

## Evaluation of Impacts of Microplastics and Associated Chemicals on Marine Ecosystem

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[Abstract]

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The present study investigated the uptake and excretion of microplastics (MPs) by aquatic organisms, their particle toxicity, distribution and characteristics of hazardous chemicals in MPs in marine environments. Also the exposure and transfer of the chemicals from ingested MPs to biota and their effects were studied. Lower to higher trophic organisms were targeted. Major findings are as follows. Medaka fish (*Oryzias latipes*) and *Artemia* were selected as a model of fish and invertebrate, respectively. When medaka fish was exposed to MPs (2, 20, 200  $\mu\text{m}$ ), MPs (except 2 $\mu\text{m}$  MP) were rapidly accumulated in and then eliminated from bodies. Its bioconcentration factor was estimated to be less than  $\sim 10^3$ . Also, no biomagnification was observed in the medaka fish fed with MP-accumulated *Artemia*. From the results of MPs exposure studies, no effect was observed in survival and reproduction of medaka and artemia, while some gene expression levels were changed in the medaka intestine and artemia whole body. Ubiquitous occurrence of hydrophobic chemicals such as polychlorinated biphenyls and polycyclic aromatic hydrocarbons (PAHs) as well as sporadic occurrence of high concentrations of additives such as brominated flame retardants and benzotriazole UV-stabilizers in neuston and beaches MPs were revealed. Their transfer to biota and the effects were investigated. Medaka was exposed with anthracene and/or MP. As a result, PE-MPs may act as a vector to concentrate and transfer anthracene to medaka upon ingestion, but the presence of these particles may have limited adverse effects on fish under the co-exposure systems of the type used in this study. Mixture exposure of MP and antidepressant drug diazepam might decrease schooling behavior. It was revealed that benthic invertebrates that ingested MPs accumulated chemical compounds such as PCBs and additives associated with MPs, and that they were transferred to benthic fish through the consumption of prey invertebrates that consumed MPs. Another experiment was conducted that fed plastic to chicks of streaked shearwater demonstrated that plastic ingestion has some negative impacts on its organ weight, and that plastic additives were transferred to the tissue of birds. Analysis using a next-generation sequencer revealed different gene expression patterns in the exposed and control groups of the seabird, especially in the thyroid hormone system and bile acid synthesis system.

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