

Studies on biomonitoring of microplastic
pollution in seashores and midgut dysbiosis in
wharf roaches, *Ligia* spp.

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Title : Studies on biomonitoring of microplastic pollution in seashores and midgut dysbiosis in wharf roaches, *Ligia* spp.
(フナムシ *Ligia* spp.を用いた海岸域におけるマイクロプラスチック汚染のモニタリングと其中腸における細菌叢異常)

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Thesis Summary

Plastic pollution has emerged as a significant global issue in aquatic environments, with most studies focusing on marine organisms. However, buoyant plastics often accumulate along tidal lines, causing severe contamination that can impact organisms inhabiting these areas. Wharf roaches (*Ligia* spp.), which are omnivorous scavenger isopods, are globally distributed and inhabit rocky intertidal zones, ports, and artificial structures, where exposure to plastics is likely. Previous studies have demonstrated the accumulation of various contaminants (e.g., PAHs, TBTs, and Cs) in their bodies, highlighting their potential as biomonitoring models for environmental pollution. This study aimed to monitor plastic pollution in sandy and rocky areas using wharf roaches, evaluate the survival and physiological effects of expanded polystyrene (EPS) ingestion, and investigate the effects of EPS ingestion on gut microbiota.

To confirm EPS ingestion and assess its toxicity under laboratory conditions, wharf roaches were collected from the Nishinoura Port, Fukuoka. After three days of starvation, the wharf roach was fed an EPS block. No mortality was observed during the two-week survival test, indicating no acute toxicity of EPS. After feeding for 2 days, the wharf roach bodies were transparent for observation and the presence of EPS in the digestive tracts of the experimental groups was confirmed.

To confirm plastic ingestion in sandy and rocky areas and assess the potential of wharf roaches as microplastic generators, 45 individuals were collected from coastal areas in 10 Japanese cities. Among these, 97 plastic particles were detected in 36 individuals, 80 of which were identified as polystyrene. This suggests frequent EPS ingestion in the tidal zones. Laboratory EPS feeding experiments revealed the fragmentation of EPS blocks into smaller particles within their digestive tracts, indicating their potential contribution to microplastic generation.

To evaluate the effects of EPS ingestion on the gut microbiota, wharf roaches were divided into two groups: a starvation group and an EPS-fed group. After 10 days, the gut samples were collected and subjected to shotgun metagenomic analysis. Changes in the relative abundances of bacterial, archaeal, eukaryotic, and viral communities were observed, with a notable increase in methanogenic archaea (*Methanospirillum*) in the EPS-fed group.

In conclusion, wharf roaches residing in tidal zones frequently ingest EPS, contributing to their fragmentation and the generation of microplastics. EPS ingestion affect the gut microbiota and metabolic pathways, potentially influencing their health and the surrounding ecosystem. Further research is required to elucidate the relationships between plastic ingestion and tidal zone organisms as well as to explore comparisons with other bioindicator species.