

Microplastics in water and sediments of the Vistula River in the Warsaw area

Dr Ilona Sekudewicz

i.sekudewicz@twarda.pan.pl



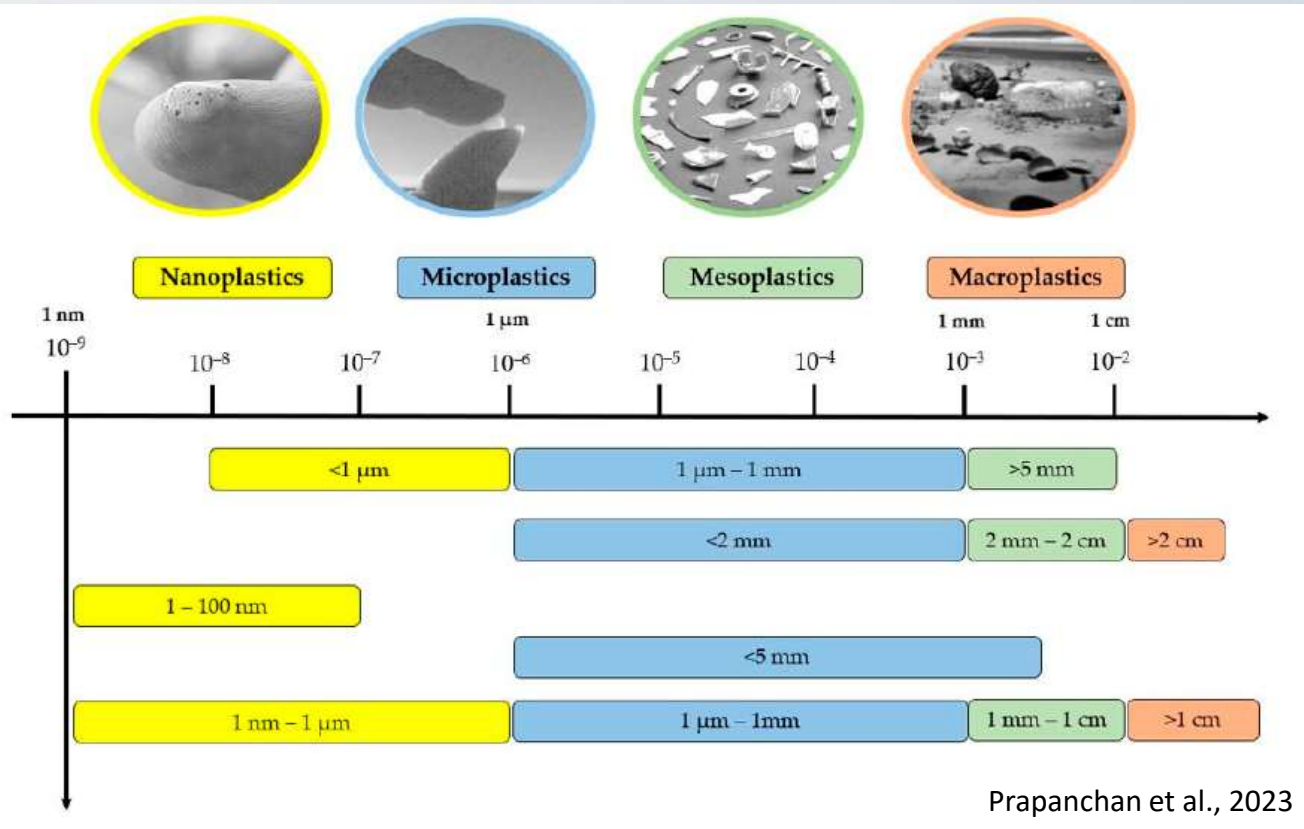
Institute of Geological Sciences
Polish Academy of Sciences

Earth and Planetary Research Centre



What are microplastics?

Different authors' stated definitions of plastics based on size
(Prapanchan et al., 2023)



Microplastics (MPs) are usually defined as plastics with a size smaller than 5 mm (e.g., Arthur et al., 2009; Cole et al., 2011; Hidalgo-Ruz et al., 2012).

Classification
by source

Primary MPs
(Manufactured plastic pieces 5 mm or less in size)

Secondary MPs
(Formed when large plastics break down into pieces smaller than 5 mm)

Where did the idea come from?

Scholarship in the Department of Marine Systems at Tallinn University of Technology
(Pioneers into Practice 2019: EIT Climate-KIC)

Microplastics in the Baltic Sea



Fot. Ilona Sekudewicz

Collection of microplastics from surface water using a manta trawl



Fot. Ilona Sekudewicz

Preparation of sediment samples at Tallinn University of Technology

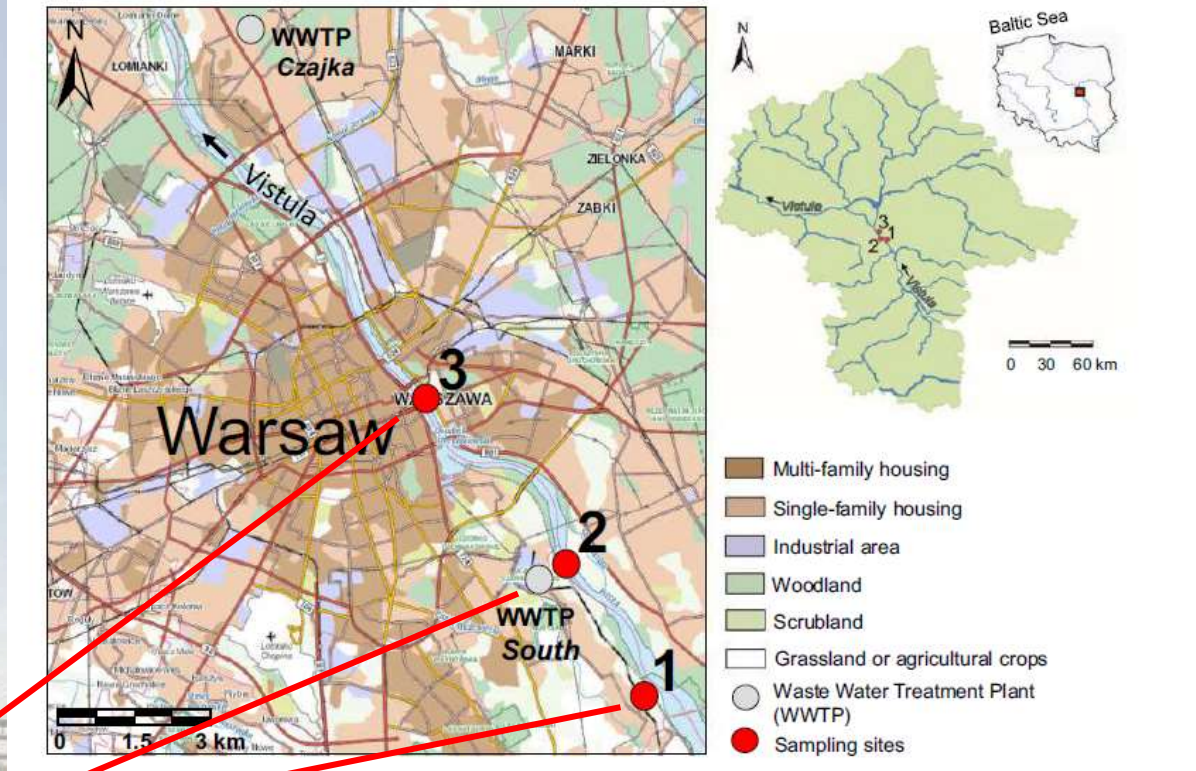
Aim of the study

The present study aimed to investigate **microplastic pollution** in the highly urbanized and industrialized **section of the Vistula River** in Poland.

We hypothesized that the highest microplastic contamination would occur in the Warsaw city centre.

To test this hypothesis, water and sediment samples were collected from:

- 1) a less populated area (near to Wilanow Zawady Beach),
- 2) a site near the tributary outlet and wastewater treatment plant (WWTP 'South'),
- 3) a sampling point (Beach by the Poniatowski Bridge) close to the city centre.



Study area (Sekudewicz et al., 2021)



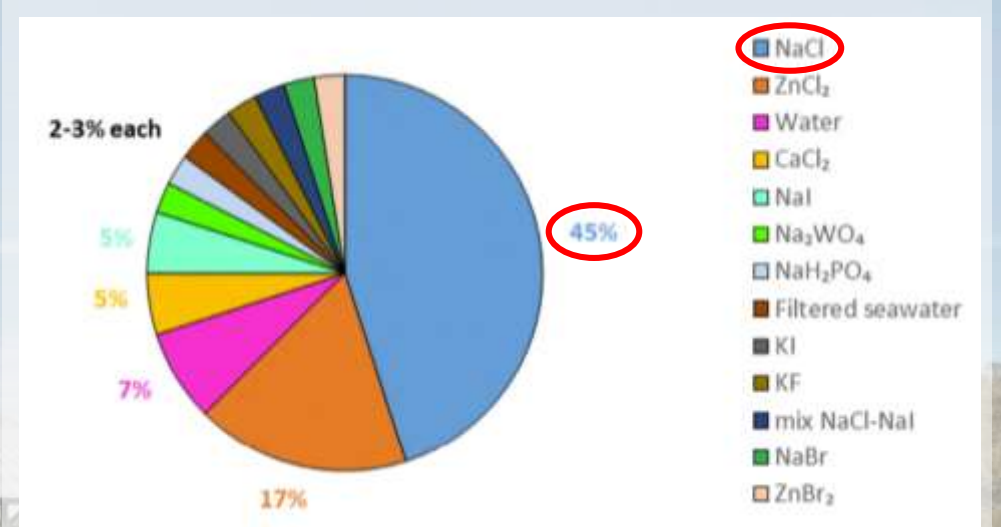
Beach by the Poniatowski bridge

Samples collection and preparation



Plankton net

The extraction of microplastics from sediments using a NaCl solution (density 1.2 g mL^{-1})



Chemicals used to perform density separation in considered studies (Bellasi et. al., 2021)



sklep-chemland.pl

Glass Filtration Set



www.fishersci.se

Glass fibre filters

Results



Fot. Ilona Sekudewicz

Samples of macro- and microplastics (MPs) collected from the bank of the Vistula River



Fot. Ilona Sekudewicz



Fot. Ilona Sekudewicz

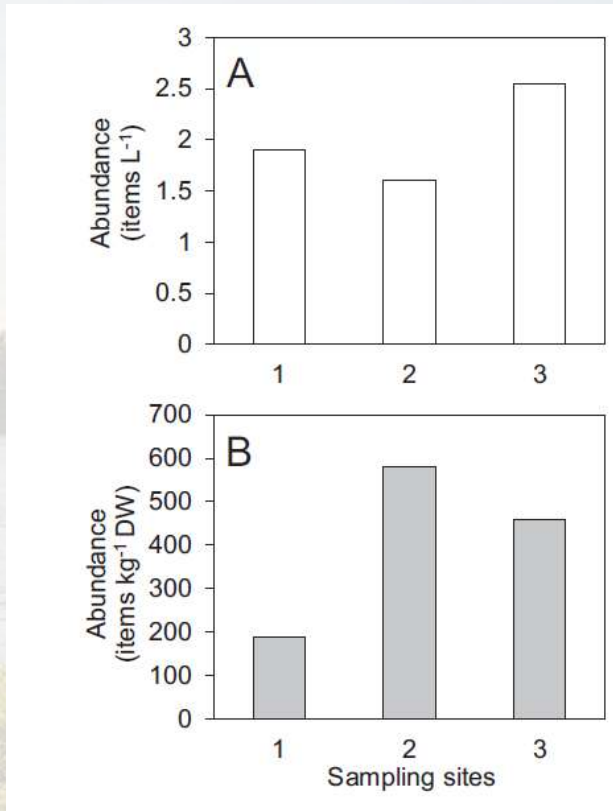
MP particles were detected directly on the filters under a stereomicroscope (Delta Optical SZ-630B) with Delta Optical DLT-Cam Viewer software



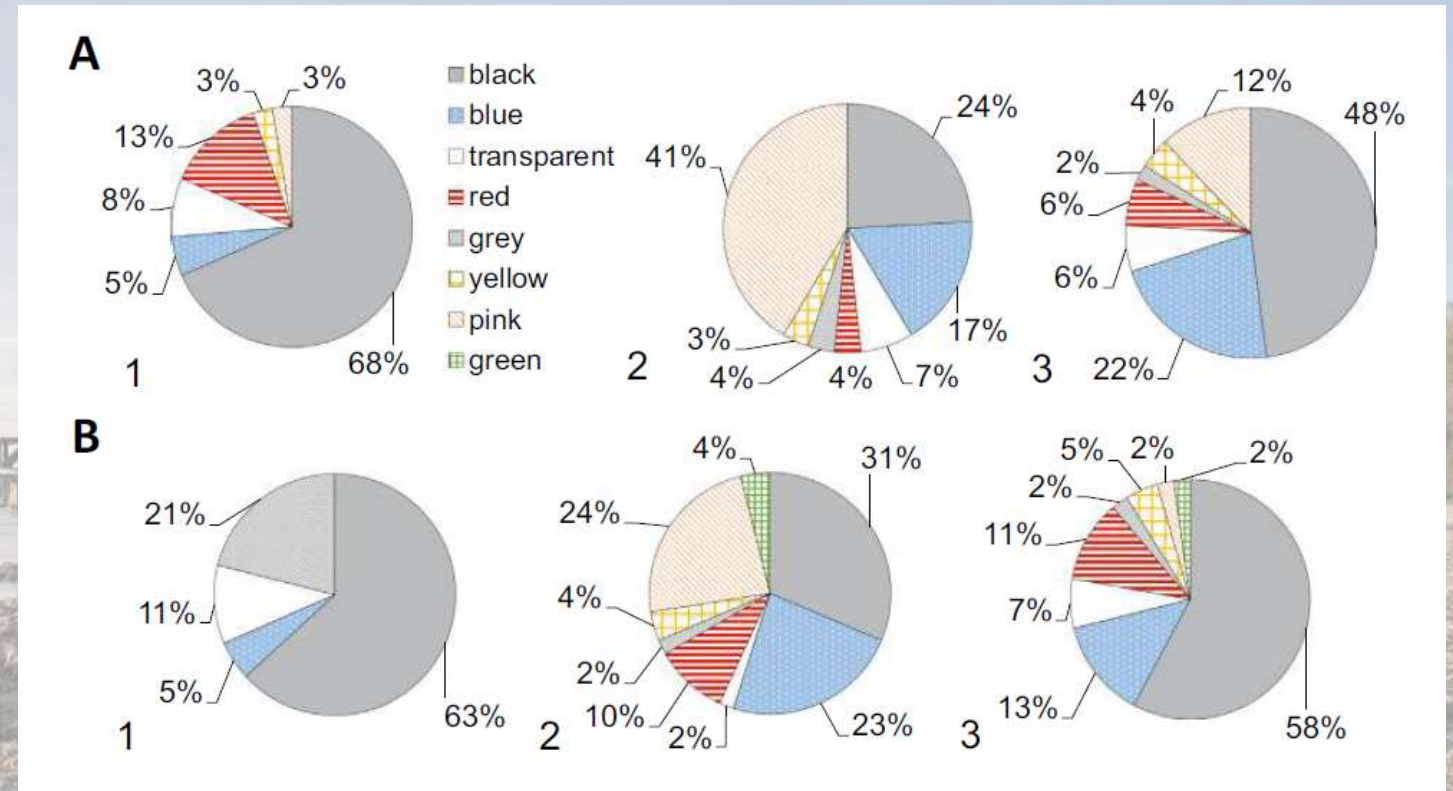
Fot. Ilona Sekudewicz

The concentrations of MPs in the **water** ranged from **1.6** items L⁻¹ (site 2) to **2.55** items L⁻¹ (site 3), whereas, in the **sediments**, it ranged from **190** items kg⁻¹ (site 1) to **580** items kg⁻¹ (site 2).

Results

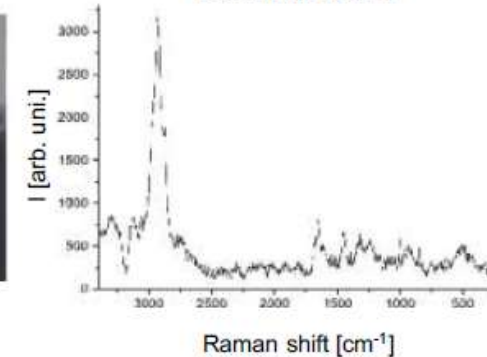
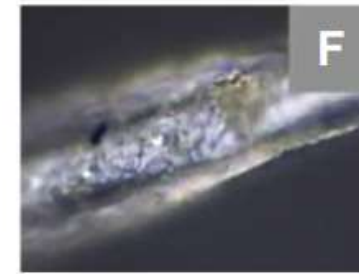
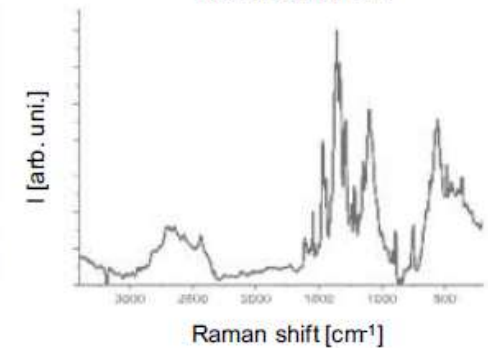
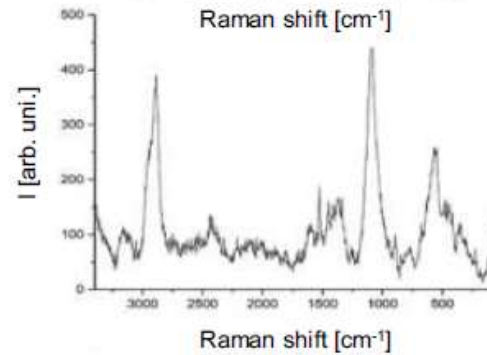
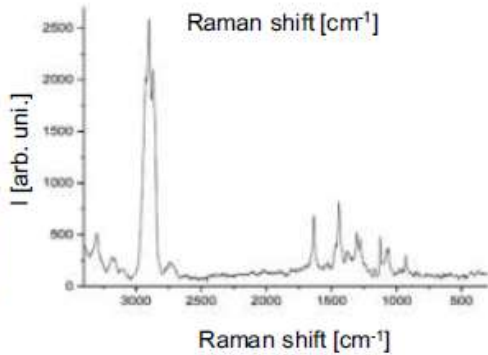
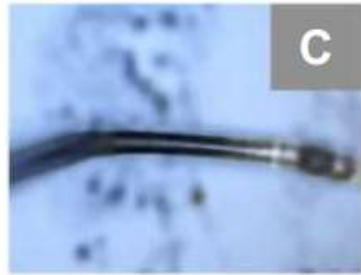
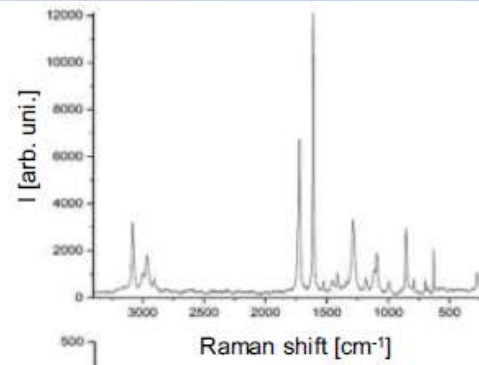
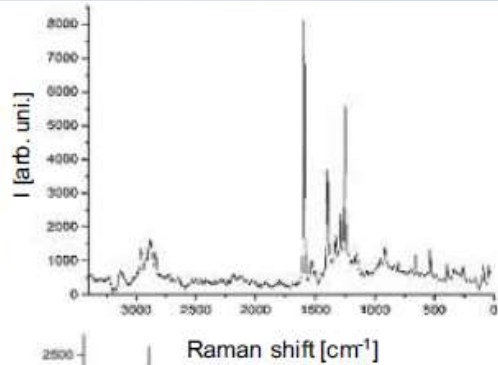
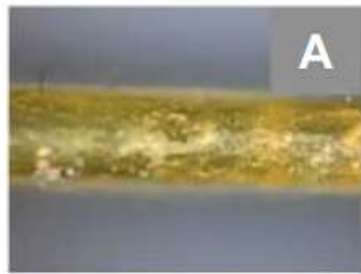


Distribution of MPs along the selected section of the Vistula River (sampling sites 1–3) in the water (A) and sediment (B) samples.



Composition of different colours (%) of MP particles extracted from water (A) and sediment (B) samples collected from the Vistula River (sampling sites 1–3).

Results

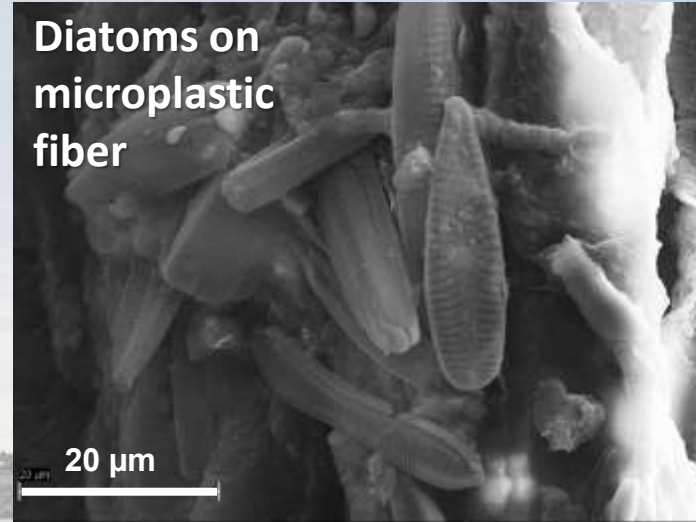


Raman spectroscopy results for the fibres (A and F – sediment; B, C and D – water) and fragment (E – sediment) detected under the microscope and classified as being of polymer origin (due to the presence of the -CH₂ and -CH₃ chemical groups).

Author: dr Agnieszka Monika Dąbrowska, University of Warsaw, Faculty of Chemistry

Sekudewicz et al. (2021)

Results



Scanning Electron Microscopy (SEM) Imaging

Author: dr Marcin Syczewski, University of Warsaw, Faculty of Geology

Sekudewicz et al. (2021)

Conclusions:

- A section of the Vistula River crossing the Warsaw metropolitan area is significantly polluted by MP particles.
- River water samples collected close to the city centre were the most polluted, whereas the highest content of MPs in bed sediments were observed at a site near the tributary outlet and the WWTP 'South'.
- The MPs were characterized by Raman spectroscopy as polystyrene (PS), polypropylene (PP), and a variety of other materials with different levels of deterioration.
- The variation in MP abundance along the selected section of the river was associated with the sedimentological conditions, as confirmed by the grain size analysis of sediments.
- Additional research is essential to gain a deeper understanding of the factors and processes driving the migration and distribution of MPs in river and lake ecosystems.
- Further in-depth studies on MPs, supported by complementary research, are crucial to better understand the role of rivers in transporting MPs to the sea.

References:

- ❖ Arthur, C. V., Baker, J., & Bamford, H. A. (2009). Proceedings of the international research workshop on the occurrence, effects, and fate of microplastic marine debris. NOAA Technical Memorandum NOS-OR&R-30.
- ❖ Bellasi, A., et al. (2021). The extraction of microplastics from sediments: An overview of existing methods and the proposal of a new and green alternative. *Science of the Total Environment*, 758, 143535.
- ❖ Cole, M., Lindeque, P., Halsband, C., Galloway, T.S., 2011. Microplastics as contaminants in the marine environment: A review. *Mar. Pollut. Bull.* 62, 2588–2597.
- ❖ Hidalgo-Ruz, V., Gutow, L., Thompson, R. C., & Thiel, M. (2012). Microplastics in the marine environment: A review of the methods used for identification and quantification. *Environmental Science & Technology*, 46(6), 3060–3075.
- ❖ Prapanchan, V. N., et al. (2021). A global perspective on microplastic occurrence in sediments and water with a special focus on sources, analytical techniques, health risks, and remediation technologies. *Environmental Pollution*, 265, 114668.
- ❖ Sekudewicz, I., Dąbrowska, A.M., Syczewski, M.D., 2021. Microplastic pollution in surface water and sediments in the urban section of the Vistula River (Poland). *Sci. Total Environ.* 762, 143111.

**Thank you for your
attention!**



**Institute of Geological Sciences
Polish Academy of Sciences**

Earth and Planetary Research Centre

