
First global map of risks of microplastic in the ocean surface

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Abstract

Current studies on the risk of microplastic (MP) in the aquatic environment suggest that the *in situ* concentrations are on average several orders of magnitude lower than the concentrations where effects are expected to occur. There is a need to identify hotspots of risk to prioritise mitigation measures, as MP concentrations are expected to increase in the future. Here, we examine the risk of floating MP in the ocean surface by integrating environmental MP concentrations with ecotoxicity data. We first quantified unacceptable levels of MP concentrations based on ecotoxicity data available in scientific literature. In parallel, we quantified past (1970), current (2010) and future (2050 and 2100) environmental concentrations of MP based on microplastic distribution. To draw conclusions about the past, current and future risk of MP at the ocean surface [< 5 m depth], we compared *in situ* MP concentrations with the corresponding unacceptable levels using a probabilistic approach.

Effect data for 23 different species from eight phyla were included in our assessment: *Arthropoda*, *Chordata*, *Cnidaria*, *Echinodermata*, *Haptophyta*, *Mollusca*, *Ochrophyta*, and *Rotifera*. The resulting median unacceptable level was 1.21×10^5 MP m⁻³ (95% CI: 7.99×10^3 MP m⁻³ – 1.49×10^6 MP m⁻³). We found strong indications that organisms in parts of the Mediterranean Sea and the Yellow Sea are currently at risk. By 2100, we expect that 68.7% and 53.9% of the Mediterranean Sea and the Yellow Sea will have unfavourable conditions for marine life due to MP pollution, under a worst case and in a business as usual scenarios, respectively.

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Our results showed substantial spatial differences in the risk of MP in the ocean surface layer (0 – 5 m depth). Global mapping of the MP risks is instrumental to identify marine regions that need increased attention for mitigation measures.

Keywords: Environmental risk assessment, Marine ecosystems, Multidecadal, Spatial distribution, Microplastic