Journal of
Marine Science and Engineering

MDPI

Editorial

Effects of Emerging Contaminants to Marine Organisms: In Vitro and In Vivo Studies

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The aim of this Special Issue (SI) was to publish original research papers and reviews dealing with the effects of emerging contaminants on marine organisms (vertebrates, invertebrates, plants, and microalgae). Emerging contaminants represent a large group of substances—mainly synthetic—that can enter coastal marine ecosystems. Among them, there are, for example, pharmaceuticals and personal care products, nanomaterials, microplastics, pesticides/herbicides, and industrial chemicals. Despite their widespread and increasing use, however, for most of these compounds, information concerning their transfer, environmental levels, fate, and toxicological effects on marine organisms is limited.

Regarding the manuscripts published in this Special Issue, the effects of emerging contaminants have been evaluated in different marine species and at different levels of biological organization. For example, in mollusks, Munari et al. [1] evaluated the effects of the exposure of the mussel *Mytilus galloprovincialis* to natural pH (8.1) and two reduced pH values (pH −0.4 units and pH −0.7 units), both in the absence and in the presence of environmentally relevant concentrations of diclofenac (0.05 and 0.5 µg/L). Clearance rate, respiration rate, and excretion rate were measured after 7 days of exposure to pH only after 14 (T1) and 21 (T2) days of exposure to the various pH*diclofenac combinations. The authors observed that pH significantly affected all the biological parameters considered at all sampling times, whereas diclofenac generally exhibited a significant influence only at T2. As a review, De Felice and Parolini [2] summarized information from the most recent papers addressing the application of the so-called "omics" techniques (e.g., proteomics, genomics, metabolomics, and lipidomics) in the field of nanoparticle ecotoxicology. In particular, the advantages and limitations of proteomics as a tool for studying the effects and mechanism(s) of action of nanoparticles in marine bivalves are critically discussed. Pagano et al. [3] studied the effects of pesticides, such as neonicotinoids, in marine organisms, summarizing available data on the effects on mussels. The authors highlighted the importance of studying the ecotoxicological effects of neonicotinoids in such organisms, being filter feeders that can accumulate this type of pollutant, becoming dangerous for human health due to seafood consumption. Among herbicides, glyphosate is the active ingredient of numerous commercial formulations applied in different sectors, from agriculture to aquaculture. The presence of glyphosate in aquatic ecosystems has aroused the attention of researchers because of its potential negative effects on non-target organisms, both animals and plants. The review of Matozzo et al. [4] summarized the results of studies aimed at evaluating the effects of glyphosate (both as an active ingredient and component of commercial formulations) on marine invertebrates. The authors highlighted that the data obtained in acute toxicity tests indicate that glyphosate and its commercial formulations are lethal at high concentrations (not environmentally realistic), whereas the results of long-lasting experiments indicate that glyphosate can markedly affect the biological responses of marine invertebrates.

Two papers of this Special Issue deal with the effects of emerging contaminants on the sea urchin *Paracentrotus lividus*. Asnicar et al. [5] evaluated the effects of glyphosate-based herbicide (Roundup®), glyphosate as an active ingredient, and its main degradation

Citation: Matozzo, V.; Marin, M.G. Effects of Emerging Contaminants to Marine Organisms: In Vitro and In Vivo Studies. *J. Mar. Sci. Eng.* **2022**, *10*, 1813. https://doi.org/10.3390/jmse10121813

Received: 21 November 2022
Accepted: 22 November 2022
Published: 24 November 2022

product aminomethylphosphonic acid (AMPA) on the larval development of the sea urchin *P. lividus*. The authors found that AMPA and its parent compound glyphosate have similar toxicity, whereas Roundup® seemed to be less toxic than the glyphosate alone. The authors concluded that glyphosate-related chemicals are harmful to sea urchin populations as smaller larvae were produced, which had a higher frequency of abnormalities, and fewer reached the pluteus stages and with higher energy requirements. In the same species, Campoy-López et al. [6] tested the effects of one of the most abundant flame-retardant additives for plastics, tris (1-chloro-2-propyl) phosphate (TCPP), and the synthetic hormone ethinylestradiol (EE2) on the gametogenesis and gonad development of adult sea urchins. The authors found that EE2 and TCPP exposure did not cause histological damage in the gonads. Some evidence of the estrogenic effects of TCPP within the μg/L range and EE2 within the ng/L range was observed. The authors revealed that the patterns of response were affected by the high inter-individual variability, the differing initial stage of the gonad, and the dosage administered.

Lastly, one paper dealing with the effects of emerging contaminants in ascidians has been published. In detail, Cima and Varello [7] evaluated the in vitro effects of dichlofluanid on immunocyte lines (phagocyte and cytotoxic lines) from the colonial ascidian *Botryllus schlosseri.* The authors observed that dichlofluanid induced haemocyte apoptosis and cell shrinkage with a decrease in both motility and phagocytosis. In addition, the inhibition of the pivotal enzymatic activities of phagocytes and cytotoxic cells was recorded.

We are aware that many other studies need to be carried out to better understand the effects and mechanisms of action of emerging contaminants in marine species. In this context, we hope that the articles published in this Special Issue will encourage researchers' interest in these issues.

Author Contributions: Writing—original draft preparation, V.M. and M.G.M.; writing—review and editing, V.M. and M.G.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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