Abstract

[Project Information]

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[Abstract]

This study aims to assess the ecological impacts of micro- and nanoplastics (MPs and NPs) on marine ecosystem through bioassays involving zooplankton exposed to model secondary microplastics. We established a new field-sampling platform capable of capturing MPs and NPs ranging from 300 nm to 350 μm, enabling high-precision density assessments in the marine environment. Focusing on the western coastal waters of Kyushu, we conducted a comprehensive evaluation of MP and NP densities across surface, midwater, and sediment layers. Density data were shared with other subthemes to support biological impact assessments and model development. Regular surveys clarified vertical distributions in the water column, while sediment surveys revealed plastic accumulation on the seafloor, providing insights into the "missing plastics problem." We demonstrated MP ingestion in marine fish and its correlation with environmental densities, offering valuable information for food safety and environmental risk evaluations.

The model microplastics was produced using a new degradation method by degradation using sulfate ion radicals in seawater while adjusting pH was successfully developed, and MP and NP samples of polypropylene (PP), polystyrene (PS), and polyethylene (PE) could be produced in about 15 days and finally succeeded in developing an efficient method for the production and recovery of NPs. These MPs and NPs were used for the bioassay.

The bioassay employed the euryhaline rotifer *Brachionus plicatilis* sensu stricto to evaluate the effects of plastic particles on marine organisms. The anthropogenic secondary MPs and NPs, which contained additives, exhibited no significant effects on the asexual reproductivity of rotifers.

However, variability in sexual reproduction was observed, due to sensitivity to environmental fluctuations. The impacts of MPs and NPs on fish larvae via the marine food chain were assessed using rotifers and larvae of red sea bream *Pagrus major*. Fish larvae were subjected to two exposure methods: (1) direct exposure, in which plastic particles were added into the larval culture medium; and (2) indirect exposure, in which rotifers that had accumulated MPs or NPs in their digestive tracts were fed to the fish larvae. A consistent pattern of decreased survival rates was observed in both the direct MP and NP exposure groups. Notably, the lowest survival rate occurred in the group indirectly exposed to NPs. These findings highlight the potential ecological risks posed by NPs, particularly their adverse effects on higher trophic levels, and emphasize the urgent need to prioritize NPs in environmental monitoring and remediation strategies.

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