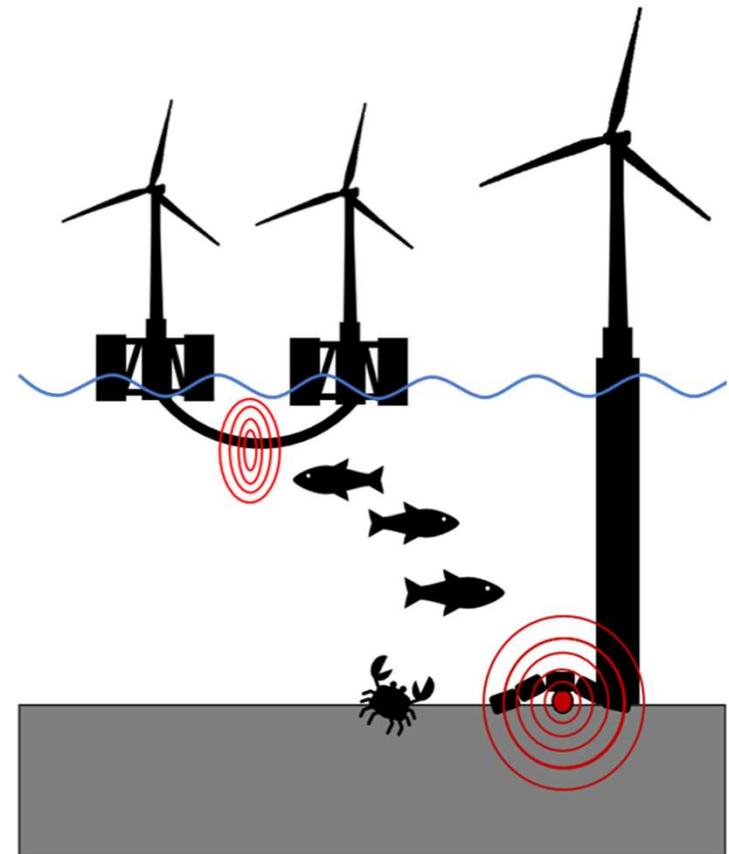


Electromagnetic fields from subsea power cables & potential effects on marine species

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Research Fellow



Electromagnetic fields from subsea power cables & potential effects on marine species

- What are electromagnetic fields (EMFs)?
- How do we characterize EMFs?
- Known EMF effects on marine life
- Methods used in assessments
- Advancing our understanding
- Broader offshore wind context

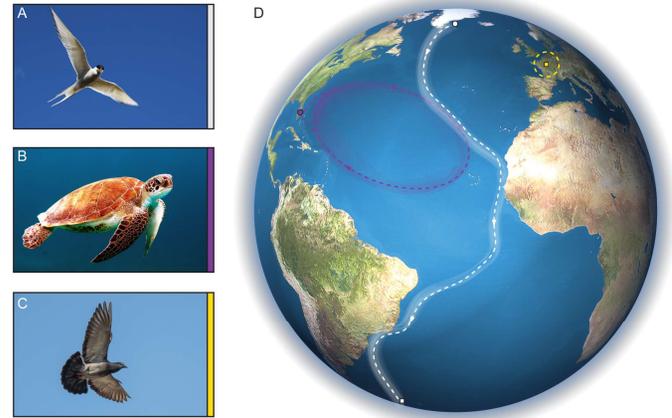
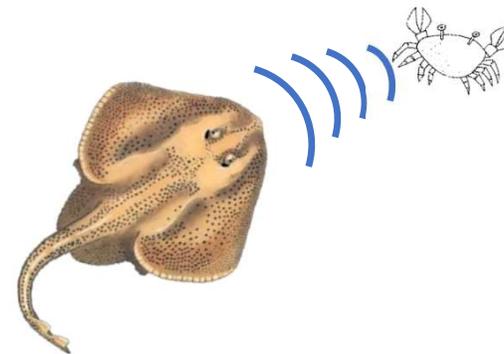
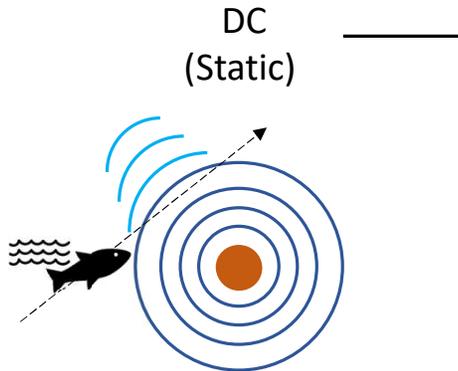


Image Source: Nordmann et al., 2017



What are Electromagnetic Fields?

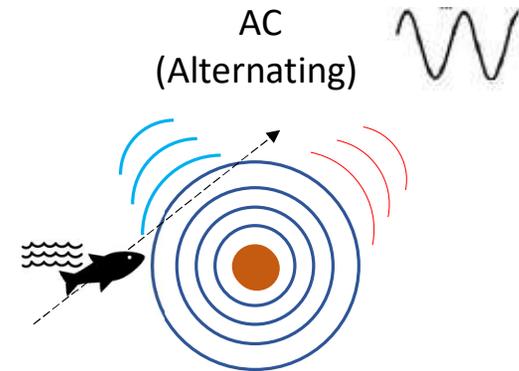
Two interacting components, electric and magnetic fields = electromagnetic fields



Electric field is
contained within
the cable
sheathing

Magnetic field (direct)

Motionally induced electric field

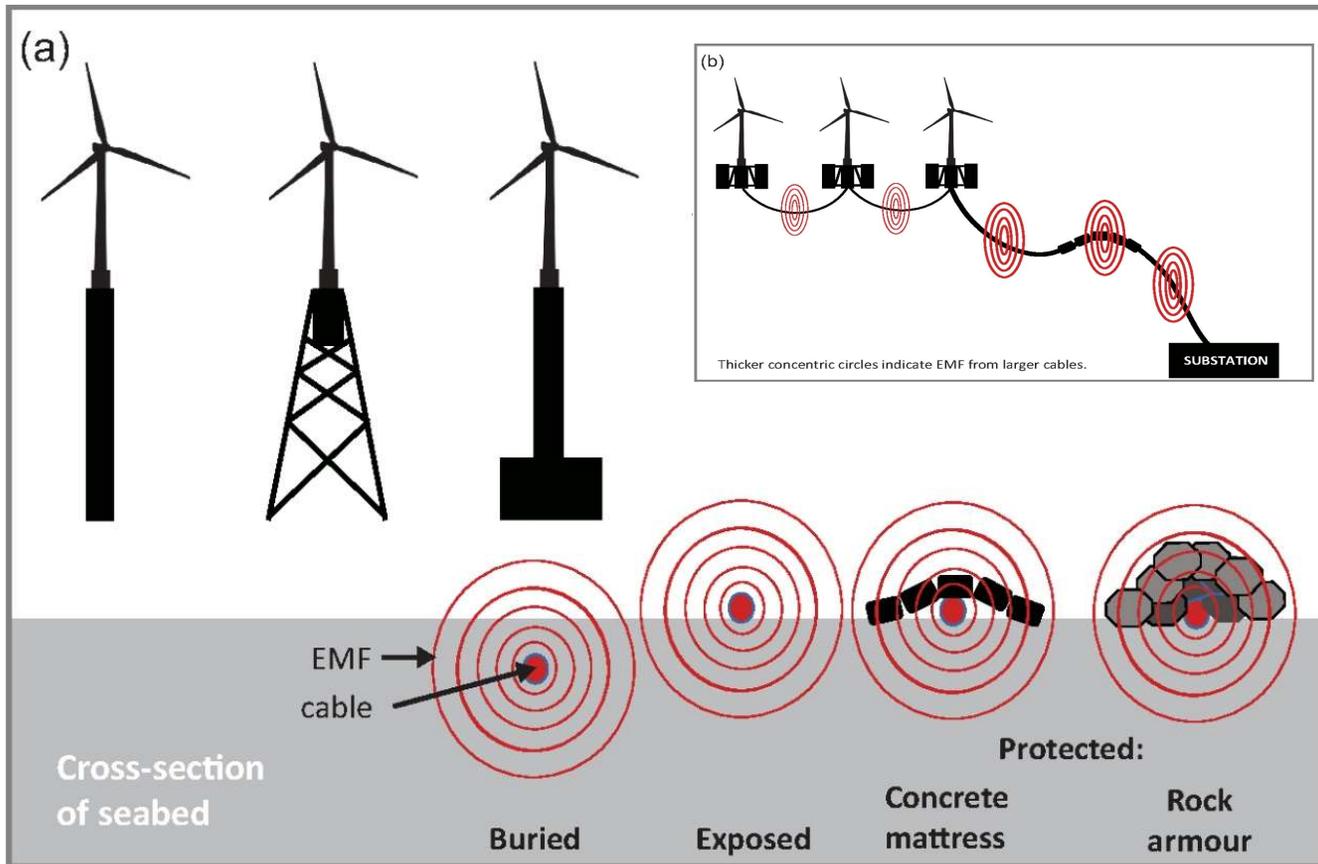


Magnetic field (direct)

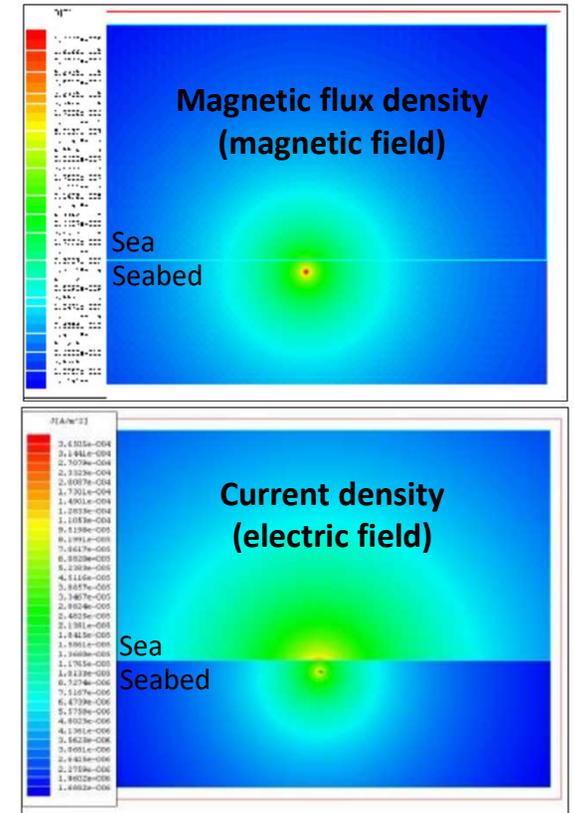
Induced electric field

Motionally induced electric field

What are Electromagnetic Fields?

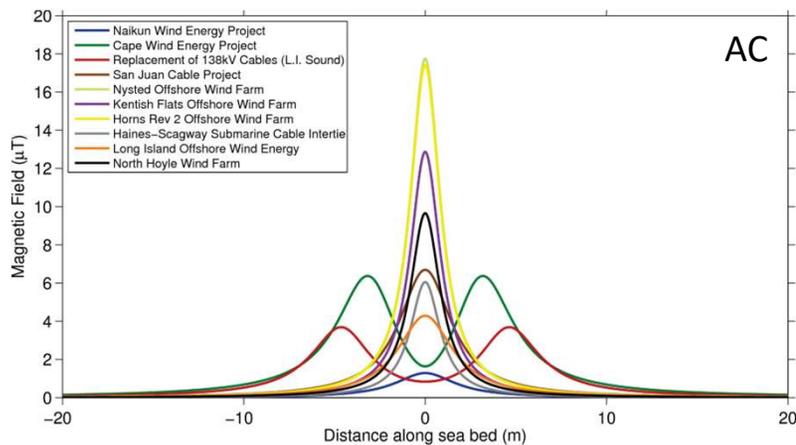
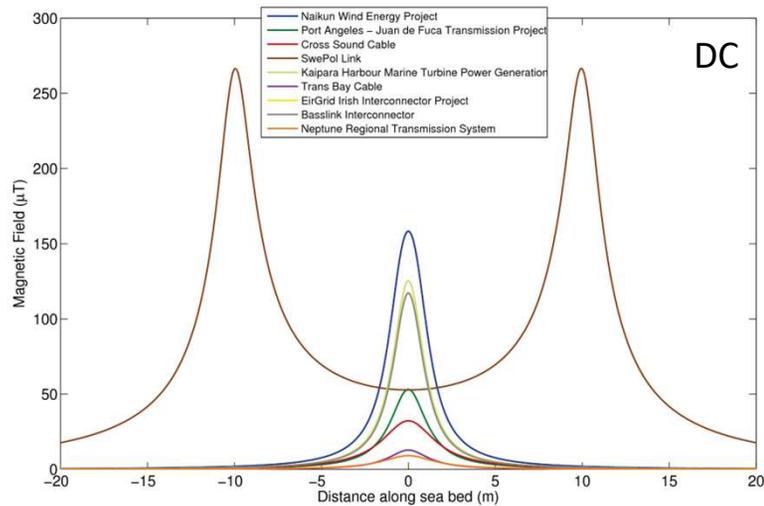


Adapted from Hutchison et al., 2020, *Oceanography*

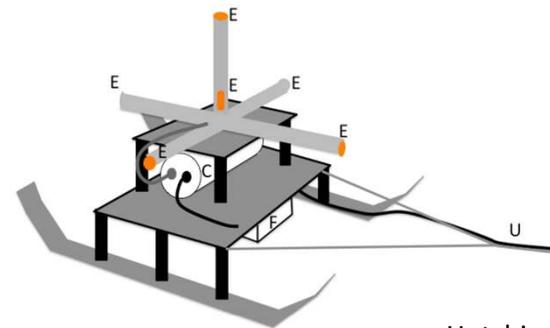


Adapted from CMACS, 2003; Gill et al., 2012, *IEEE*

How do we characterize EMFs?



- EMFs (magnetic fields) are usually modelled and rarely measured
- Modelled & measured EMF from the Cross Sound Cable (buried, 330MW, HVDC)
 - Power transmission
 - Variable burial depth
 - Interaction with the local geomagnetic field
 - AC fields as well as DC fields



Known EMF Effects on Marine Life



Stankevičiūtė et al., 2019
Jakubowska et al., 2019



Stankevičiūtė et al., 2019



Malagoli et al., 2004



Scott et al., 2018



Love et al., 2015, Love et al., 2017



Hutchison et al., 2020



Taormina et al., 2020

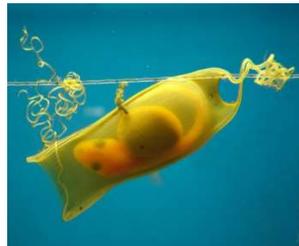
Known EMF Effects on Marine Life



Westerberg & Lagenfelt, 2008
Hutchison et al., forthcoming 2021



Wyman et al., 2018



Ball et al., 2016



Kimber et al., 2011, 2014



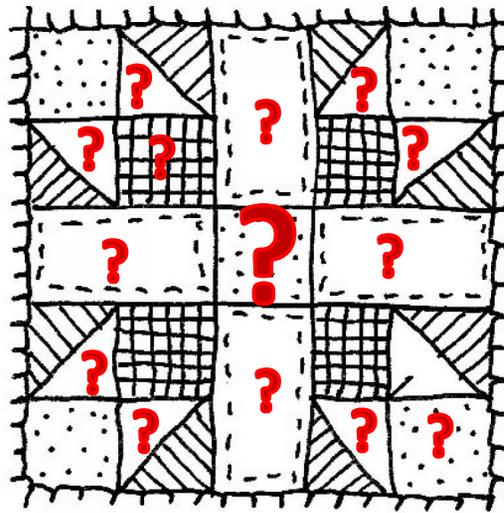
Gill et al., 2009
Hutchison et al., 2020

Variety of Methods

Numerous species & a variety of endpoints

Range of techniques

- In situ free-ranging
- In situ mesocosm
- Aquarium



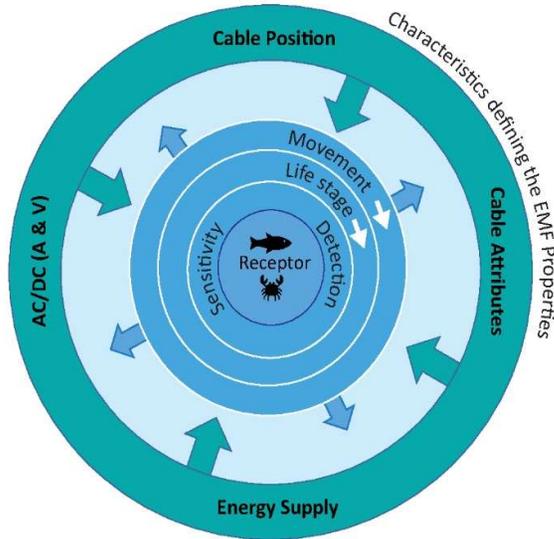
Range of exposures

- AC, DC
- Intensity
- Spatially variable
- Temporally variable

Key Importance: Relevance to Offshore Wind



Advancing our Understanding

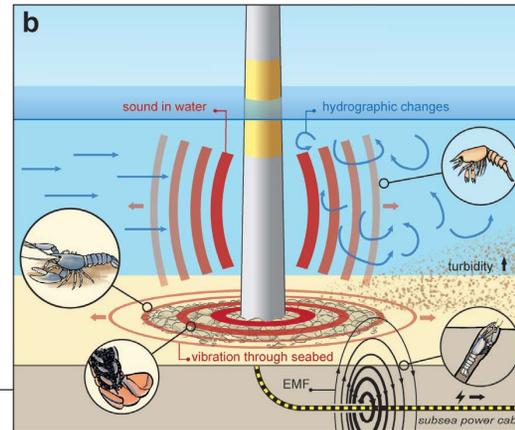
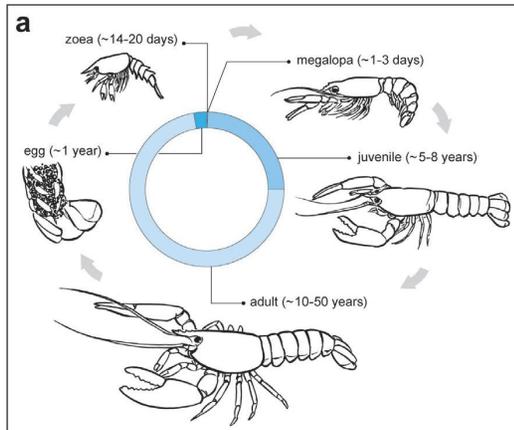


Take the vantage point of the receptive species

- Take their position in space and time
- Consider how they perceive their sensory environment
- Which cues are important at that time
- More informed by OSW cable characteristics

Adapted from Hutchison et al., 2020, Oceanography

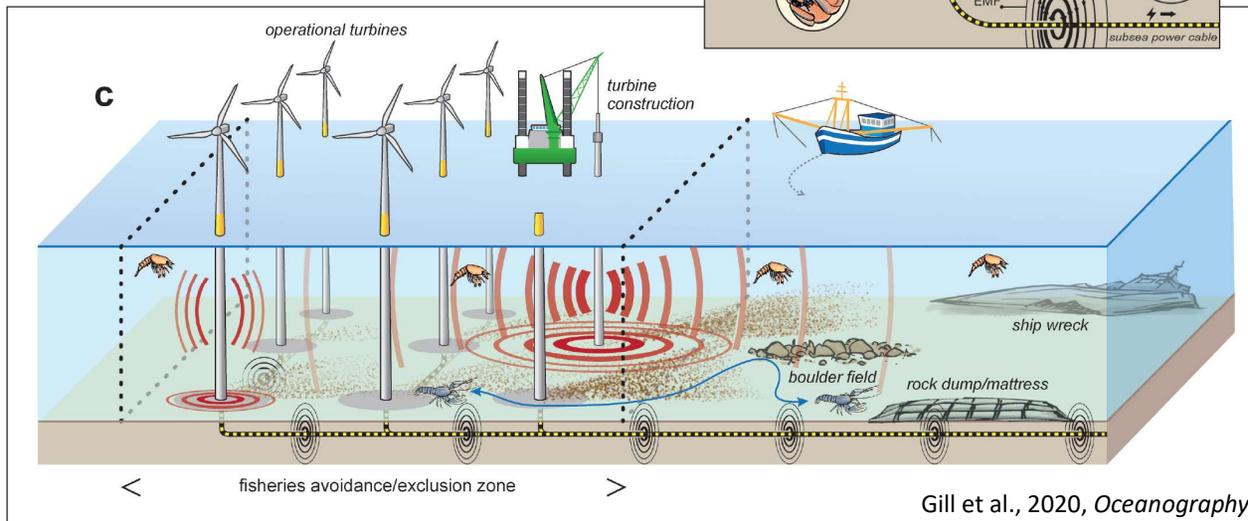
Broader Offshore Wind Context



Taormina et al., 2020 Mar. Environ. Res.



HDR, 2020, BOEM Report No. 2020-044



Gill et al., 2020, *Oceanography*

Resources of Interest

Reviews

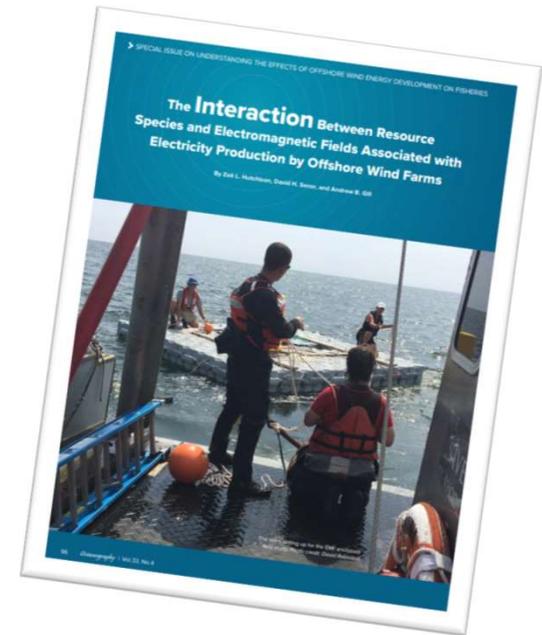
Hutchison, Z. L., D. H. Secor, and A. B. Gill. 2020a. The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. *Oceanography*, 33(4):96–107, <https://doi.org/10.5670/oceanog.2020.409>.

Gill, A. B., and M. Desender. 2020. Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices; Pp. 86–103. In *OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World*. A. E. Copping, and L. G. Hemery, eds, Report for Ocean Energy Systems (OES) <https://doi.org/10.2172/1633088>.

Studies on the Cross Sound Cable, Lobsters and Skates

Hutchison, Z. L., A. B. Gill, P. Sigray, H. He, and J. W. King. 2020b. Anthropogenic electromagnetic fields (EMF) influence the behaviour of bottom-dwelling marine species. *Scientific Reports*, 10(1):4219, <https://doi.org/10.1038/s41598-020-60793-x>.

Hutchison, Z. L., P. Sigray, H. He, A. B. Gill, J. King, and C. Gibson. 2018. Electromagnetic Field (EMF) Impacts on Elasmobranch (Shark, Rays, and Skates) and American Lobster Movement and Migration from Direct Current Cables. OCS Study BOEM 2018-003 pp. <https://espis.boem.gov/final%20reports/5659.pdf>



Thank you!

Acknowledgements

- ❖ John King, University of Rhode Island
- ❖ Andrew B Gill, Cefas, Pangalia
- ❖ Peter Sigray, KTH Royal Institute of Technology
- ❖ Haibo He, University of Rhode Island
- ❖ David H. Secor, University of Maryland
- ❖ BOEM as funders of previous work