Tracing Microplastics in Marine Isopods

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Background

'Microplastics' have been recognized as a severe environmental problem since the 1970s. They are classified as particles < 5 mm *(1)* originating e.g. from fragmentation of larger plastic items, sewage-treatments and hygienic products. Due to their small size, micro-plastics can be ingested by a wide range of organisms *(2).* Today, plastic particles are found in the sediments of the remotest beaches from the poles to the equator *(3).*

Still, there is only marginal information about the potential adverse effects of microplastics on benthic species *(4).*

Objectives

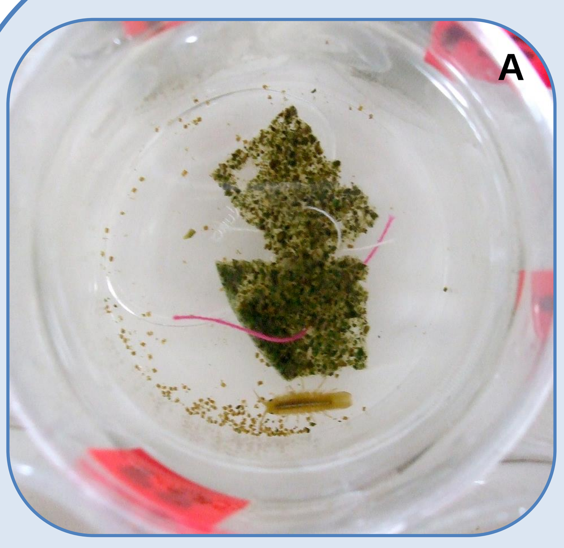
Invertebrates play an important role in marine ecosystems. Therefore, it is crucial to study the uptake and effects of microplastics on these species. Here we address questions about the transport and deposition of microplastics in the digestive tract of crustaceans:

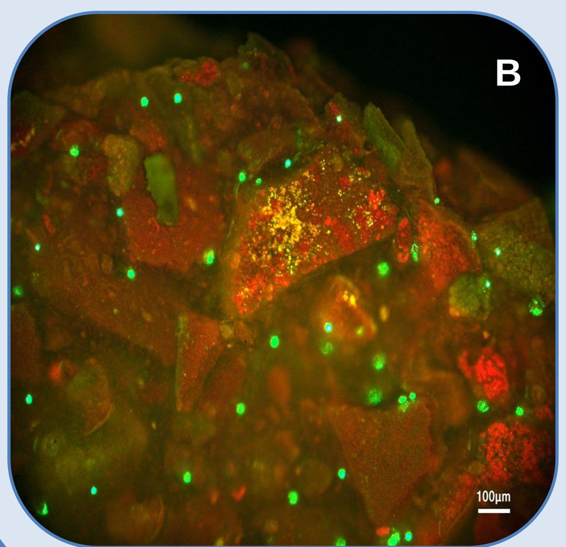
- Do ingested particles pass through the intestines (fecal deposition) or do they accumulate in specific sections of the digestive tract?
- Do isopods prefer offered food items without plastics to items that contain microplastics?

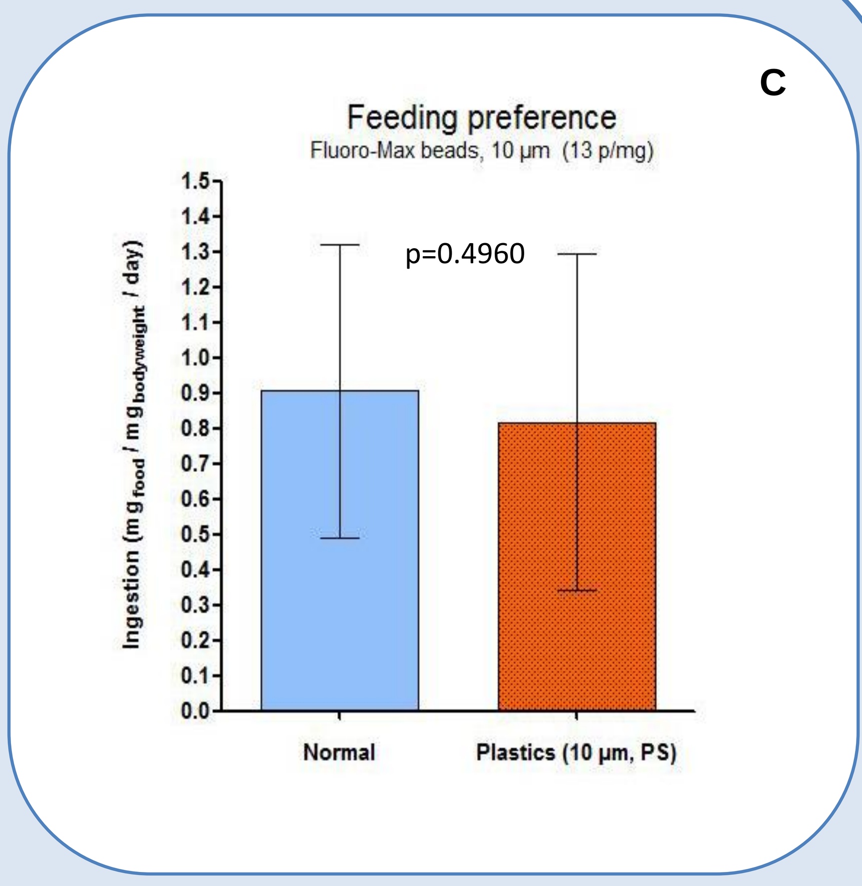
Materials and Methods

The marine isopod *Idotea emarginata* is a common benthic species feeding on a wide range of seaweeds and detritus. Individuals were fed with pieces of agar ("artificial food", *5)* containing dried algal tissue (*Fucus vesiculosus*) and fluorescent microplastics (10 µm, ~3000 beads/mg). After three days the animals were shock-frozen in liquid nitrogen. Transversal and longitudinal cryo-sections of the whole animals were prepared to locate the ingested microparticles in the digestive tract (Fig. 1-4).

In a choice feeding assay two pieces of artificial food *(5)* were offered to each of 24 isopods, one piece containing fluorescent microplastic beads (10 µm, ~13 beads/mg) the other without plastics (Fig. A,B). After 3 days (13°C, 12:12 light/dark) the amount of consumed material was determined for each piece. Consumption rates of the isopods for the different food types were analyzed by a paired t-test (Fig. C).



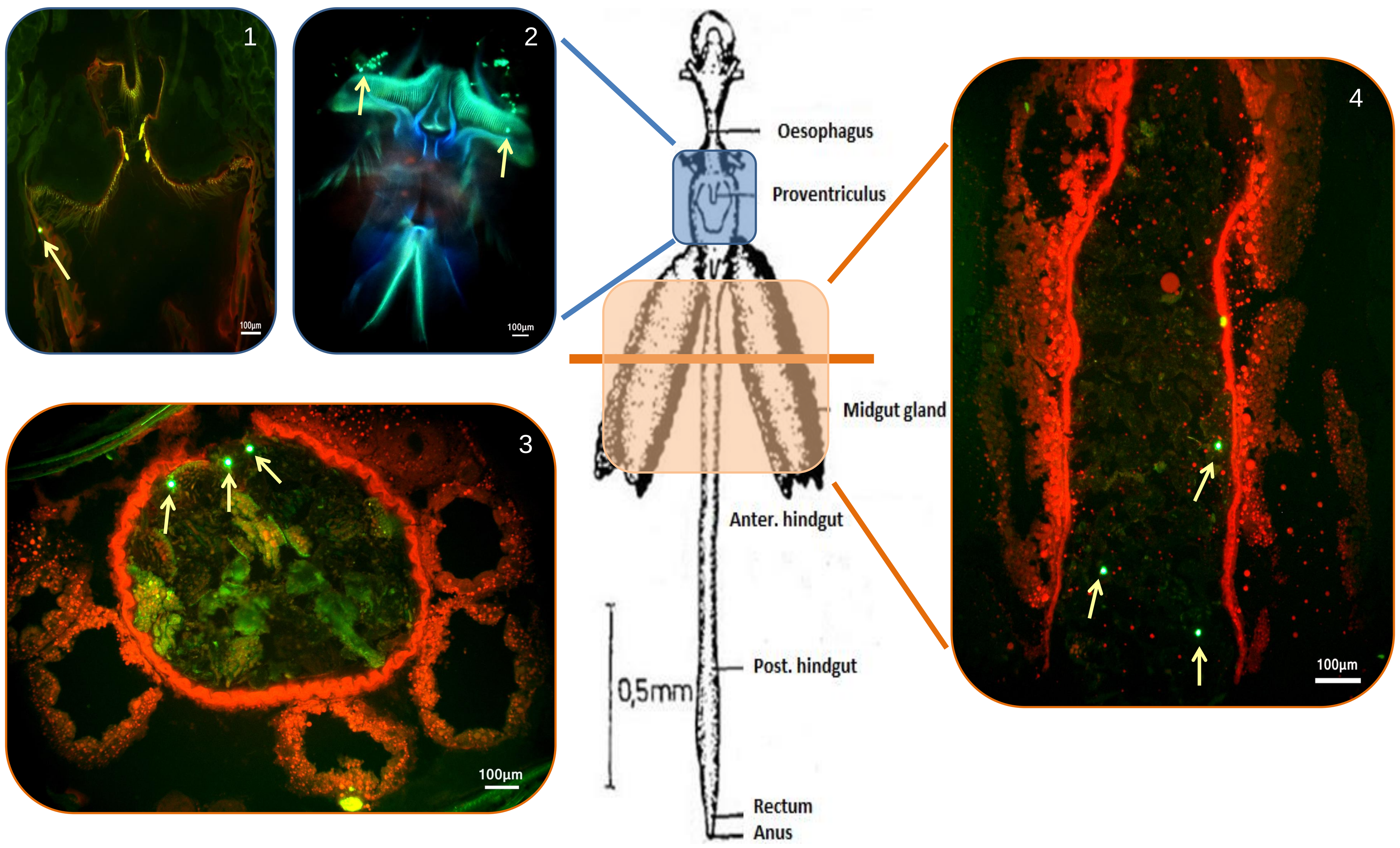




A - Choice feeding assay with *Idotea emarginata*

B - A piece of artificial food containing green fluorescent plastic beads (PS, 10 µm)

C - Result of the choice feeding assay:Comparison of the ingestionrates using a paired t-test



Cryo-sections of ingested microplastics (arrows) in the intestines of *I. emarginata,* visualisation with fluorescence microscopy / **1** – Longitudinal section through the stomach / **2** – Squash preparation of dissected stomach / **3** – Transversal cut of gut and midgut caeca / **4** –Longitudinal section through gut and midgut caeca. Sketch of the internal tract of isopods, modified after Jones et al. 1969 (6).

Results & Outlook

All individuals ingested the offered microplastics. The green fluorescent beads were regularly identified in the stomach (Fig. 1), the gut (Fig. 3,4) and in the fecal pellets. No particles were observed in the midgut glands, the principal digestive organ of crustaceans. Apparently, the unique anatomy of the digestive tract with the fine-meshed filter apparatus between stomach and midgut gland prevents the passage of the particles into the gland.

In the choice feeding assay the isopods did not distinguish between food items with and without microplastic beads (Fig. C, p=0.4960). In similar experiments using food items with microplastic fibres and fragments (1-100 µm), respectively, the isopods did not differentiate between food with and without microplastics. Our results clearly indicate that marine isopods do not reject food particles contaminated with plastics even when alternative food sources are available.

Based on this knowledge, we are currently conducting a long-term experiment to investigate the effects of ingested microplastics on the isopod fitness (e.g. mortality, ingestion rates and intermoult period).

References

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