frontiers | Frontiers in Marine Science

TYPE Editorial
PUBLISHED 10 April 2024
DOI 10.3389/fmars.2024.1402991



OPEN ACCESS

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RECEIVED 18 March 2024
ACCEPTED 02 April 2024
PUBLISHED 10 April 2024

CITATION
Dieguez LV, Mauffret A and Brooks S (2024) Editorial: Model organisms in marine pollution.
*Front. Mar. Sci.* 11:1402991.
doi: 10.3389/fmars.2024.1402991



# Editorial: Model organisms in marine pollution

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KEYWORDS

**ecotoxicology, biological effects assessments, biomarkers, marine pollution, monitoring**

Editorial on the Research Topic
Model organisms in marine pollution

Marine pollution is a global concern with far-reaching ecological and economic consequences (Escher et al., 2020). Understanding the effects of chemical pollutants on marine organisms is vital for providing effective monitoring and management strategies. Model organisms are representative species, which are studied to gain important insights into the interactions of chemicals with biological processes, providing important information on the impacts of chemicals in the marine environment (Tlili and Mouneyrac, 2021).

Findings from studies on model organisms are typically extrapolated to predict the impact of pollutants on non-model species, including economically and ecologically important marine organisms. Consequently, assumptions are made that the model species is representative of the other organisms within the same environment. Care must be taken not to over interpret the response of a model organism to represent the responses from the whole ecosystem (van Straalen, 2003). It is therefore encouraged to use several model organisms that occupy different parts of the trophic food web, habitat type, feeding mode etc. to provide a better representation of the ecosystem overall (Hylland et al., 2021).

For chemical risk assessments in the aquatic environment, regulatory test species (model organisms) included in OECD, ISO and ASTM guidelines are typically used to determine the toxicity of chemicals and the risks they pose to the aquatic environment. Where the results of these acute and chronic short term toxicity tests are used to provide threshold levels (i.e. predicted no effect concentrations, PNECs) for the protection of the environment. Although such assessments are valid, they do raise criticism around their ability in providing adequate protection based on the toxic responses of a few selected individual species under laboratory conditions (Santos et al., 2021). To overcome this, risk assessments tend to use large and conservative assessment factors in the calculation of the PNEC values. It is only when data are available from multiple species in repeated acute and especially chronic long-term toxicity tests that the assessment factors are reduced and the PNEC values are considered to be more reliable (van Straalen et al., 2022). The underlying feature of such risk assessments is to include as many different types of model organisms as

possible, representing various taxonomic and trophic levels, habitat and feeding groups so that the different aspects of the ecosystem are considered and protected.

For *in situ* monitoring and observation of the chemical impacts on indigenous species, selecting appropriate model organisms for monitoring is important in order to obtain applicable and meaningful data about the impact of stressors on the aquatic ecosystems (Siddig et al., 2016). Since chemical concentrations together with the biological effect responses, measured in the cells and tissues of the organisms, provide an indication of the level of contaminant status of a particular habitat, it is important that the organisms used are representative of the environment (Davies and Vethaak, 2012). Several factors need to be considered when choosing organisms for monitoring. These factors include: ecological relevance; life history traits including trophic group, habitat preference and mode of feeding; availability, abundance and accessibility; sensitivity and responsiveness to chemical exposure; as well as ethical considerations, where lower species, such as invertebrates and algae are more often selected than higher organisms such as mammals.

Species exhibit varying responses to chemical contaminants based on their physiological, ecological, and genetic characteristics. The differences in these responses can be attributed to factors such as tolerance, susceptibility, life history traits, and acclimation and adaptive mechanisms. Understanding these differences among a set of model species is essential for assessing the overall impact of chemicals on individuals, populations and the ecosystems they inhabit.

Model organisms serve as reliable biomonitoring tools to assess the health of marine environments. Threshold values such as Background Assessment Criteria (BAC) and Environmental Assessment Criteria (EAC) have also been established for the bioaccumulation of chemicals in the tissues of model organisms (OSPAR, 2009). Much of this work has been developed by the ICES Marine Chemistry Working Group (MCWG), where threshold values have proved highly useful to differentiate between clean and contaminated sites in coastal monitoring programmes.

Mussels (*Mytilus* spp.) are a typical model organism, where they have been used extensively in coastal monitoring programmes. Mussels bioaccumulate chemicals in their tissues, which provides an indication of chemical exposure as well as having a wide range of biological effects methods at their disposal. Such biological effects methods include responses at different levels of biological complexity including subcellular, tissue and whole organism responses. These provide important information on either general health impacts and/or more specific information on the mechanisms of toxicity of chemicals, such as genotoxic, neurotoxic and oxidative stress responses. Threshold levels (BAC and EAC) have been established for many of the biological effects endpoints in mussels as a central task of the ICES Working group on the biological effects of contaminants (WGBEC), providing information on the impact on the organism, severity of pollution and its potential ecological consequences (Davies and Vethaak, 2012). Threshold values have to a greater degree been established for several fish species for many of the biological effects responses (Burgeot et al., 2022). However, it is known that species differences in biological response to chemical pollution differ greatly and there may be a need for species specific assessment criteria to be established in organisms that represent different trophic levels, habitat preferences, feeding groups etc, to provide a more holistic assessment (Sussarellu et al., 2022; Roubeix et al., 2023).

Although some advancement has been made in the last 20 years on monitoring of the effects of chemical contaminants, there is still developments needed. The present Research Topic includes a selection of innovative studies on the use of marine organisms to provide an assessment of the concentrations of pollutants in the marine environment as well as the effects these contaminants are causing, and the biological processes involved. The horseshoe crab was used as model species to assess the effect of copper and nanoparticles individually or combined (Arif et al.). The dab was used to monitor biomarkers across the UK coastal waters (Dalessandri et al.), whilst sole was used to study the effects of cadmium (Briaudeau et al.). This Research Topic therefore demonstrates that invertebrates such as crabs and fish are potential model species for the monitoring of the biological effects of contaminant in the marine environment.

## Author contributions

SB: Writing – original draft, Writing – review & editing. LD: Conceptualization, Writing – original draft, Writing – review & editing. AM: Writing – original draft, Writing – review & editing.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

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