

RESPONSEABLE

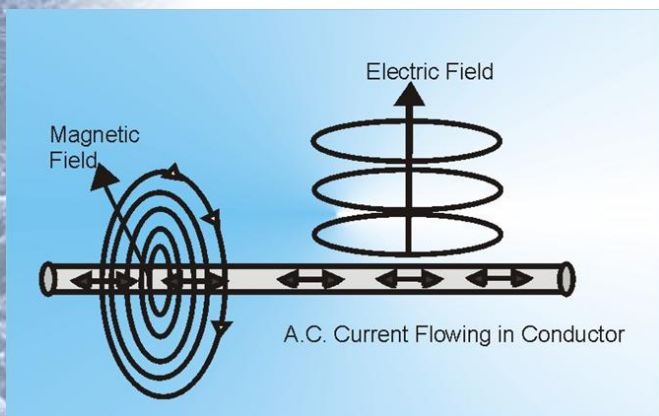
Disturbances

1. *Electromagnetic fields*
2. *Turbidity*
3. *Noise*



1. ELECTROMAGNETIC FIELDS

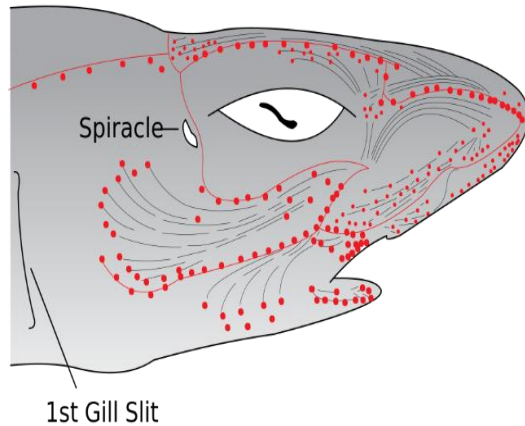
- Naturally occurring EMFS:
 - Geomagnetic fields (earth)
 - Bioelectric fields (organisms)
- Unnatural EMFS:
 - Physical field produced by electrically charged objects



- New kid on the block...
- Entering in EIA's
- **Science is scarce/patchy**

1. ECOLOGICAL IMPACT ELECTROMAGNETIC FIELDS

Electro-receptive sensory
systems



Small-spotted Catshark



Atlantic Salmon



Bottle Nose Dolphin.
I.P. Magnetism



Thornback Ray

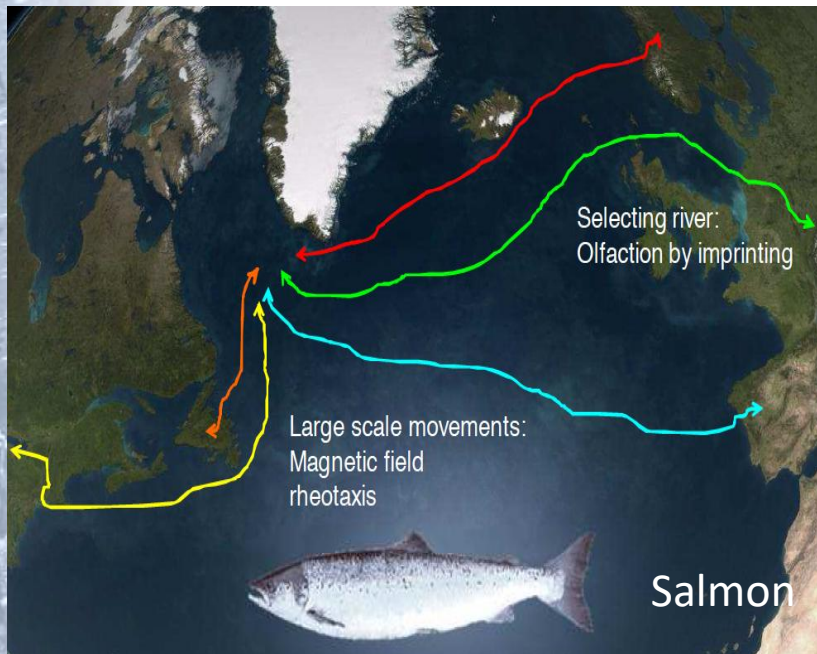


ELECTRO-RECEPTION USES

- Electro location *PREY, NAVIGATION*
- Electro communication *FINDING MATE*
- Particularly in murky waters

Magneto-reception used for:

- Navigation



SHARK ATTACKS

Google will coat it's trans-pacific fiber-optic cables in a Kevlar-like material

future tense THE CITIZEN'S GUIDE TO THE FUTURE AUG. 15 2014 3:23 PM

The Global Internet Is Being Attacked by Sharks, Google Confirms

By Will Oremus



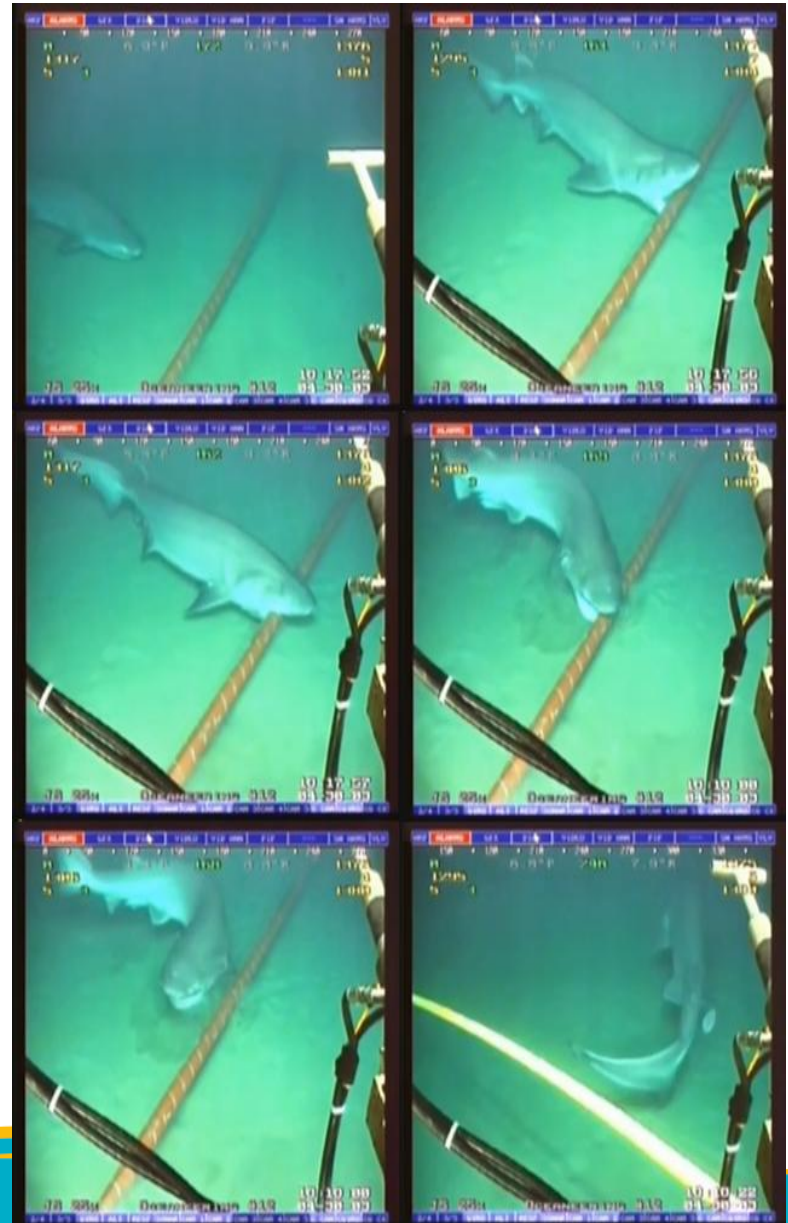
35.7k

55



Sharks' attraction to undersea fiber-optic cables has been well-documented over the years.

Screenshot / YouTube



POTENTIAL EFFECTS

- Waste energy hunting
- Barrier effects (affecting natural movement/behaviour)
- Disrupt navigation



Atlantic Salmon



Cuckoo Ray



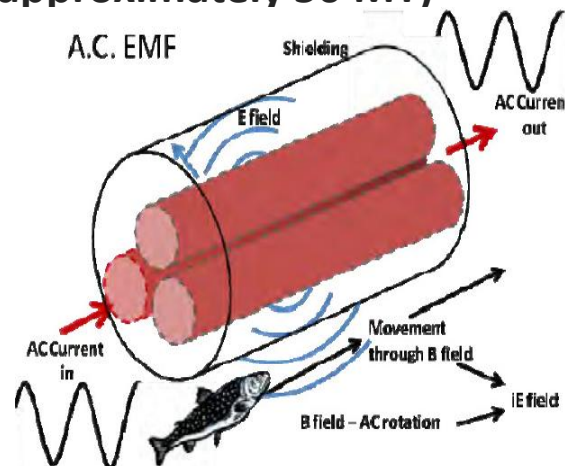
Small-spotted Catshark



Basking shark

EOWDC-Project

- Sharks = Most sensitive ($\mu\text{V}/\text{CM}$)
- Electric cables coated \rightarrow Ensures that electric fields are contained within the cable
- Magnetic fields EOWDC are small (1.5 MT) compared to magnetic field of the earth (approximately 50 MT)



Conclusions:

- Potential for impacts
- Field tests have been inconclusive
- Recognize need for improved understanding

RESPONSEABLE

2. Turbidity



2. TURBIDITY

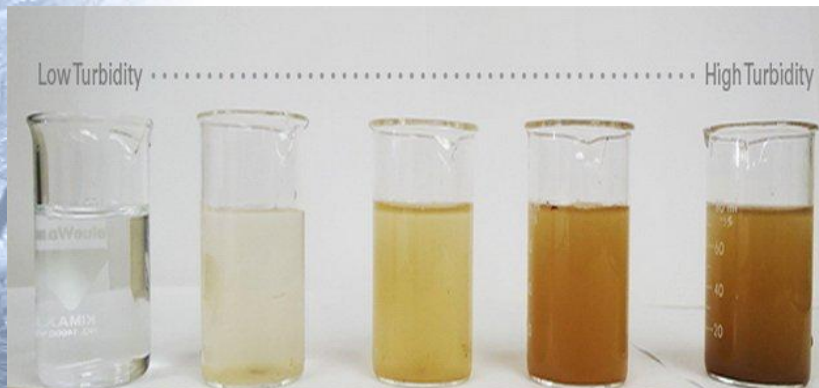
Decrease in light and visibility by suspended materials



Most turbidity risks with respect to offshore wind farms are construction related, but the existence of a wind farm may cause turbidity increase as well.

HOW CLEAR IS THE WATER?

Measured with SECCHI disk or Nephelometer.



Clay 0.004 mm
sand 1.0 mm

Expressed in NTU
(Nephelometric Turbidity Unit)

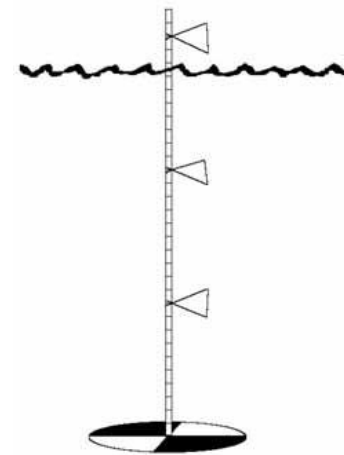


Photo credits: Eshan Mousavi; www.BeeldbankVenW.nl, Rijkswaterstaat/North Sea Foundation

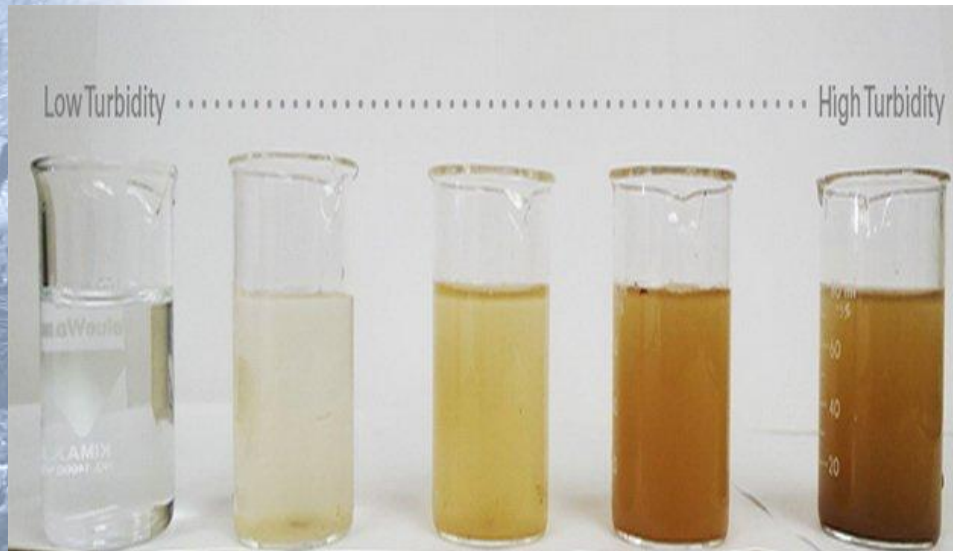
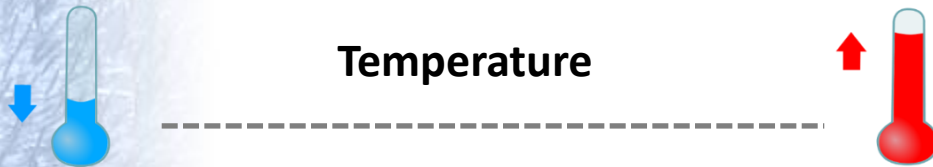


Primary production

Oxygen & Sugar

Productivity

POTENTIAL EFFECTS IN WATER



Bacteria



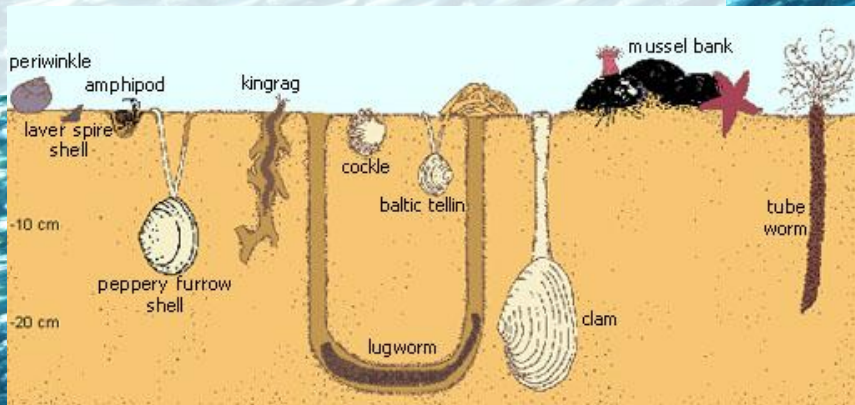
Oxygen shortage



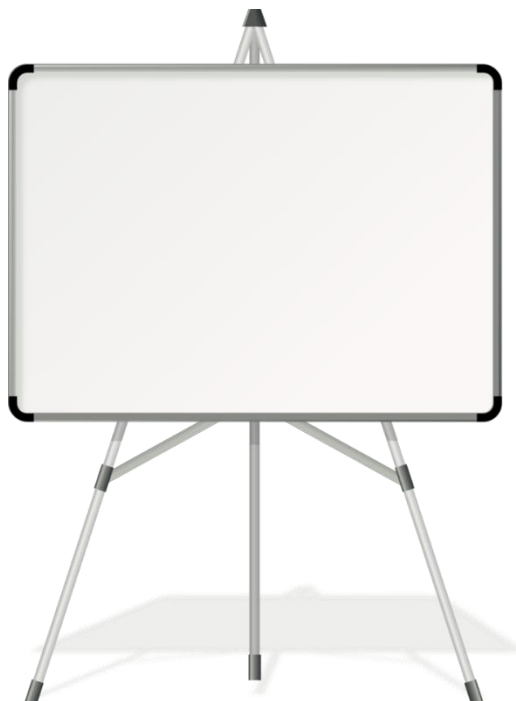
Photo credits: Eshan Mousavi

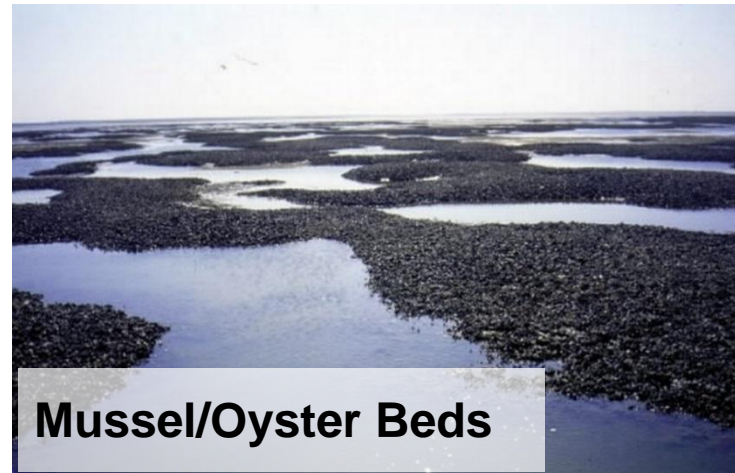
EFFECTS MARINE LIFE:

- **Clogging gills**
- **Diseases**
- **Growth Adults/Larvae/Eggs**
- **Affecting behaviour** Finding prey
- **Smothering** benthic life



Which **sites** are at highest risk for impacts of turbidity?





Get clogged

Food: sediment ration

Which **time in the year** is at highest risk for impacts of turbidity?



RESPONSEABLE

3. Noise



1. NOISE

Sound is as important for marine life as sight/light is for us

- Sight is limited
- Sound goes **faster** and **further**

Most important sense !



USE OF SOUND

- Communicate
- Reproduce
- Navigate



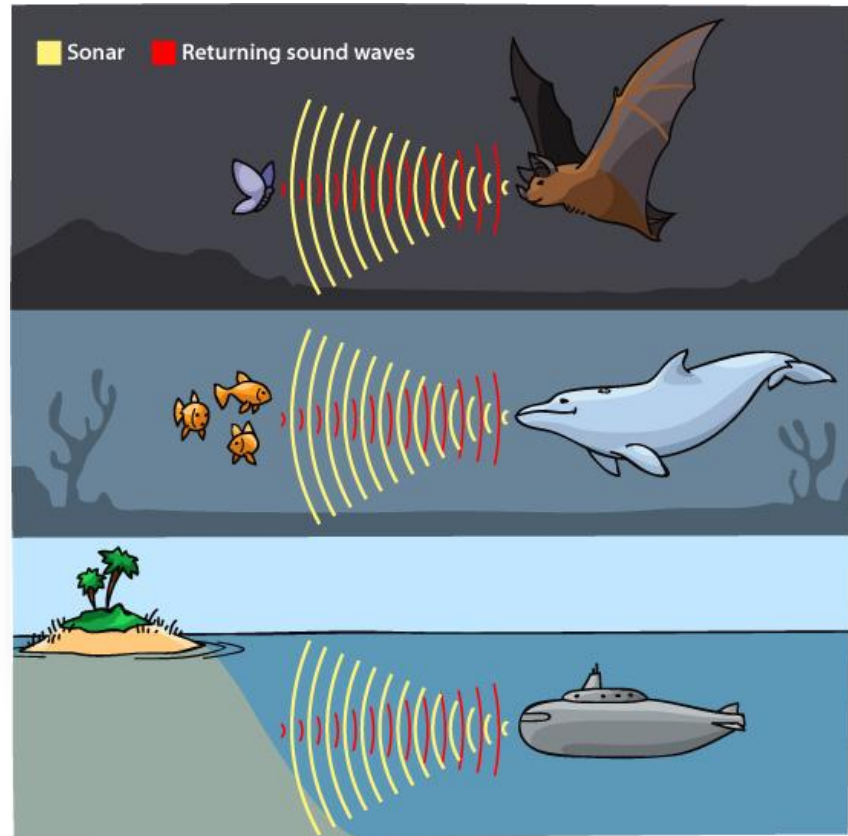
SEA MAMMALS

Cooperate

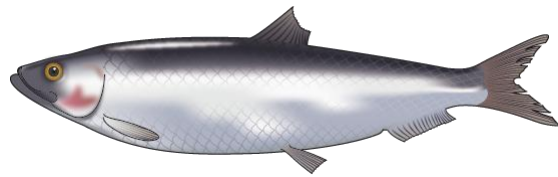


Echolocate

Food & Navigation



Communication – Finding food



EFFECTS



- Change in behaviour
 - Collision with ships
 - Beaching
- Damage
 - Background noise
 - Disco effect / Threshold shift
 - Overlapping frequency
 - Mist effect / masking



SHIPPING



- Cavitation
- Busy: Doubling of noise levels, every 10 years (for the last 60)
- Larger, louder & **lower frequency**

SHIPPING

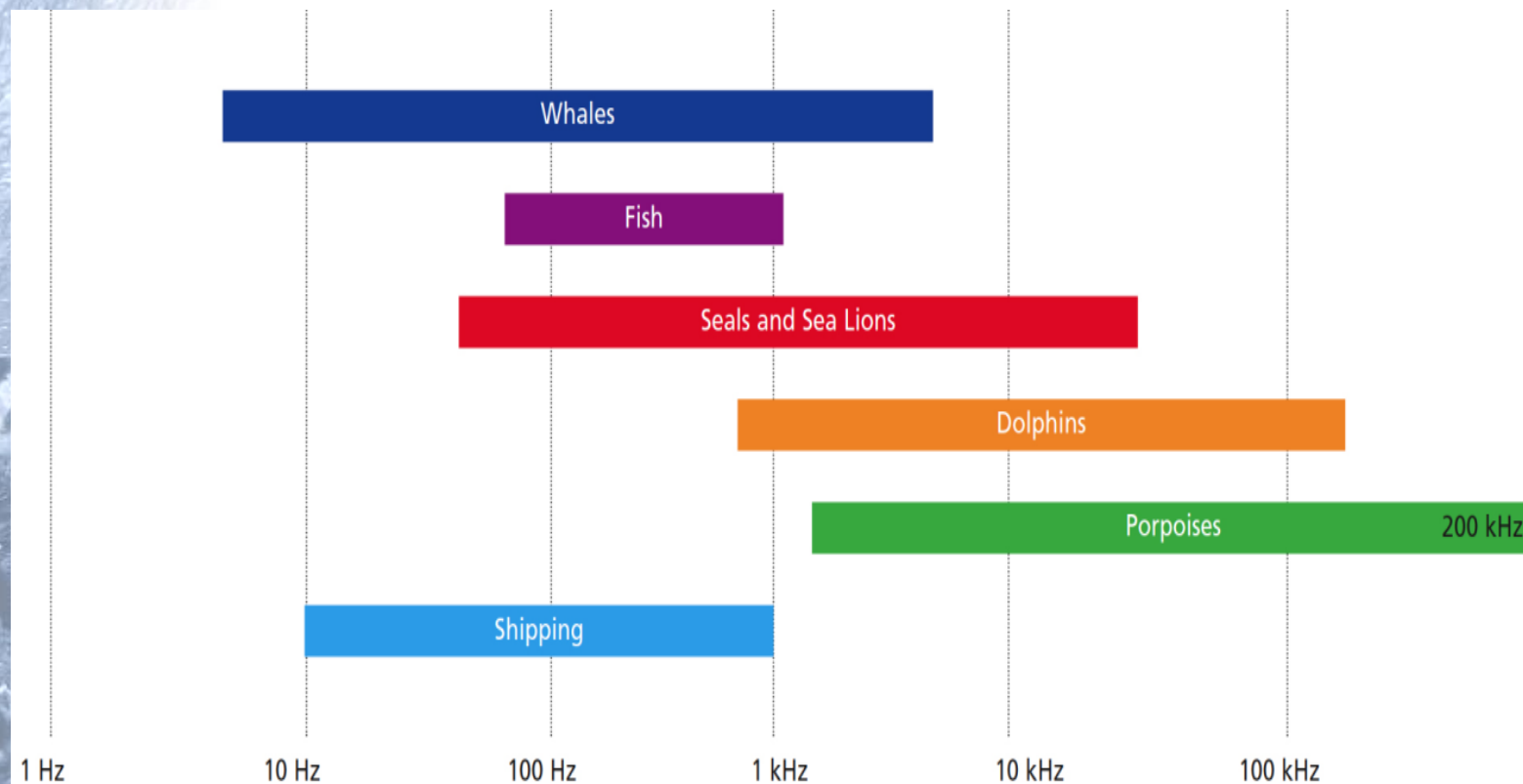


Illustration credits: NOAA

DREDGING



TRANSPORT

Strong and continuous sound



EXCAVATION

**Influenced by soil properties
Sometimes explosives and
hammering**



**MATERIAL
PLACEMENT**

**Regular rumbling sound,
Low frequency,
Fairly constant and continuous**

DREDGING



TRANSPORT



EXCAVATION



**MATERIAL
PLACEMENT**

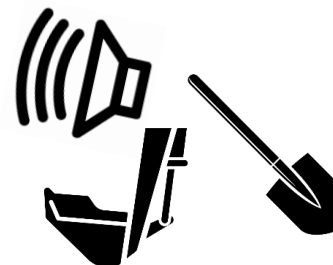
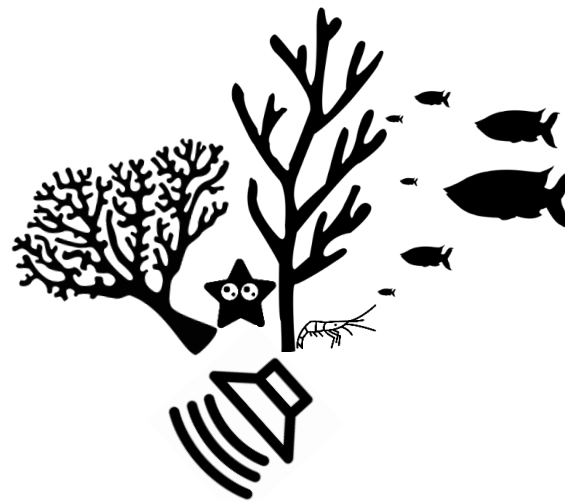
- **Damage**
- **Background noise**
- **Overlapping frequency**
- **Change in behaviour**
- **Navigation of reef fish larvae**



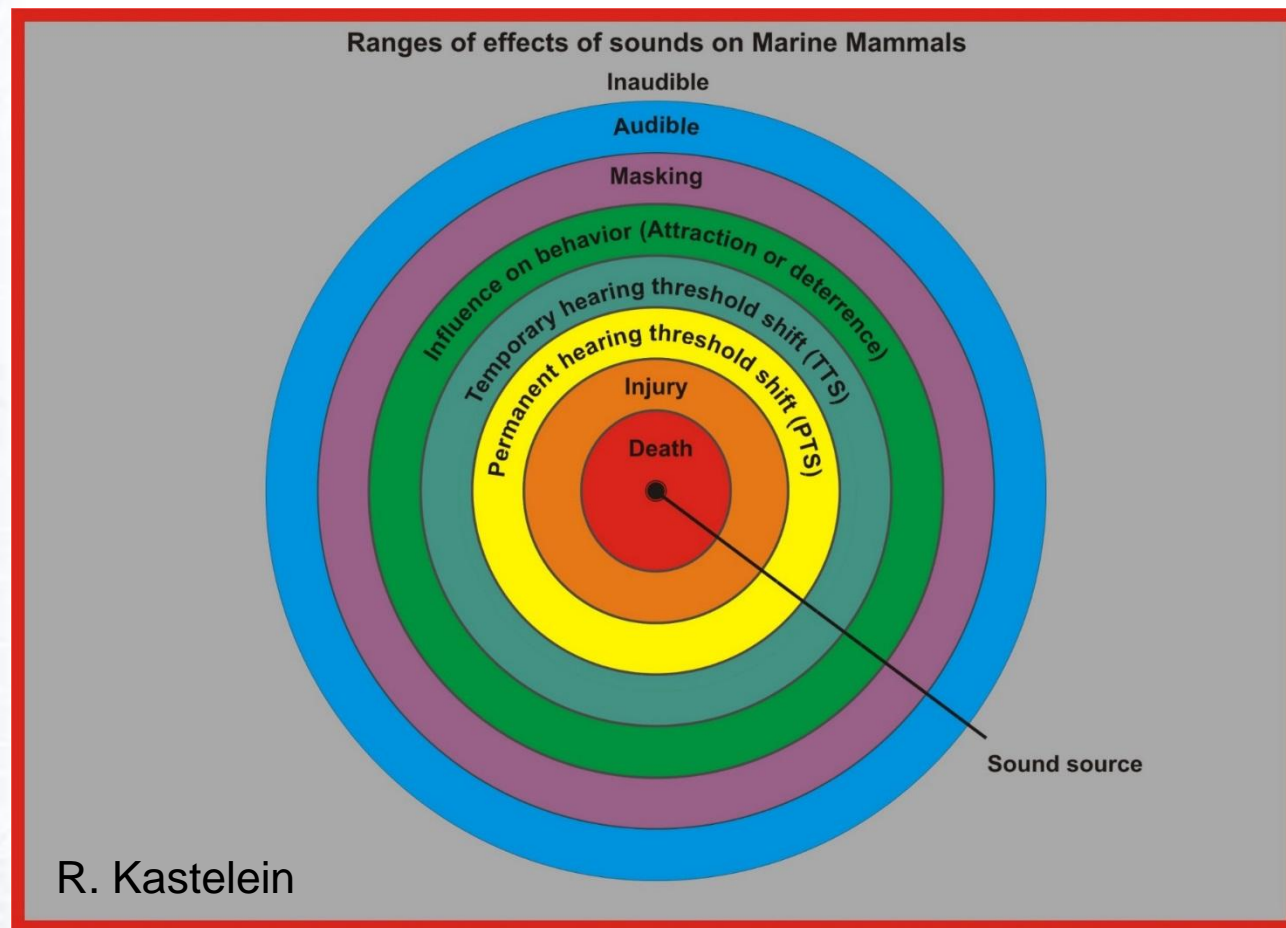
EXCAVATION



MATERIAL
PLACEMENT



PILING



PILING



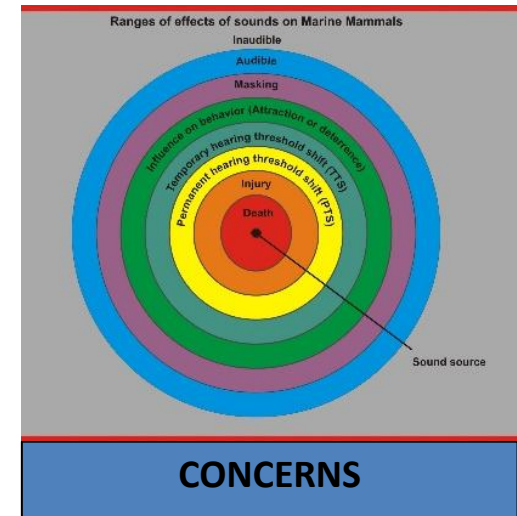
ISSUE

- Serious noise!
- Enormous sound levels
- Piles bigger and bigger
- Offshore wind ambitions



SOLUTIONS

- Better understanding/research
- Timing
- Ramping up/MMO's
- Bubble screens
- Driving or gravity base foundations
- Suction bucket jacket SUCTION BUCKET JACKET



- Death/injury
- Disturbance, Hindrance
- Expulsion: population effects

CONCLUSIONS NOISE

- Understand the location
 - Regulation/Hazid
 - Baseline study (Seabed, Hydrography, sensitivities)
 - EIA
- Selection of technology
- Technical measures (curtains)
- Monitoring, Modelling
- **Timing!!**



Photo credits: www.BeeldbankVenW.nl, Rijkswaterstaat/North Sea Foundation

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Thank You



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