Composition and spatial distribution of microplastic in marine waters of Latvia

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BACKGROUND & AIM

Microplastic pollution in the marine environment is a globally growing concern. Monitoring spatial distribution of microplastic concentrations, type, size and chemical composition may help to identify sources and entry pathways. Such information has crucial role in initiating focused mitigation. This study investigates microplastic pollution in marine surface waters of Latvia as a first step **to understand the dynamics involved in microplastic spatial distribution and chemical composition as well as to improve and optimise sample treatment process**.

STUDY AREA

Samples were collected in the marine waters of Latvia – **open sea** and **semi-closed Gulf of Riga** (Figure 1).

The **sampling sites were selected to represent coastal as well as open waters**, with particular attention to ports.

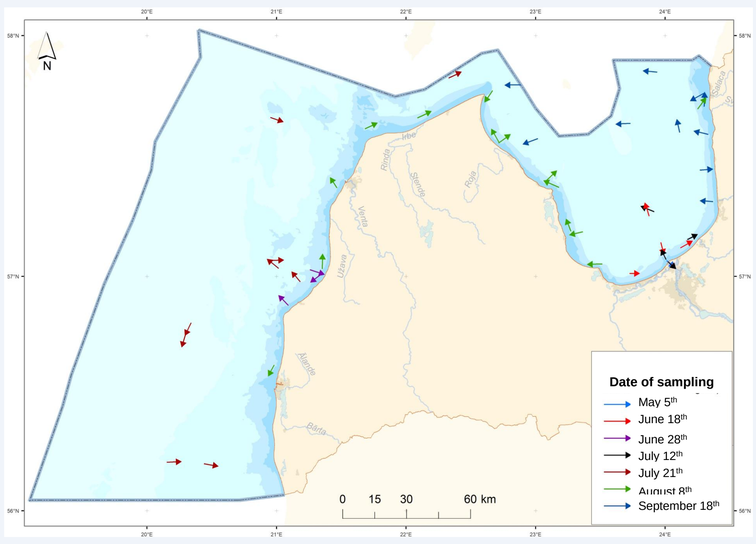

***Figure 1**. Microplastic sampling sites in marine waters of Latvia.*

METHODS

Sampling	*Time*: **May to September 2018** *Amount*: **45 transects** *Equipment*: **"Manta" net** (300 µm) *Sampling specifics*: net attached to the side of vessel and trawled for **1 hour at speed of 2 knots**
Preperation of samples	*Sample treatment*: **10% NaOH, 15% H_2O_2, enzymes** *Particle collection*: filtration on **GF/F filters**
Analysis of samples	*Microplastic detection*: **image analysis** *Equipment*: Leica DM400 B LED and camera DFC 295 *Classification*: **colour, size and type** (fragment, film, pellet, bead, filament, foam)
Determination of plastic polymer	*Identification of chemical structure*: **Fourier-transform infrared spectroscopy** *Equipment*: ThermoFisher Scientific Nicolet iSO20 spectrometer

SAMPLE TREATMENT METHOD DEVELOPMENT

To reduce the time necessary for sample analysis, **sample size was reduced using Folsom Plankton splitter** to determine the best aliquot size (Figure 4), and treatment process was improved (Figure 5) **experimentally assessing the best treatment steps** and performing quality control.

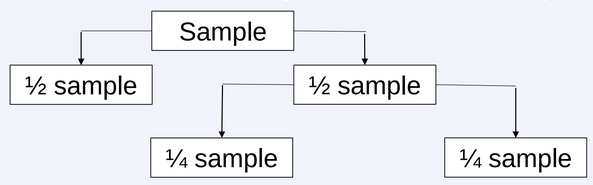

***Figure 4.** Scheme for assessing the best aliquot size for reducing sample size.*

RESULTS: reduction of sample size

The highest efficiency for aliquoting samples was observed when **splitting sample no more than one time**. Efficiency was evaluated by total particle amount and proved to be in a ratio between 51:49, 53:47 and 56:44

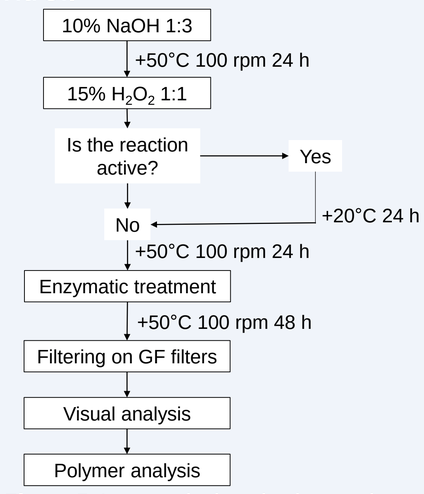

***Figure 5.** Improved microplastic sample treatment method.*

RESULTS: spatial distribution

- Results show the **presence of microplastics in all samples** (from 0.08 to 2.54 particles/m^3)
- **Open sea part has lower microplastic concentration** (0.08-1.11, average 0.42 particles/m^3) **than semi-closed Gulf of Riga** (0.11-2.54, average 0.67 particles/m^3)
- **Highest particle concentration was recorded at the Southern part of Gulf of Riga** and might be caused by inflowing Daugava river water and costal currents
- **Spatial distribution of microplastic abundances were highly variable** among investigated sites

Graphs for spatial distribution

RESULTS: type

Detected particles were affiliated to one of the six categories (Figure 2)

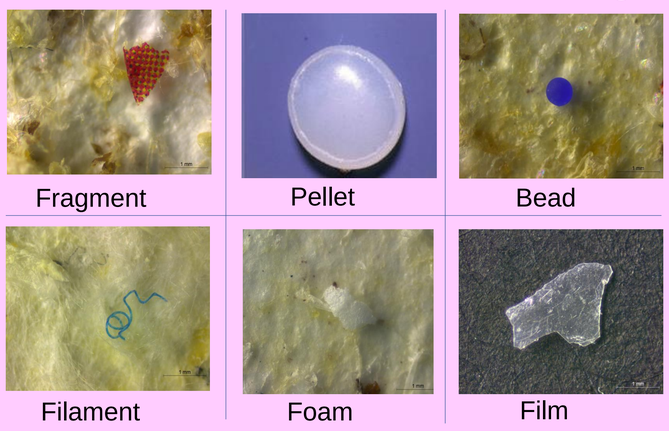

***Figure 2**. Types of particles found in samples – plastic fragments, pellets, beads, filaments, foams, films.*

From total amount of particles

Most common types were:
- Filaments (55.86%)
- Plastic fragments (37.66%)
- Film particles (4.91%)

Least common types were:
- Beads (1.22%)
- Foam (0.30%)
- Pellets (0.04%)

RESULTS: size

A tendency was observed for the abundance of particles to increase as the size of particles decreases (Figure 3)

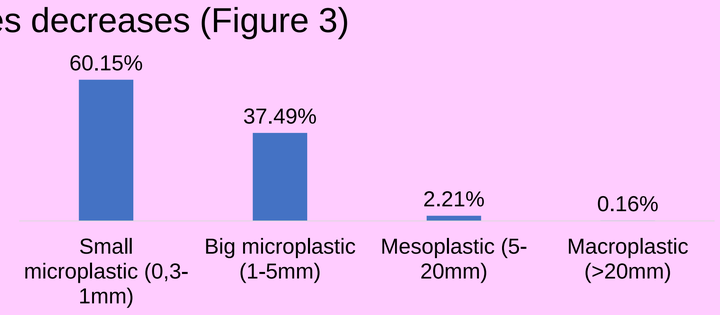

***Figure 3**. Distribution of microplastic particles in different size categories.*

RESULTS: plastic polymers

- **Dominant microplastic polymers were polyethylene compounds** and degradation products (Figure 6)
- Relatively **smaller group was polypropylene and polystyrene** particles

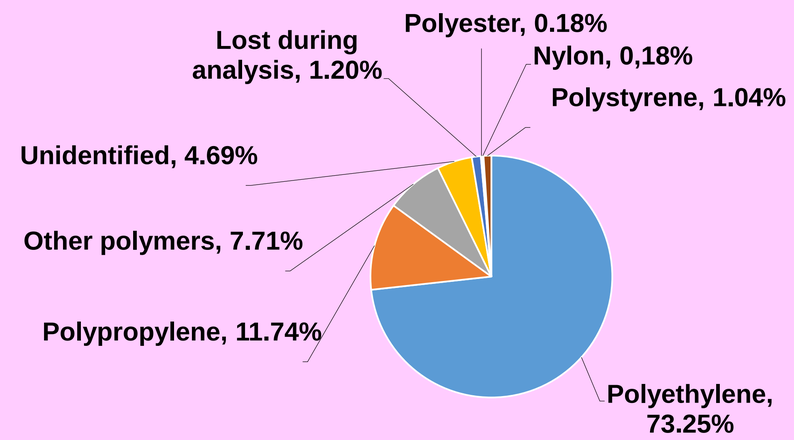

***Figure 6.** Chemical composition of tested particles, results of infrared spectra.*

CONCLUSION

- **Abundance of microplastics and composition by type and chemical structure varies between sampling sites** and the time of sampling.
- **Open sea part has lower microplastic concentration than Gulf of Riga**.
- **Improved sample treatment method significantly reduced time** for visual analysis.
- Further research should be done for monitoring purposes by performing **repeated sampling at the same sampling sites for several periods** to assess the seasonal and spatial dynamics of microplastic.
- **Abiotic factors** such as water physical properties, currents, weather and others **should be taken into account** when analysing aquired data.

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