

Quantification of microplastics in surface water collected during SO268/3 between Vancouver and Singapore

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Background

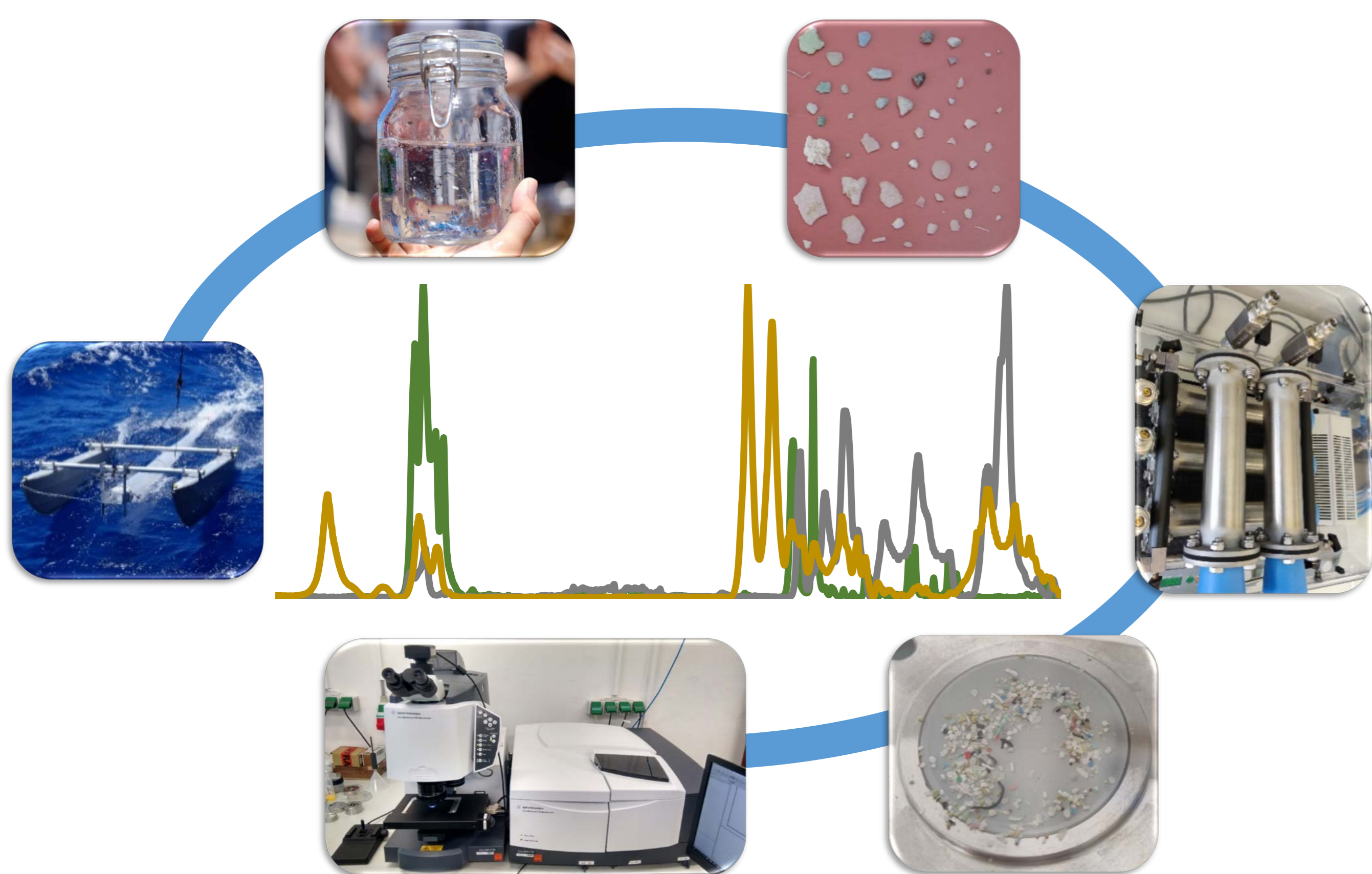
The amount of plastic produced worldwide yearly is constantly increasing. The lack of sufficient recycling technology or infrastructure, mismanagement of plastic waste and (un)intentional littering lead to an increasing pollution of the marine environment with plastic particles. About 50% of the plastic mass produced globally consists of the polymers polyethylene and polypropylene. Because of their comparably low density these polymers are positively buoyant in marine water and float on the ocean surface if they are not colonized by substantial biofilms. Ocean currents form gyres and lead to accumulation zones in their centers. In these zones the concentration of plastic particles at the surface is supposed to be higher compared to other regions. Due to their persistent nature plastic particles are present in the environment for a long time.

Hypotheses

- A:** Microplastics are ubiquitous in Pacific Ocean surface waters.
- B:** Ocean currents favor their accumulation in the area of the North Pacific Gyre - the Great Pacific Garbage Patch (GPGP).
- C:** Plastic concentrations vary along the cruise track. Remote regions show lower concentrations compared to the GPGP.
- D:** Surface (micro)plastics are dominated by low density polymers and show an increased degree of fragmentation and weathering with greater distance from land.

Key findings

- A:** Microplastic particles > 500 µm were found **at all sampling sites** along the cruise track between Vancouver and Singapore. (Rynek et al., in preparation)
- B:** **Two accumulation zones** were identified – Papahānaumokuākea Marine National Monument (**Fig. 1, 5**) and Great Pacific Garbage Patch (**Fig. 1, 9**).
- C:** Concentrations varied between 10.000 items/km² and 172.000 items/km² (**Fig. 2, right**).
- D:** Plastic items > 2 mm were dominated by **fragments** (72%), followed by **undefined particles** (13%) and **fibers** (10%). **Polyethylene** (80%) and **polypropylene** (18%) were most abundant (**Fig. 2, left**). Results were **consistent with modelling approaches** and **litter survey** data (Tekman et al., in preparation).



Methods

Surface water samples were collected with a 330 µm catamaran net at 9 stations during the cruise SO268/3 on the German research vessel SONNE between Vancouver and Singapore from May to July, 2019. The collected particles were rinsed into glass containers and stored frozen until further processing in our laboratories. Suspended particle samples were wet sieved and potential plastic items were optically sorted out from the >2 mm fraction. The smaller size fraction was cleaned by a combination of enzymatic and oxidative digestion (Löder et al., 2017) to remove natural particles. Residual particles were wet sieved again to yield fractions > 500 µm and 500-330 µm. All particles > 500 µm were analyzed by attenuated total reflection fourier transform infrared spectroscopy (ATR-FT-IR). Measured spectra were compared with a reference database using the software siMPle. Particles <500 µm were deposited on Anodisc membranes and analyzed by FT-IR imaging. Imaging data is evaluated with the Purity Microplastics Finder software.



Fig. 1 - Comparison of plastic concentrations from different sampling stations. Two accumulation zones (5 – Papahānaumokuākea Marine National Monument, 9 – Great Pacific Garbage Patch) were identified.

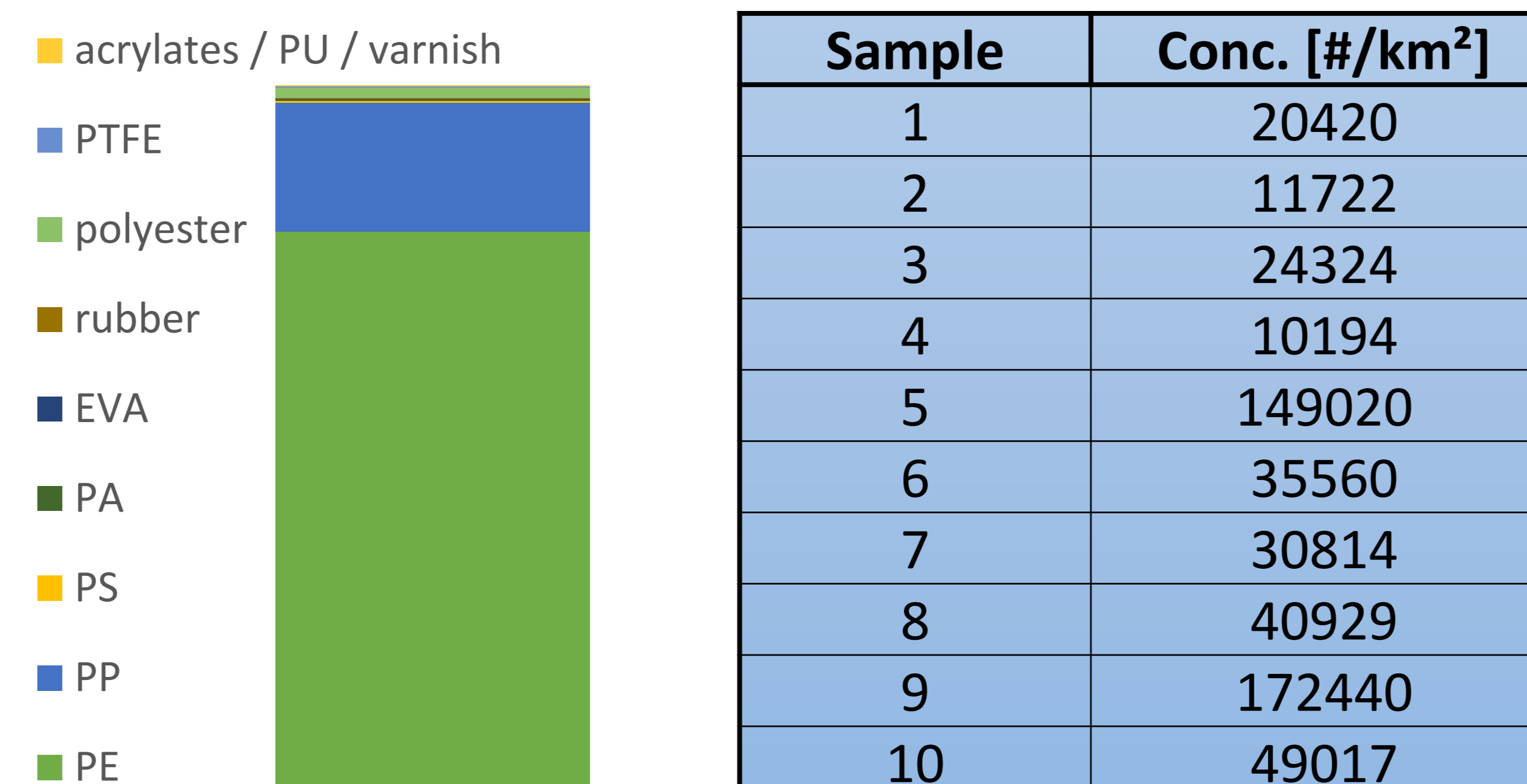


Fig. 2 - Proportions of detected polymers (left) and number concentrations of plastic items (> 500 µm) found at different sampling locations (right).