Prioritization of munition piles in the German Baltic Sea using multi-criteria analysis

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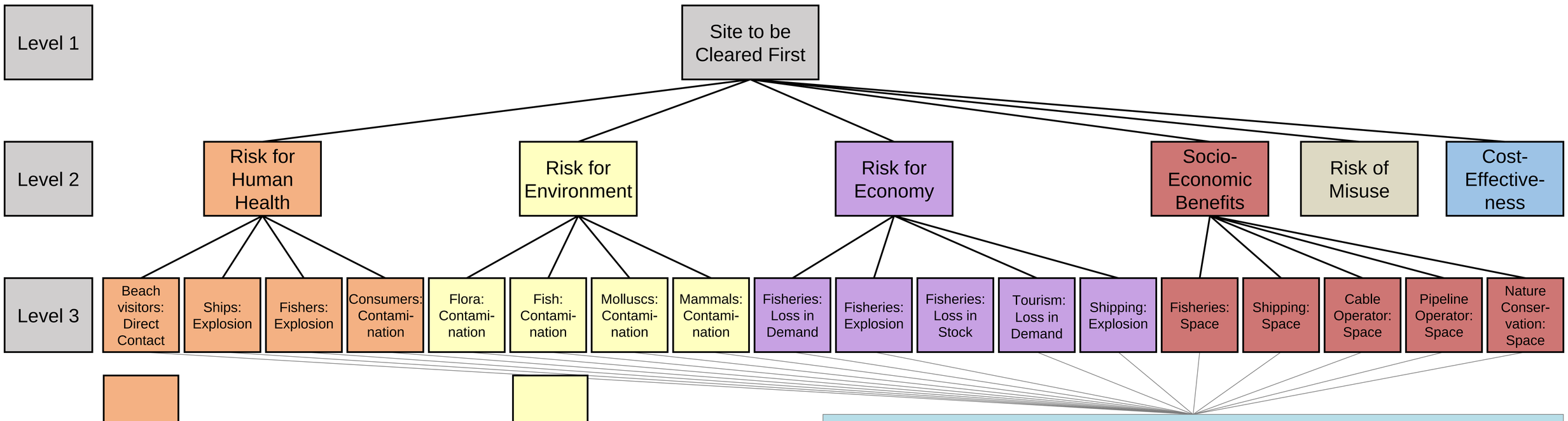
Introduction:

There are about 1.6 million tonnes of legacy ammunition in the German Baltic and North Seas. These are not only threatening aquatic ecosystems but also impeding anthropogenic offshore activities such as the construction of wind parks or fishing. The large amount of munition in the German seas and the complexity of retrieving it make remediation efforts time-consuming and costly. An important question is therefore: **How should munition piles in the German Baltic Sea be prioritised for clearance?**

Methodology:

To create a priority list for the remediation of munition piles in the German Baltic Sea, a multi-criteria analysis is performed. To structure the many factors that are relevant for decision-making and to capture the preferences of relevant stakeholders, the analytic hierarchy process (AHP) is used. AHP guides complex decisions about a set of alternatives. This is done by structuring relevant criteria in a hierarchy tree (Figure 1) and comparing them pairwise. A series of stakeholder and expert workshops are organised to identify, weight, and compare the criteria. To prioritise munition piles, the criteria in level 3 of the hierarchy tree are quantified by using geophysical, biological, chemical, toxicological, economic, and other spatial data.

Hierarchy Tree:



Example 1: Risk for Fish through Contamination

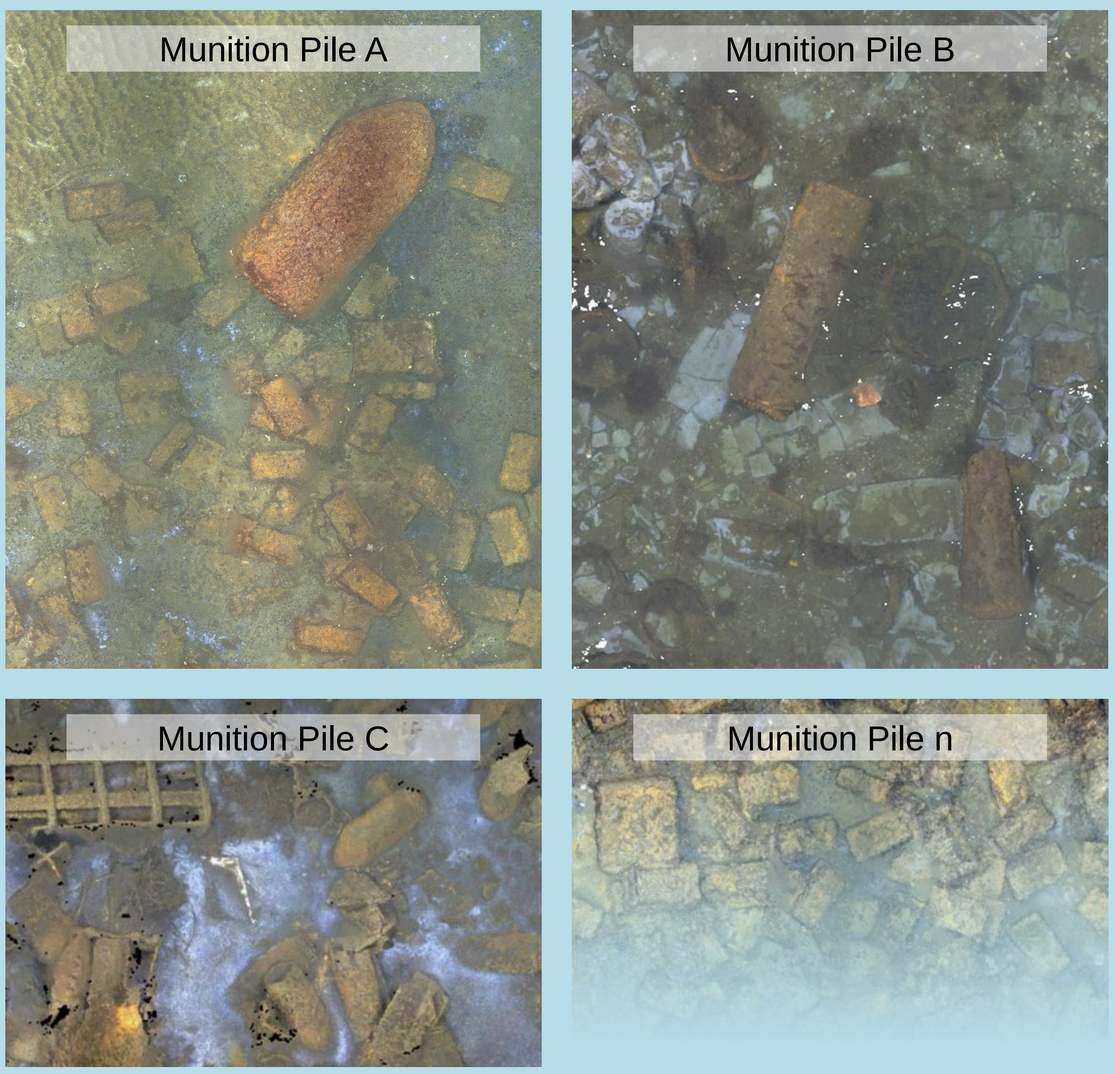
Consequence data:	Liver tumour rates
Receptor data:	Explosive compounds in bile and filet
Pathway data:	Explosive compounds in water/sediment/prey
Source data:	Amount of explosive material; corrosion state

Example 2: Risk for Beach Visitors through Direct Contact

Consequence data:	Number of fatalities and injuries
Pathway data:	Number of beach finds and beach visitors
Source data:	Amount of explosive material; corrosion state; current velocity and direction; distance to coast and beaches

Figure 1: Hierarchy tree for the prioritization of munition dump sites. Examples 1 & 2 show the Source-Pathway-Risk-Consequence (SPRC) model which was used to identify and categorize available data.

Alternatives for prioritization:
(There are over 100 munition piles)



Future Work:

Future work on dump site prioritisation will include information from pilot explosive ordnance disposal (EOD) operations which are scheduled to commence this year (2023). It will also investigate larger parts of the German Baltic Sea as well as parts of the German North Sea.