The European Commission's science and knowledge service

Joint Research Centre

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The Challenges of Unexploded Munitions – Brussels, 20 February 2019

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Munitions in the marine environment

Unexploded munitions containing explosives and warfare agents are known to be present in the marine environment

- ***Baltic Sea***
- ***North Sea***
- ***Adriatic Sea***
- ***Potentially other areas…***

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Adverse effects of munition constituents

Munition chemical constituents (MC) are known to have adverse effects

- **Cytotoxic, genotoxic, and carcinogenic effects**
- **Acute toxicity in the environment is unlikely (dilution)**
- **Potential sublethal genetic and metabolic effects in aquatic organisms**
- **Corroded munitions may act as hard substrate habitat for organisms**

Significant knowledge gaps regarding MC persistence, bioaccumulation and environmental impacts on the marine environment

Potential to release chemical munition constituents

Corrosion of munition housings and release of MC

- Release rates are expected to increase in 21st Century (Baltic)
- Chemical munitions dumped in the Baltic following WWII have corroded by 70-100%
- Munitions in the Bornholm Basin found "completely corroded"
- Extensive corrosion in munition on the seafloor in the Adriatic Sea
- Significant to severe degree of corrosion found in 95% of submerged WWII-era munitions analyzed in Hawaii

Evidence of environmental occurrence and impacts

Substances can be found in seawater, sediments and biota

Examples:

- **Measurements of arsenic-containing compounds in the Gdansk Deep**
- **Elevated levels of As and Hg in fish tissues near a dumping site in the Southern Adriatic Sea**
- **Mustard agent compounds detected in sediments near chemical munition dumpsites in Skaggerak basin**
- **TNT and its breakdown products detected in close vicinity of the munitions in Halifax (Canada)**

Potential environmental impacts of underwater unexploded ammunition

The risk of chemical release remains uncertain

- **Location, quantity, identity not yet understood**
- **Challenging analytical quantification of MC**
- **Uncertainty in the environmental processes that influence the release and fate of MC in the marine environment (dissolution, degradation to toxic products, uptake by aquatic biota, toxicity…)**

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The EU Marine Strategy Framework Directive (MSFD, 2008/56/EC)

Goal: to achieve Good Environmental Status (GES) of EU marine waters

"The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive" (Article 3)

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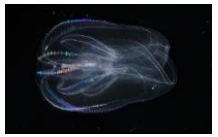
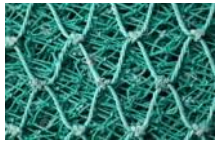
MSFD Descriptors

D1
Biodiversity is maintained



D2
Non-indigenous species do not adversely alter the ecosystem



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Population of commercial fish species is healthy

D4
Elements of food webs ensure long-term abundance and reproduction

D5
Eutrophication is minimized

D6
Sea floor integrity ensures functioning of the ecosystem

D7
Alteration of hydrographical conditions does not adversely affect the ecosystem

D8
Concentrations of contaminants give no pollution effects

D9
Contaminants in seafood are below safe levels

D10
Marine litter does not cause harm

D11
Energy introduction (noise) does not adversely affect the ecosystem

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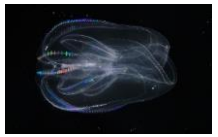

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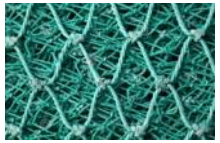

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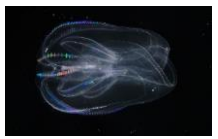

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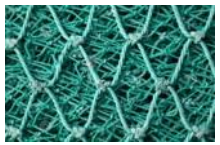

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Ammunition as a pressure in the context of MSFD

D8

Concentrations of contaminants are at levels not giving rise to pollution effects

D8C1

Concentration of contaminants

D8C2

Health of species and condition of habitats

Substances identified under the Water Framework Directive (WFD)

Additional contaminants that may give rise to pollution effects, selected through (sub)regional cooperation

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Ammunition as a pressure in the context of MSFD

D9
Contaminants in fish and other seafood for human consumption do not exceed levels established by Union legislation or other relevant standards

D9C1
Concentration of contaminants in edible tissues of seafood

Substances regulated under the Food legislation

Additional contaminants, selected through (sub)regional cooperation

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MSFD contaminants

MSFD requires comparable and consistent monitoring and assessments

Elements of MSFD assessments *(linked with Water Framework Directive)*

- **Substances**
- **Matrices**
- **Threshold values**

MSFD expert network on contaminants

- Close collaboration with Regional Sea Conventions
- Platform for harmonization of MSFD contaminant monitoring, assessment, reporting
- Upcoming meeting 14.+15.5.2019, Vigo, Spain

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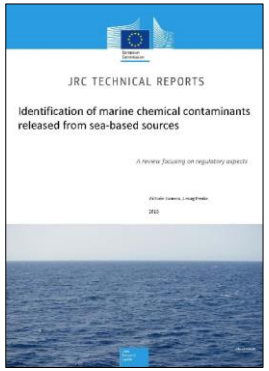
Chemical Substances as Munition Constituents

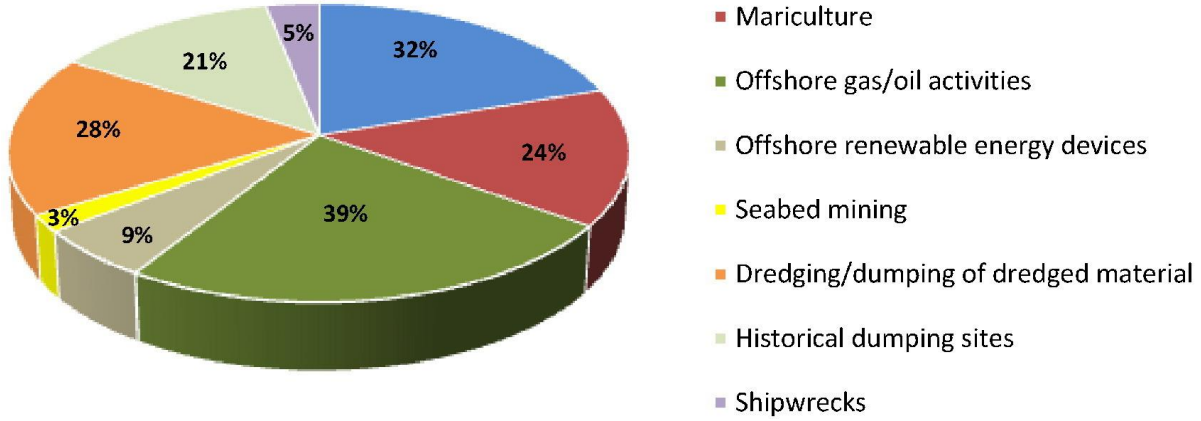


List of 276 marine-relevant contaminants

35 related to munitions

Support for setting-up of monitoring approaches

Percentage of the total number of identified substances linked to each sea-based source



List of main chemical constituents of warfare material

- Conventional munitions (e.g. TNT, RDX…)
- CWA: blistering agents (e.g. sulfur mustard, arsenic-containing compounds), nerve agents, choking agents…
- Propellants/plastizicers/stabiliziers/additives…
- Metals

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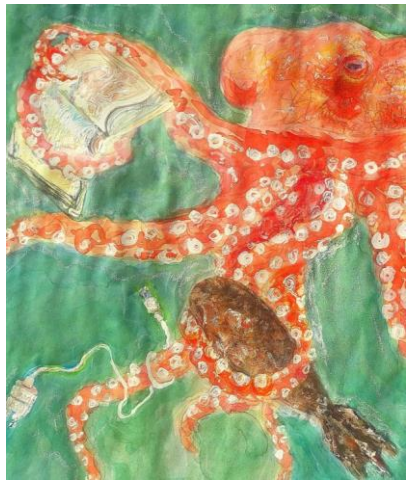
Munition as Marine Litter

MSFD D10 Properties and quantities of marine litter do not cause harm to the coastal and marine environment

Litter (excluding micro-litter), classified in the following categories(1): artificial polymer materials, rubber, cloth/textile, paper/ cardboard, processed/worked wood, **metal,** glass/ceramics, **chemicals**, undefined, and food waste.

"any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. Marine litter consists of items that have been made or used by people and deliberately discarded into the sea or rivers or on beaches; brought indirectly to the sea with rivers, sewage, storm water or winds; accidentally lost, including material lost at sea in bad weather (fishing gear, cargo); or deliberately left by people on beaches and shores (UNEP, 2005)"

Munition as Marine Litter



Need for agreement on the consideration for harmonized MSFD assessments (MSFD Technical group on Marine Litter)

Profit from synergies with monitoring seafloor litter

- Currently Seafloor Litter data are mostly based on bottom trawling surveys (opportunistic sampling during fishery survey cruises, limited spatial coverage)
- Monitoring methods for munitions are related to litter monitoring approaches (visual/camera based observations)
- New methodologies are upcoming (AUVs, etc.) to complete mapping of munitions

Thank you!