Introduction
Degradation processes at munition dumpsites expose marine organisms such as fish to various nitroaromatic contaminants. Trinitrotoluene (TNT) and its metabolites are known for their mutagenic effects but genotoxicity of these compounds remains still unclear. Here we test genotoxicity of nitroaromatic compounds to fish by using the comet assay as experimental setup. This study clearly proves that TNT and its degradation products pose a genotoxic risk to fish.

Results & Discussion
- After exposure for 48 h even the lowest tested concentration of 2-ADNT (1 mg/l) and TNT (0.1 mg/l) led to a significant increase of genotoxicity in zebrafish embryos compared to the control (see Figure 2). Comparable effects were observed in experiments with 4-ADNT.
- No clear dose-response relationship could be found.
- The higher solubility of TNT in water compared to its primary metabolites could explain the higher genotoxic potential of TNT.
- Since TNT is rapidly metabolized in vivo, the genotoxicity of 2-ADNT and 4-ADNT plays a crucial role in explaining adverse effects on fish in the marine environment.

Methods

![Figure 2: Genotoxicity of TNT and 2-ADNT in primary cells of zebrafish embryos after in vivo exposure for 48 h. DNA damage is expressed as percentage of DNA in the tail (% tail DNA). Dilution water was used as negative control (NC), 0.1 % DMSO as solvent control (SC) and hydrogen peroxide (48 hpf embryos were exposed for 15 min) as positive control (PC). A comet assay was used for two slides per treatment was evaluated, 5 replicates each. Asterisks express significance, determined by one-way ANOVA with Dunnett's multiple comparisons test.]

![Figure 3: Genotoxic induction in zebrafish embryos after in vivo exposure for 48 h. The genotoxic induction was calculated by dividing the maximum median tail moment of the treatment by the median tail moment of the corresponding control.]

Conclusion
- TNT as well as their primary degradation products (ADNT’s) are clearly genotoxic for fish.
- Genotoxicity of TNT is more than 6 times higher than that of degradation products (see Figure 3).