PLASTOX

Direct and indirect ecotoxicological impacts of microplastics on marine organisms

JPI OCEANS

Project factsheet

Project Description

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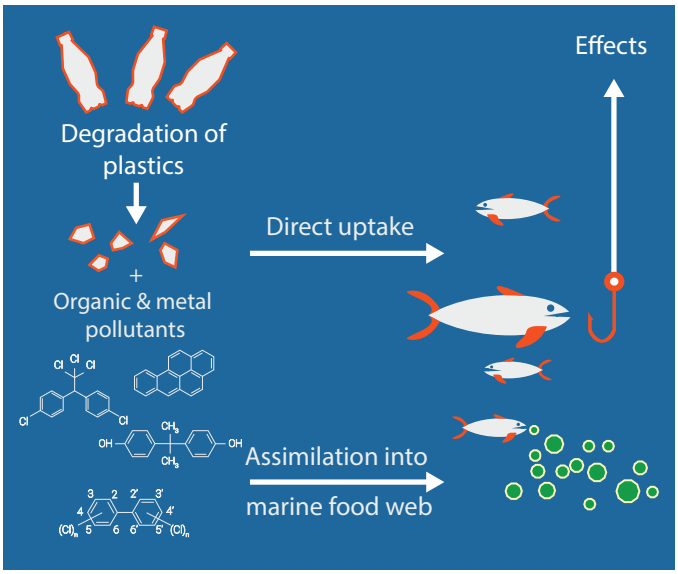
The PLASTOX project investigates the ingestion, food-web transfer, and ecotoxicological impact of microplastics (MPs), together with the persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems. It also studies the temporal dynamics of MP colonisation by microbial communities in the field and the influence of microbial biofilms on ingestion rates and POP toxicity. The influence of MP physicochemical properties (e.g. size, shape, surface area and composition) on these processes are evaluated.

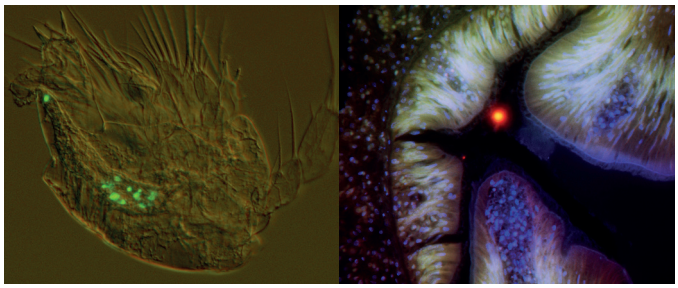


PLASTOX employs a combination of commercially available feedstock MP and multi-component marine litter-derived MP mixture that has been cryo-milled from litter collected along the northern Dutch North Sea coast and characterized in detail. Two additional single-component MP reference materials have been prepared from beached fish-boxes and characterized. The use of common reference materials allows a meaningful comparison of data generated by different partners and across the different activities of PLASTOX.

Adsorption and desorption of organic and inorganic pollutants to MPs are being investigated using a range of common POP and metal contaminants. Ongoing activities include optimised laboratory studies and long-term field experiments (up to 2 years) at 13 locations representing a range of European marine environments. A method for extracting a broad range of POPs and additives from seawater has been developed. Studies have highlighted how adsorption/desorption behaviour varies between different POPs, identifying which physicochemical properties are most influential, including size, production method and additive content (e.g. plasticisers and colourants). Metal adsorption tests under laboratory conditions have also been performed using PVC pellets.

PLASTOX investigates uptake through ingestion and other routes following controlled exposures and field samples. Alkaline and enzyme-based digestion methods have been developed and evaluated for MP extraction from a broad range of marine organisms. The methods have been used to study the MP content in a wide range of wild-caught species from across Europe. Data suggest that the MP content in wild-caught organisms varies significantly between species, but fibres appear to comprise a high proportion of ingested MPs in marine organisms. Laboratory studies have shown that MPs are rapidly ingested and excreted by a range of species, but that there is also evidence of retention/accumulation in some species (e.g. planktonic organisms and mussels). Such organisms are a potential vehicle for MPs along the trophic

food chain. POPs adsorbed to MPs also appear bioavailable to mussels, but the heavy metals assessed were not.



Fluorescent (right) MPs (~10 µm) in the digestive tracts of C. finmarchicus naupilii (left) and the mussel M. galloprovincialis (right). Picture credits: NTNU, SINTEF and NOVA-FCT.

The acute and sublethal ecotoxicological effects of MPs are being assessed on marine organisms from phyto- and zooplankton to (shell)fish. Data generated so far indicate ecotoxicological effects on mussels and copepods appear to be limited for pristine MPs in the sizes and concentrations evaluated in the current studies. Although no significant histopathological effects were observed in mussels, inflammatory responses and a decrease in cell membrane stability were detected. MPs also produced alterations on molecular and cellular parameters involved in mussel embryo-larval development, although there was no observable impact on the development of individuals.

Using new data and competence generated in these studies, a more detailed understanding of the potential for MP transfer between trophic levels, and the subsequent impacts this may have, will be obtained. Finally, PLASTOX will culminate in a series of experiments bringing together the knowledge generated about MPs and POPs/metals to study the combined fate and effects of these marine contaminants in food web studies. The knowledge generated will be summarized in a guidance document for development of future legislation and remedial efforts.

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