Explosive use: impacts to marine wildlife and mitigation

Yolanda Arjona

Senior MPA management advisor, Marine management Team

EMAIL: Sarah.canning@jncc.gov.uk

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Explosives use in the marine environment

- Explosives provide a high energy power source that is productive for cutting.
- Uses include:
  - Wreck removal, anchor chain removal;
  - Well perforation;
  - O&G decommissioning e.g. well abandonment; pile cutting, manifold removal, protective structure removal;
  - Unexploded ordnance (UXO) clearance.

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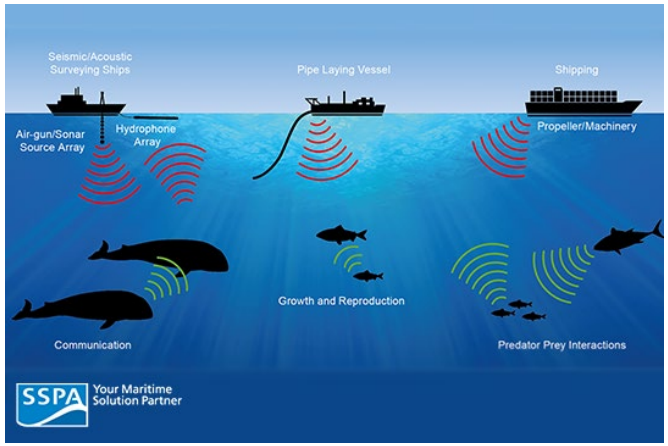
Underwater Noise: why do we care?

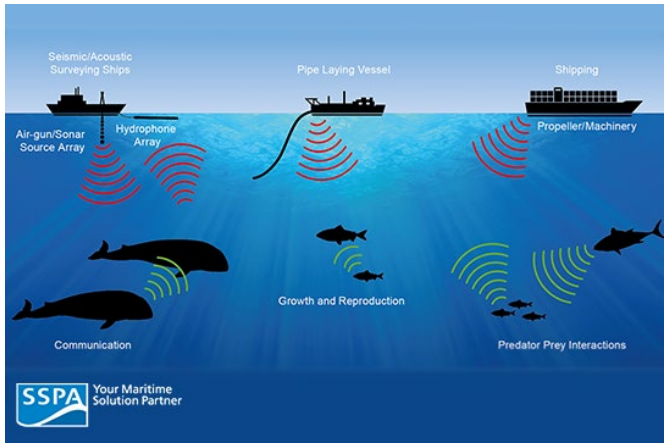


- Marine animals use sound to navigate, communicate, find food, locate mates and avoid predators.
- Flooding marine environment with sound interferes with these activities.
- Man-made noise levels increasing, doubling in some areas in the past 60 years.

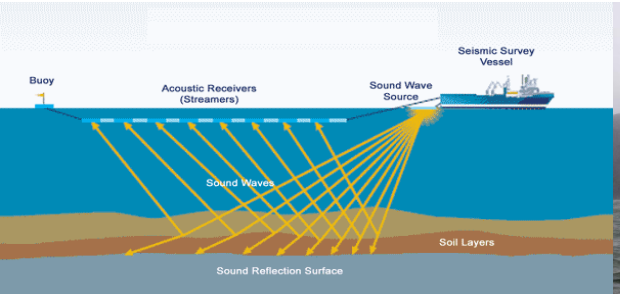




Underwater Noise: common sources



- Natural: breaking waves, rain, marine life.
- Man-made: vessel traffic, sonar, **explosives**, drilling, piling, geophysical surveys/seismic.
- A growing body of scientific research confirms man-made noise can induce range of adverse effects in marine mammals, fish and other ocean species.



Legal drivers

- Council directive 92/43/EEC = Habitats Directive
- Transposed into UK law via several regulations including:

  - Conservation of Offshore Marine Habitats and Species Regulations 2017
  - Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (amended 2007)

- Protects European Protected Species (EPS) throughout their natural range from deliberate capture, killing & disturbance (Annex IV)

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Potential impacts: marine mammals

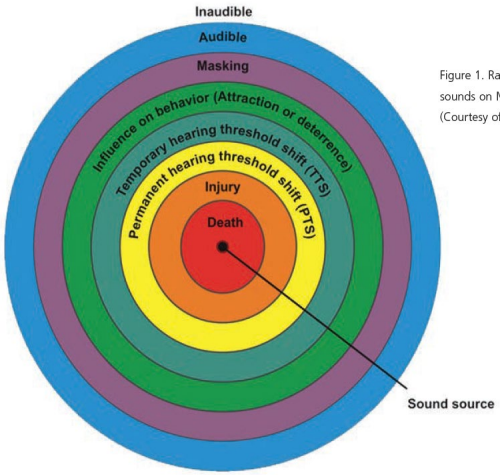
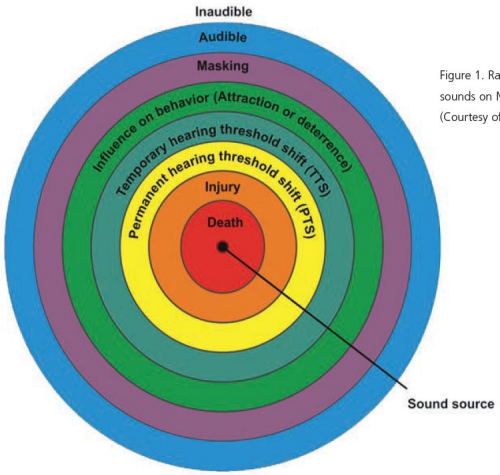


Figure 1. Ranges of effects of sounds on Marine Mammals (Courtesy of SEAMARCO).

- Can result in:
  - Stranding/death:
    - Determining the cause of a stranding or death of a stranded animal can be difficult;
    - Only very few strandings have been attributed to sound.
  - Hearing damage/loss:
    - exposure can result in temporary or permanent hearing loss, referred to as threshold shift (TTS/PTS);
    - In UK, injury defined as PTS (SNCB EPS guidance 2010).

Potential impacts: marine mammals



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- Can also result in:
  - Behavioural changes
    - varies with individual, species and circumstances;
    - can result in avoidance of key areas.
  - Masking
    - inability to perceive a sound e.g. mating calls, approaching preditors or prey;
    - uncertainties how affect marine mammals.

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Potential impacts: fish & invertebrates

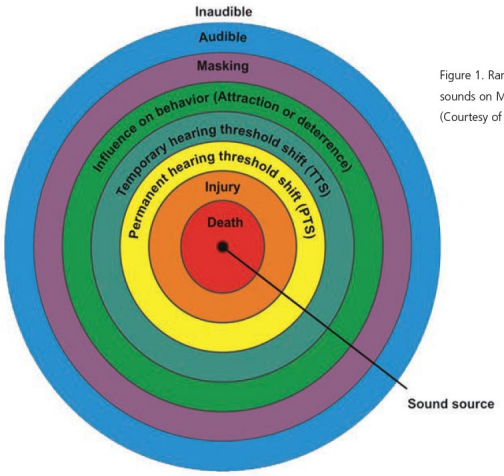


Figure 1. Ranges of effects of sounds on Marine Mammals (Courtesy of SEAMARCO).

- Fish can be categorised based on hearing ability:
  - Hearing specialists: mechanical coupling between the swim bladder and inner ear
    - Includes herring, sprat & pilchards.
  - Hearing generalist: particle motion via the otolith
    - Includes whiting, cod, plaice & elasmobranchs.

Potential impacts: fish & invertebrates

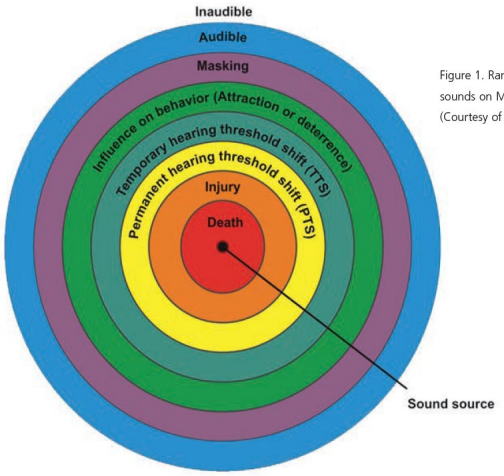
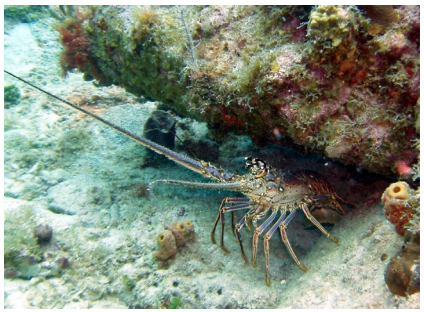


Figure 1. Ranges of effects of sounds on Marine Mammals (Courtesy of SEAMARCO).

- Sounds produced generally associated with reproduction (courtship/spawning), defence of territories, or stressful situations.
- Impacts include behavioural changes, masking, death, tissue damage or injuries that make individuals more vulnerable.



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Mitigation

- All cases considered on case-by-case basis.
- Noise modelling can predict potential injury ranges and help determine appropriate mitigation.
- General considerations when planning include :
  - Alternative methods e.g. quieter;
  - Use lowest volume explosive/sound level practical;
  - Avoid sensitive periods or seasons e.g. breeding/spawning;
  - Include mitigation into activity design.

Mitigation

- Marine mammals:
  - JNCC mitigation guidelines;
    - pre-activity search of pre-defined area for set period of time;
    - delay if animals observed within mitigation zone (MMO/PAM).
- Marine mammals & fish:
  - Acoustic deterrents;
  - Noise abatement systems e.g. bubble curtains, resonators, casings & cofferdams;
  - Soft start.

Improvements in explosive use in marine environment

- Include:
  - better optimisation of charge size needed for a given application;
  - availability of tools to better assess environmental effects including better prediction of:
    - Critical distances/volumes for fish-kill, marine mammal injury and behavioural changes;
    - Appropriate mitigation zones;
    - Establishing safe stand-offs.
  - improved mitigation options.

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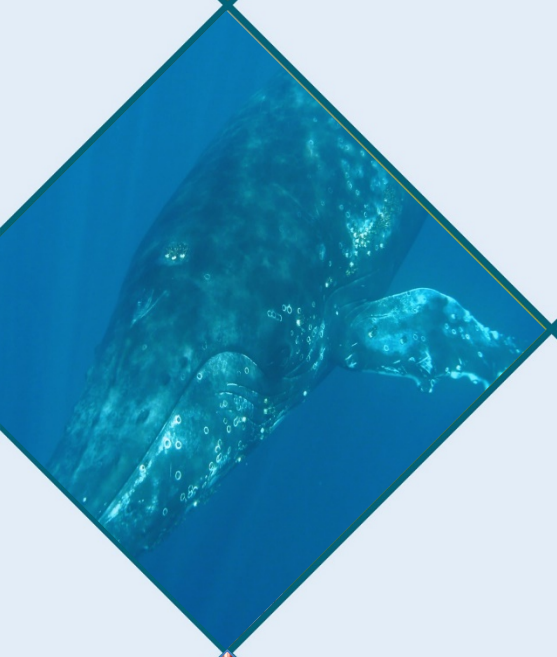
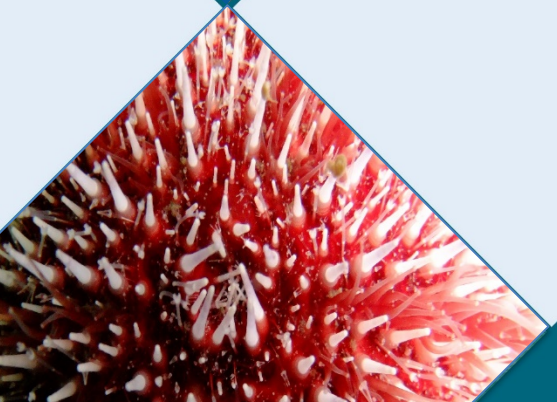
Future/ongoing JNCC work

- JNCC:
  - Update explosive/piling mitigation guidelines;
  - Develop PAM guidance for use during mitigation;
  - Reviewing MMO course content and potential requirements for PAM training.
- Characterisation of acoustic fields generated by UXO removal
  - funded by BEIS & Industrial Strategy under the SEA Programme.
- Abatement of noise from pile-driving and explosions workshop
  - London, 12 November 2019, NPL/Cefas.



Questions:
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