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Microplastic monitoring in the Ice cover of a Finnish freshwater lake

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Area of study and hypothesis

- Kallavesi is a freshwater lake next to city of Kuopio (Population ca. 120 000)
- Area of 48 000 hectares
- Mean depth of 9,65 m
- Lake is covered in ice for several months a year
 - Mean of 136 frozen days per year in the 21st century
- Study was conducted during years 2020, 2021 and 2022
- Hypothesis: **Microplastics accumulate to ice layer during winter season**

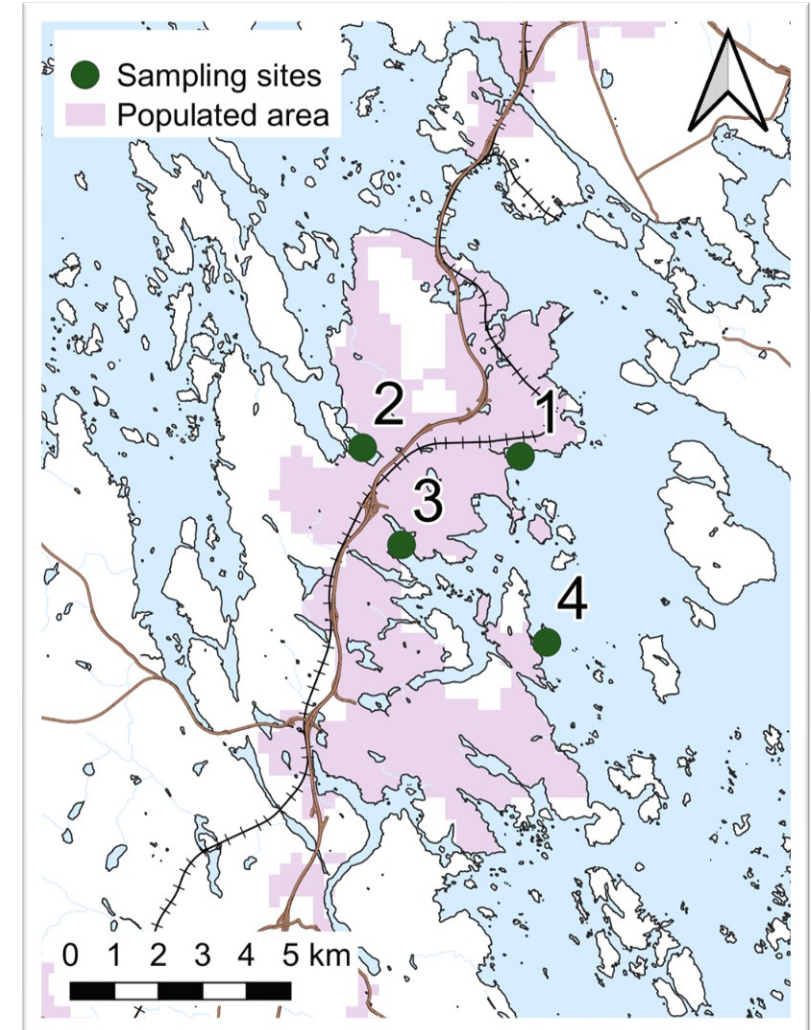


Picture: Emilia Uurasjärvi



Studied sites

- City harbor (1)
- Shallow bay (2)
- Snow dump site (3)
- Open lake (4)
- 3 replicates per site
- Water and fish samples have been taken from the same area by Uurasjärvi et al. (2020)

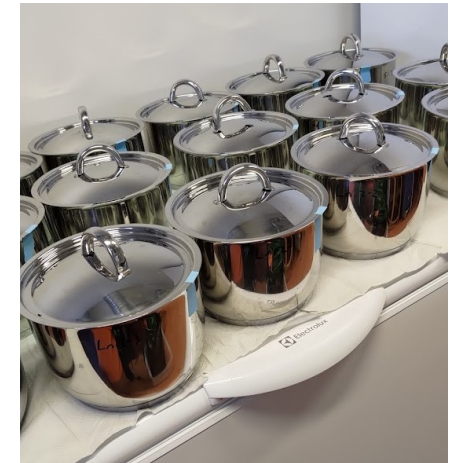
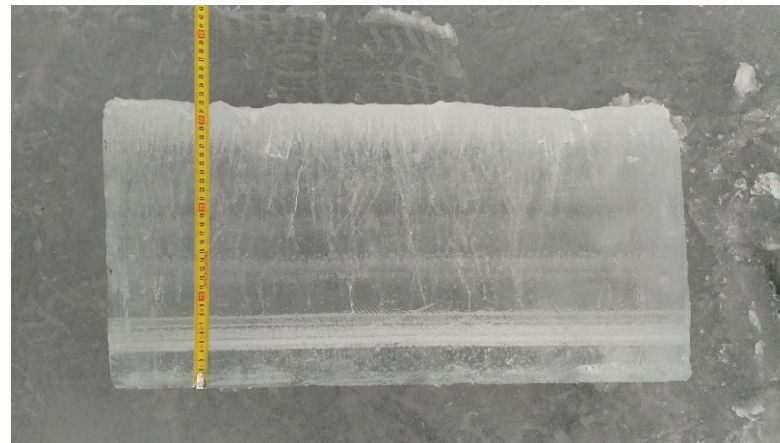


Picture: Emilia Uurasjärvi



Sampling

- Equipment
 - Battery powered chainsaw
 - Manual folding ice saw
 - Steel containers
- Only the clear ice layer was sampled = bottom layer
- Around 10-15 liters of water per site
 - In 3 replicates
- Samples were left to thaw

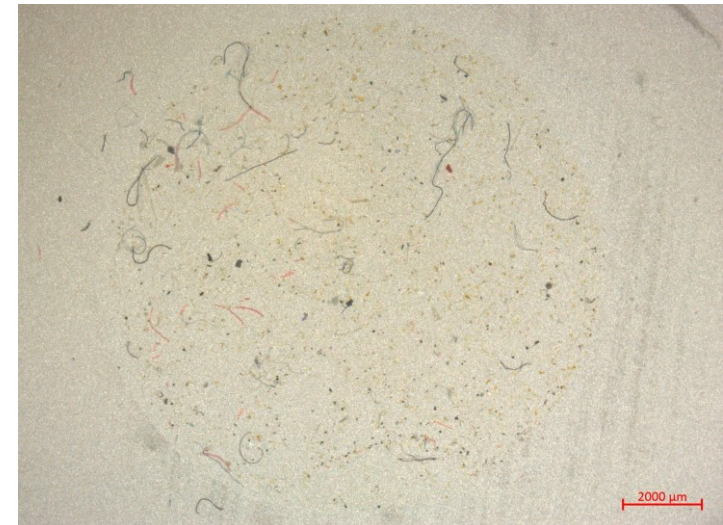


Pictures: Tuomo Soininen



Sample pretreatment

- Hydrogen peroxide to dissolve organic matter
- Density separation for inorganic matter
 - ~1,8 g/cm³ sodium polytungstate
- 5 μm pore size silver membrane filters

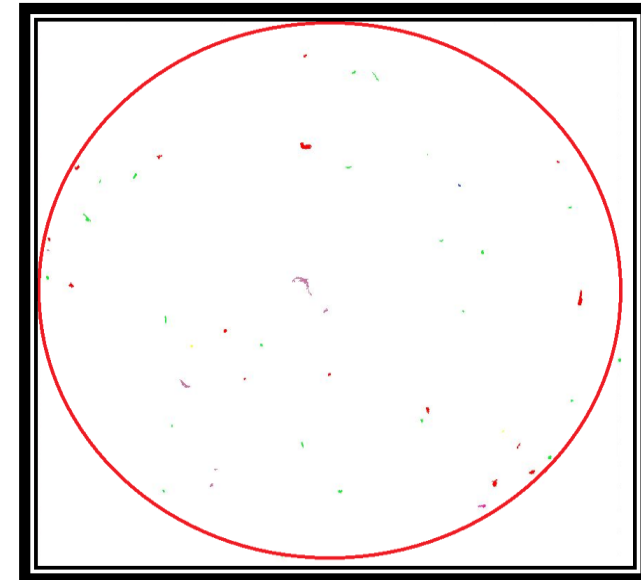
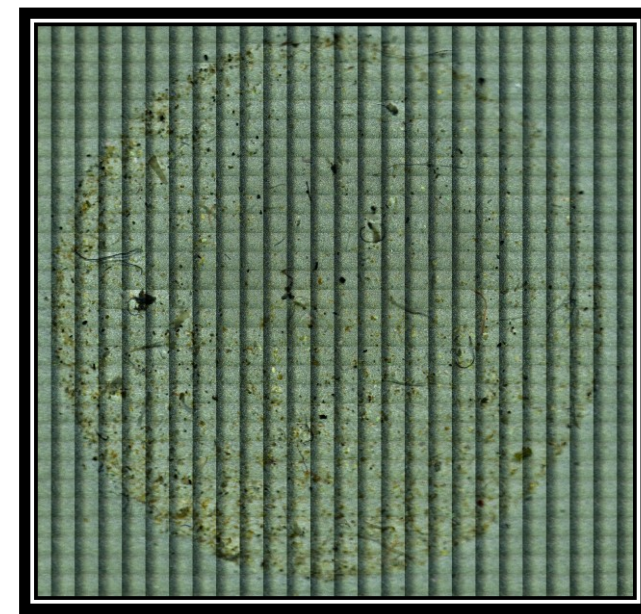


Pictures: Tuomo Soininen



Sample analysis

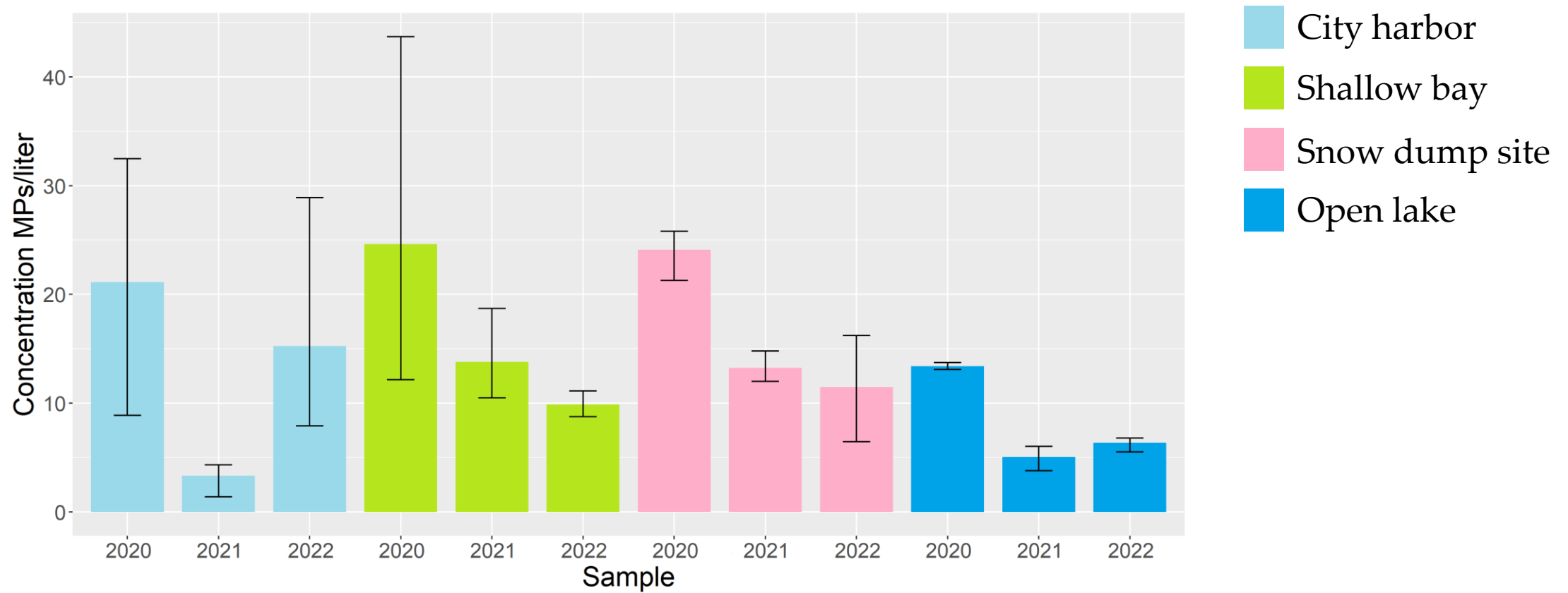
- Agilent Imaging FTIR with 128x128 FPA-detector was used
 - Pixel size 5,5 μm
- Allows analysis of the whole sample area ($\varnothing = 12 \text{ mm}$)
- Spectral analysis using SiMPLe-software
 - Inhouse spectral library
- Size limit ca. 15 μm



Pictures: Tuomo Soininen

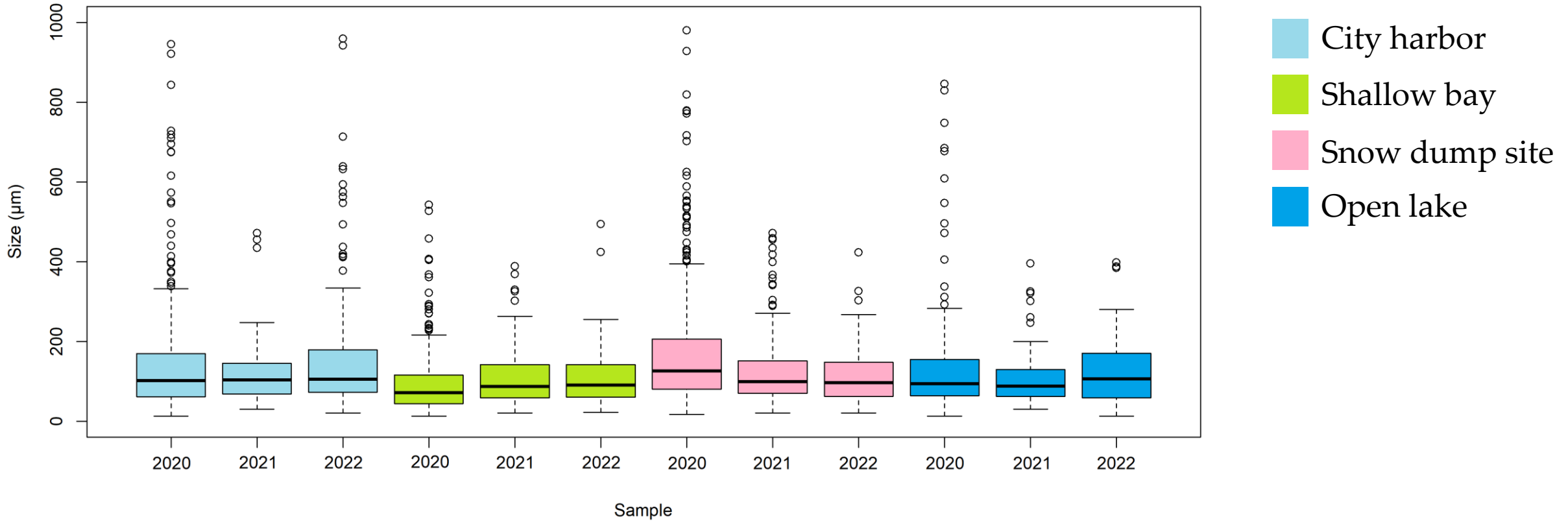


Results – Plastic concentrations



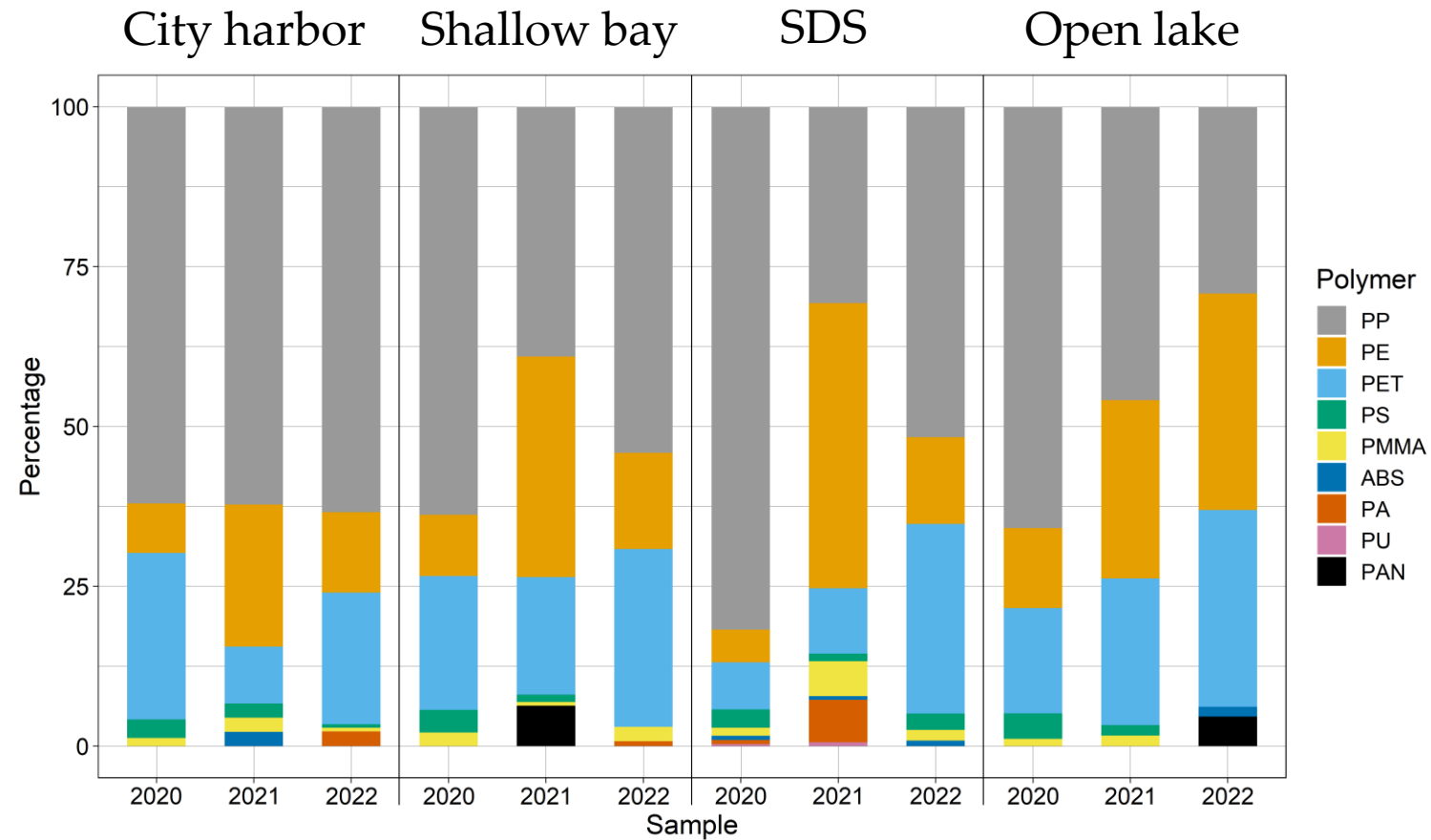


Results – Size distribution





Results – Polymer types



Relative polymer amounts. SDS = Snow dump site



Comparison with other studies

- In this study we found concentrations of plastics in ice to be **3-25 MPs/liter**
- Surface Water samples from lake Kallavesi (Uurasjärvi et al. 2020)
 - Highest concentrations **0,25 MPs/liter**
- Fish samples from lake Kallavesi (Uurasjärvi et al. 2021)
 - On average, **11 ± 16 MPs/perch and 25 ± 50 MPs/vendace**
- Surface water of lake Baikal (Moore et al. 2022)
 - Concentration **0,034-0,707 MPs/liter**
- Ice layer of lake Baikal (Karnaukhov et al., 2022)
 - Average number of microplastic fibers was **55,5 - 65 particles/liter**
- Microplastics in sea ice of Gulf of Bothnia (Geilfus et al. 2019)
 - Concentrations in sea ice **8-41 MPs/liter**



Conclusions

- Fresh water ice appears to be a temporal deposit for microplastics
 - Concentrations in ice far exceed those found in surface waters
- Snow layer might shield the ice from microplastic fallout
 - Year with no snow at all showed the highest concentrations
- Challenging area of study
 - Years are different
 - Small sample size



Discussion



18.1.2020



7.1.2022



References

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- Karnaukhov, D., Biritskaya, S., Dolinskaya, E., Teplykh, M., Ermolaeva, Y., Pushnica, V., Bukhaeva, L., Kuznetsova, I., Okholina, A., & Silow, E. (2022). Distribution Features of Microplastic Particles in the Bolshiye Koty Bay (Lake Baikal, Russia) in Winter. *Pollution*, 8(2), 435–446. <https://doi.org/10.22059/POLL.2021.328762.1159>
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Thank you!

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