# Factsheet #3
# Environmental risks of sea-dumped munitions: What we know so far

#3

English ground mine found in Kiel Bight in the dumping site Kolberger Heide. (Photo: Jana Ulrich)

**Millions of tons of munition have entered our seas during and after the two World Wars. Many coastal regions in Europe, North America, Australia, and Asia are still affected by these legacies of war today.**

## Explosives in water and sediment

Most munitions in our seas were either dumped deliberately after the wars or remained due to wartime activities. They have now been lying on the seabed for over 75 to 80 years. Even if some of the casings still appear intact, corrosion has often progressed to a point where explosive substances are leaking into the environment.

This is particularly evident in the Baltic Sea, where large quantities of dumped munitions rest uncovered on the seabed, in direct contact with oxygen-rich saltwater – conditions that accelerate corrosion. As a result, traces of explosive compounds are detected in water samples across the southern Baltic Sea, from Kiel Bight to the German-Polish border. Nearby sediments also show contamination. A similar, though less pronounced, situation exists in the German North Sea, where munitions are often buried under thick sediment layers, limiting leakage into the overlying water.

## Explosives in marine organisms

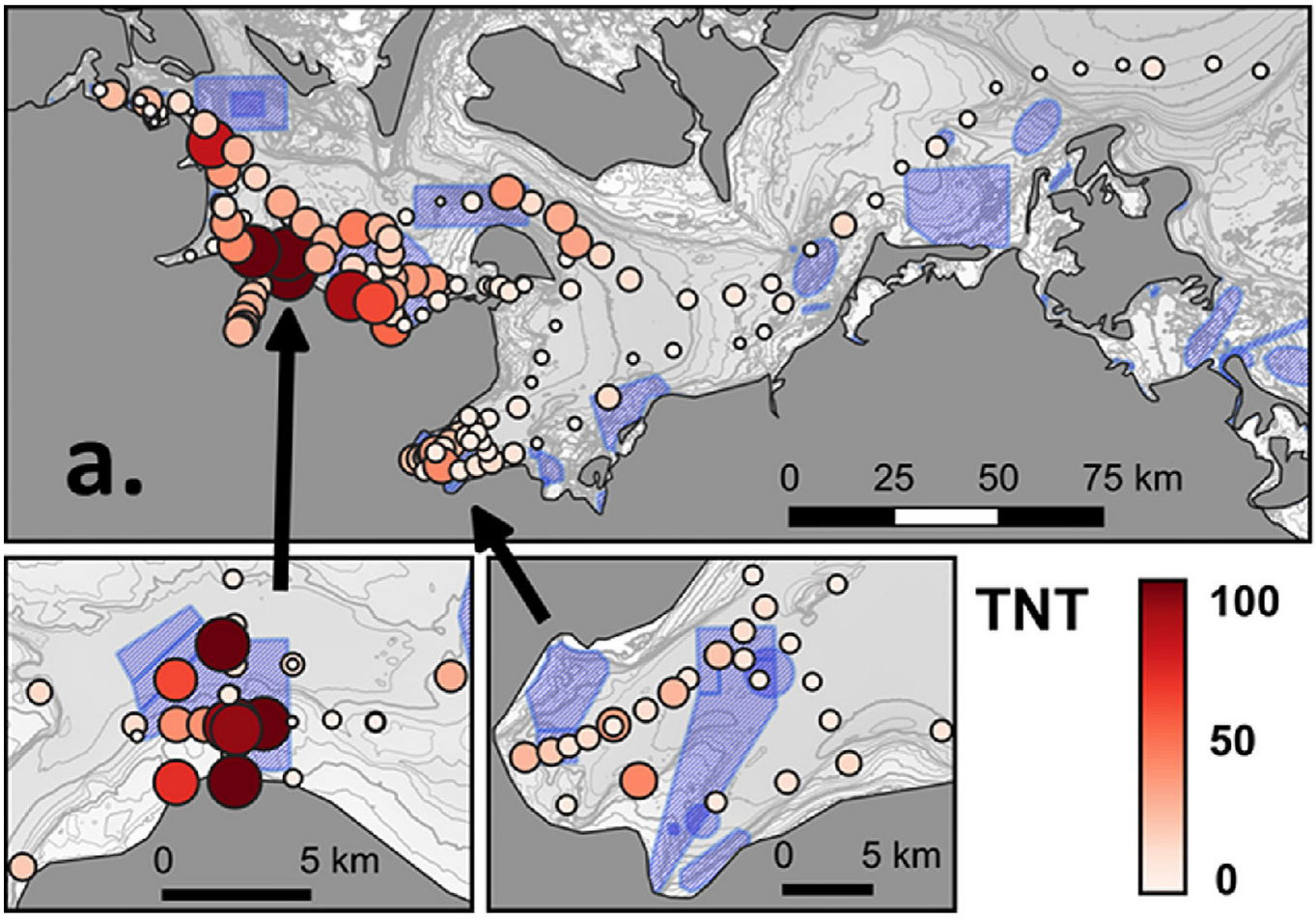
Once dissolved, explosive compounds become bioavailable and are taken up by marine organisms — especially by those living near the seabed, such as mussels, worms, and flatfish. Laboratory studies show that uptake and concentration levels in tissues depend directly on ambient concentrations.

For example, TNT absorbed via gills or food is metabolised by mussels and fish into breakdown products like ADNT. While ADNT is less reactive than TNT, it is still toxic — and potentially mutagenic and carcinogenic. Fortunately, marine organisms can eliminate these substances fairly quickly. Mussels exposed to TNT, for instance, were shown to depurate the chemicals within a few hours after being transferred to clean seawater.

## Background levels of dissolved munition compounds

In both the Baltic and North Seas, background concentrations of TNT and its breakdown products (ADNT, DANT, DNB) typically range in the nanograms per litre. However, near wrecks or dump sites, these levels can rise significantly —up to micrograms or even milligrams per litre.

GEOMAR HELCOM JPI OCEANS Council of the Baltic Sea States IOPAN AWI Umwelt Bundesamt

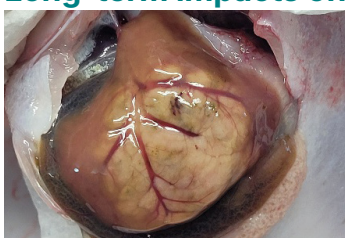



Distribution of TNT in the southern Baltic Sea (Illustration: Beck et al., 2025; Chemosphere, https://doi.org/10.1016/j.chemosphere.2025.144115)

## Acute and chronic toxicity

From human medicine, we know that direct contact with solid TNT can cause eye, skin, liver, and bladder diseases. Marine organisms exposed to dissolved TNT exhibit similar signs of stress. Lab experiments have demonstrated lethal effects at concentrations in the milligram-per-litre range after only a few days of exposure. While such high levels are rarely found in the open environment, the more relevant concern is chronic exposure to lower levels over extended periods.

## Long-term impacts on marine life



Tumour visible in a dab liver caught at a wreck site in the southern German Bight (Photo: R. Schuster)

Long-term field studies with mussels and fish near munitions sites have shown measurable biological effects even at low concentrations. Mussels exposed for several weeks to dissolved TNT show signs of metabolic disturbance, oxidative stress, and increased activity of detoxification enzymes. Flatfish such as dab (Limanda limanda), which are non-migratory and may spend their entire lives near contaminated wrecks, accumulate TNT metabolites in the liver and muscle tissue. These chemical residues are significantly associated with liver damage, including lesions, nodules, and tumours — suggesting a possible link to disease development.

## TNT in the food web

Leaked explosives from munitions are taken up by marine organisms and may enter the food web. Organisms living close to the seabed are more strongly affected than pelagic fish passing through the area. Feeding habits also play a role: if prey is contaminated, predators may ingest the substances indirectly.

Although marine organisms can eliminate TNT and its byproducts relatively quickly, trace amounts are still detectable in fish fillets and mussel tissue. These levels currently pose no health risk to humans, but because corrosion continues and more explosives become exposed, concentrations in seafood are expected to increase—especially in coastal areas of the North and Baltic Seas. This could bring levels closer to thresholds of concern over time.

## Potential impact on fish reproduction

The observed liver damage in adult fish suggests a likely reduction in lifespan. Since affected individuals belong to the reproductive portion of the population, a decline in reproductive success and overall population health cannot be ruled out.