



Microplastic Pollution and Its Environmental Impact

: A Case Study from Hachinohe, Japan

Introduction

Hachinohe, located in northern Sanriku Fukko National Park, is known for its thriving fishing industry and scenic coastal areas such as Tanesashi Coast and Kabushima. Concerned about the threat microplastics pose to local industries and natural resources, we have continued our research on microplastics (MPs).



Figure 1 Microplastic Sampling

Research Activities

1. Sampling Microplastics

Since 2019, we have continued collecting microplastics (MPs) as part of the "Participatory International Environmental Education Program on Microplastics" led by JAMSTEC and Hachinohe Institute of Technology.

The sampling procedure is as follows:

- a) A survey area of 12m × 40m was established (see Fig. 2), and sand was collected at 2-meter intervals both vertically and horizontally, to a depth of 2–3 cm.
- b) The collected sand was placed in buckets, seawater was added, and the mixture was stirred.
- c) Floating MPs were recovered after stirring and dried (density separation method).
- d) After drying, the mass of MPs was measured.

At the 2020 conference, we reported 0.459g of MPs collected from Tanesashi Coast in 2019, and 0.768g from Okuki Coast in 2020. In 2021, 0.140g was collected from the mouth of the Gonohe River, and last year, a second sampling at Tanesashi Coast yielded 0.087g. Tanesashi Coast is a popular tourist destination and undergoes more frequent beach cleanups than Okuki Coast. While ocean currents and other environmental factors may influence MP mass, we believe that the frequency of beach cleaning is one contributing factor².

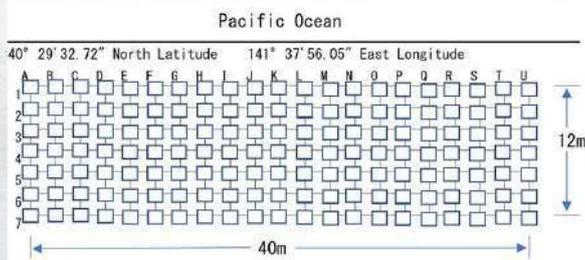


Figure 2 Survey area of Tanesashi Coast

Research Activities

2. Analysis of Adsorbed Substances

Using Gas Chromatography-Mass spectrometry, we analyzed MPs collected from Okuki Coast. Persistent organic pollutants (POPs) were not detected, but long-chain alkanes were found, likely originating from seawater³.



Figure 3 Collected Microplastics

Table 1 Detected Substances

Estimated Substances (Alkanes)	
Tetradecane	C ₁₄ H ₃₀
Hexadecane	C ₁₆ H ₃₄
Octadecane	C ₁₈ H ₃₈
Heneicosane	C ₂₁ H ₄₄
Tetracosane	C ₂₄ H ₅₀
Octacosane	C ₂₈ H ₅₈
Tetratetracontane	C ₄₄ H ₉₀

Research Activities

3. Biological Uptake and Accumulation

We raised medaka fish in water containing fluorescent microbeads. Dissection revealed fluorescence in the intestines and surrounding organs, indicating that MPs may affect internal tissues despite being excreted.



Figure 4 Medaka raised under normal conditions

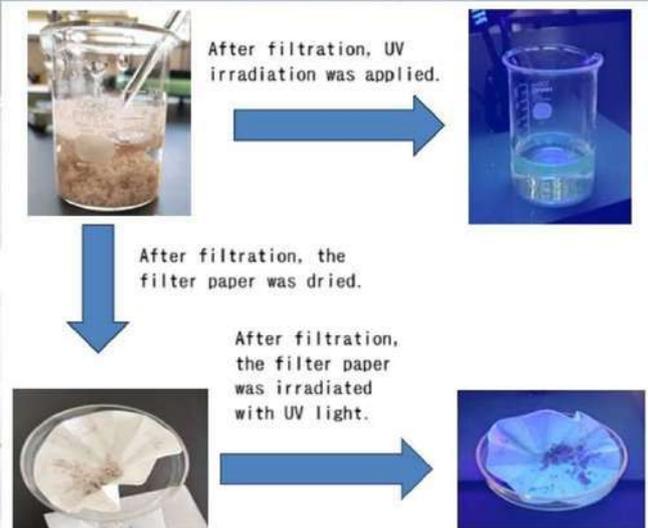


Figure 5 Medaka fed with fluorescent probes

Research Activities

4. Precipitation Experiments

Building on previous work using colloidal properties, we tested polyglutamic acid (PGA) for MP aggregation. Under optimal conditions (30°C, 2.0g PGA in 60mL solution), MPs successfully precipitated. However, fluorescence was not observed post-filtration, possibly due to PGA encapsulating the MPs.



Summary of Discussion

- a) The mass of microplastics (MPs) collected varied significantly depending on the sampling location and year.
- b) Tanesashi Coast, a popular tourist destination, undergoes frequent beach cleanups, which may contribute to the lower MP mass observed there.
- c) While ocean currents and other environmental factors likely influence MP distribution, the frequency of beach cleaning appears to be a key factor.
- d) These findings suggest that human activity, particularly cleanup efforts, can have a measurable impact on the presence of MPs in coastal environments.

Future Directions

- a) Expand MP sampling across more coastal areas and collaborate with other schools.
- b) Continue analysis of substances adsorbed onto MPs.
- c) Further investigate MP movement and accumulation in organisms.
- d) Explore PGA extraction from everyday materials like natto for MP aggregation.

References

1. Rui, Nishizuka et al. (2020). *On Microplastics*. Presented at Joint Meeting of the Tohoku Area Chemistry Societies.
2. Keiichiro, Shinyama et al. (2021). *On Microplastics (Second Report)*. Presented at the 2021 Joint Meeting of the Tohoku Area Chemistry Societies.
3. Takeji, Chikamoto & Takeshi, Maitani (1981). *n-Alkanes in Plant-Based Foods*. Journal of Food Hygiene, Vol. 22, No. 6, pp. 547–550.

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