

# Analysis of heavy microplastics in five tributaries of the Danube River, Germany and the Cumberland River, Tennessee

Mitch Wolfe and Virginia Hudspeth  
 Department of Earth and Environmental Systems  
 Faculty advisor: Dr. Martin Knoll

## Introduction

- Microplastics
  - Plastics that are manufactured (primary) or broken down (secondary) to be 5mm in diameter or less
  - Heavy microplastics (PET and PVC) are less commonly found in surface water analysis
- Danube River watershed: 83 million residents, 800,000 km<sup>2</sup>
  - German Danube basin: 9.2 million residents, 56,184 km<sup>2</sup>
- Cumberland River watershed: 2.5 million residents, 46,620 km<sup>2</sup>

## Purpose

- To quantify microplastic presence at depth in tributaries of the Danube River
- To compare microplastic levels in the Danube River watershed and the Cumberland River watershed

## Methods

- Study site: tributaries of the Danube River (the Isar, Lech, Regen, Altmühl, and Naab Rivers) in Germany near their confluences with the Danube (Figure 1)
- Two 1-liter samples were collected near the center of each tributary 1-2 meters above the riverbed
- 500 ml from each tributary was filtered through a 10-micron stainless steel filter disk
- Filter disks were visually inspected under a microscope to determine independent counts of the microplastics by two researchers, and then values were averaged
- Microplastic data filtered with 30-micron filter disks from the Cumberland River and Mud Creek were obtained from a previous study (Knoll et al., 2022)

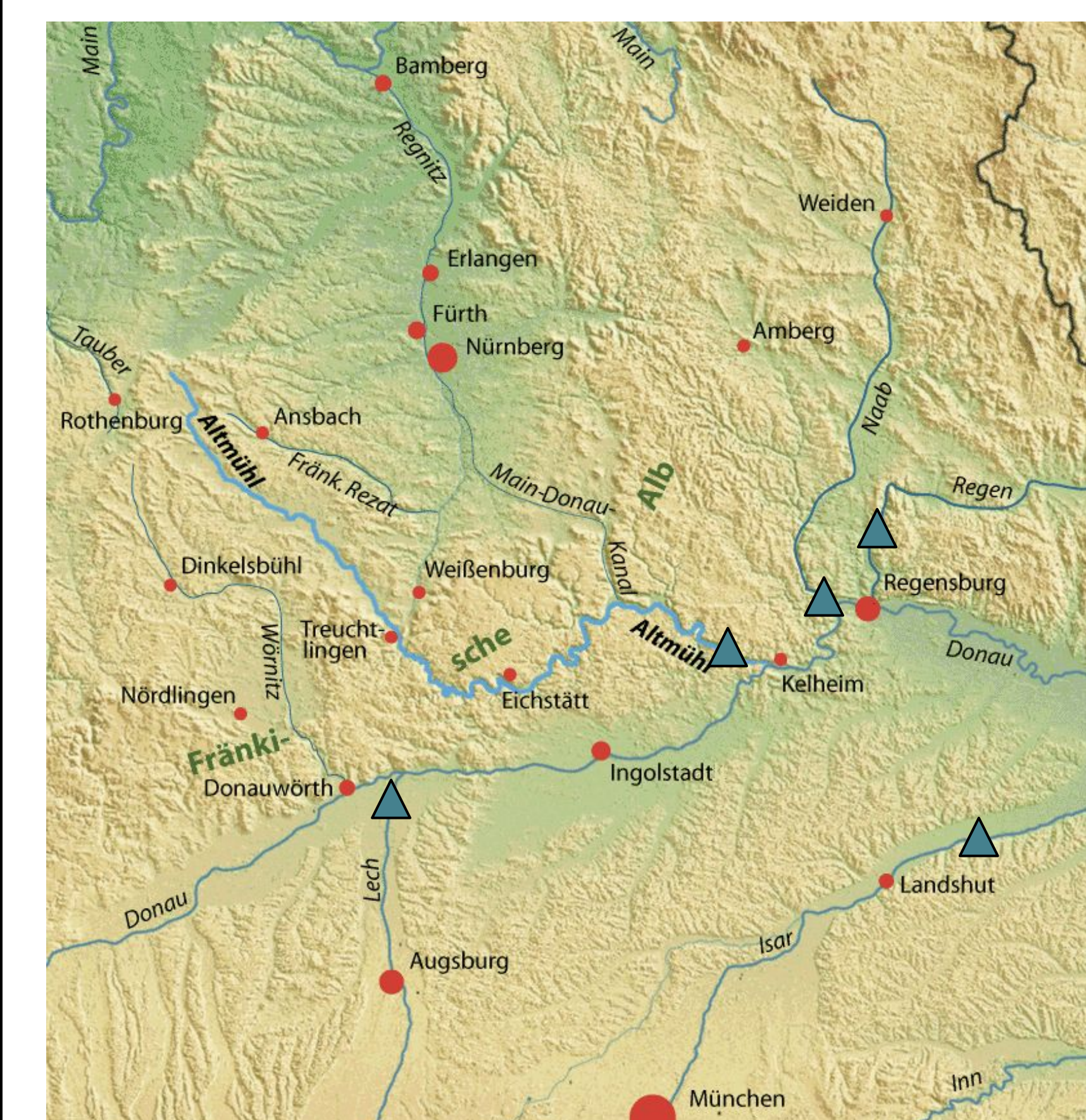


Figure 1: Map of microplastic sampling locations along tributaries of the Danube (Donau) River shown by blue triangles. Size of red dots symbolize population of surrounding towns.



Figure 2: Sample collection on the Regen (left) and the Altmühl (right)

## Results

- All microplastics found in the Danube tributary samples were fibers (primary microplastics)
- Microplastic particles per cubic meter (mp/m<sup>3</sup>) ranged from 13,000 (Lech) to 5000 (Isar) (Figure 4)
- In the Cumberland River, values ranged from 1000 to 2500 mp/m<sup>3</sup>, while levels in Mud Creek were between 4000 and 6500 mp/m<sup>3</sup> (Figure 3)
- We estimate that few, if any, microplastic fibers found in the Danube tributary samples were 30 microns or larger

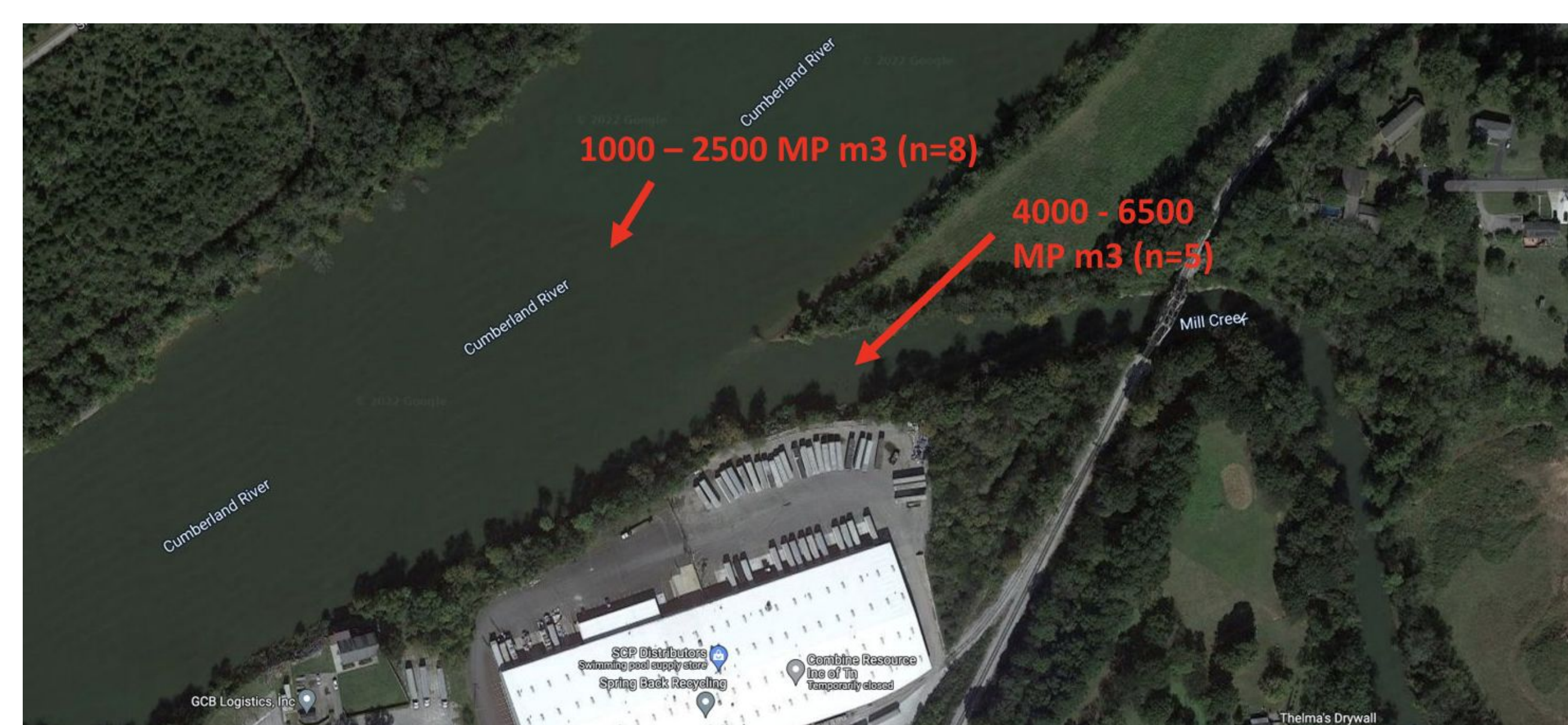


Figure 3: Cumberland River and Mud Creek site map in Nashville, TN. Microplastics found at depth and filtered with a 30 micron mesh. Measured in particles per cubic meter.

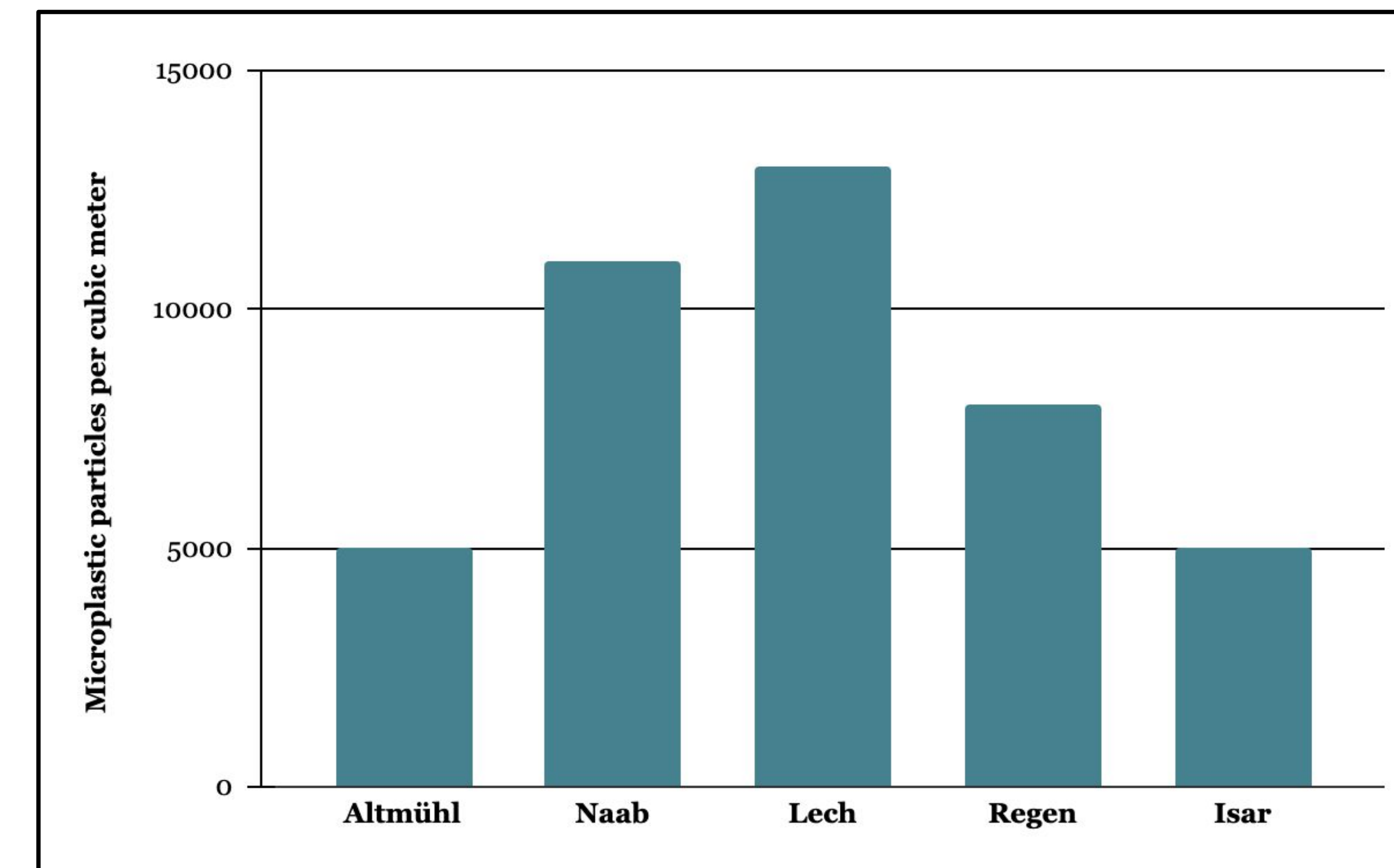


Figure 4: Number of microplastic particles per cubic meter counted in the five sampled tributaries of the Danube River

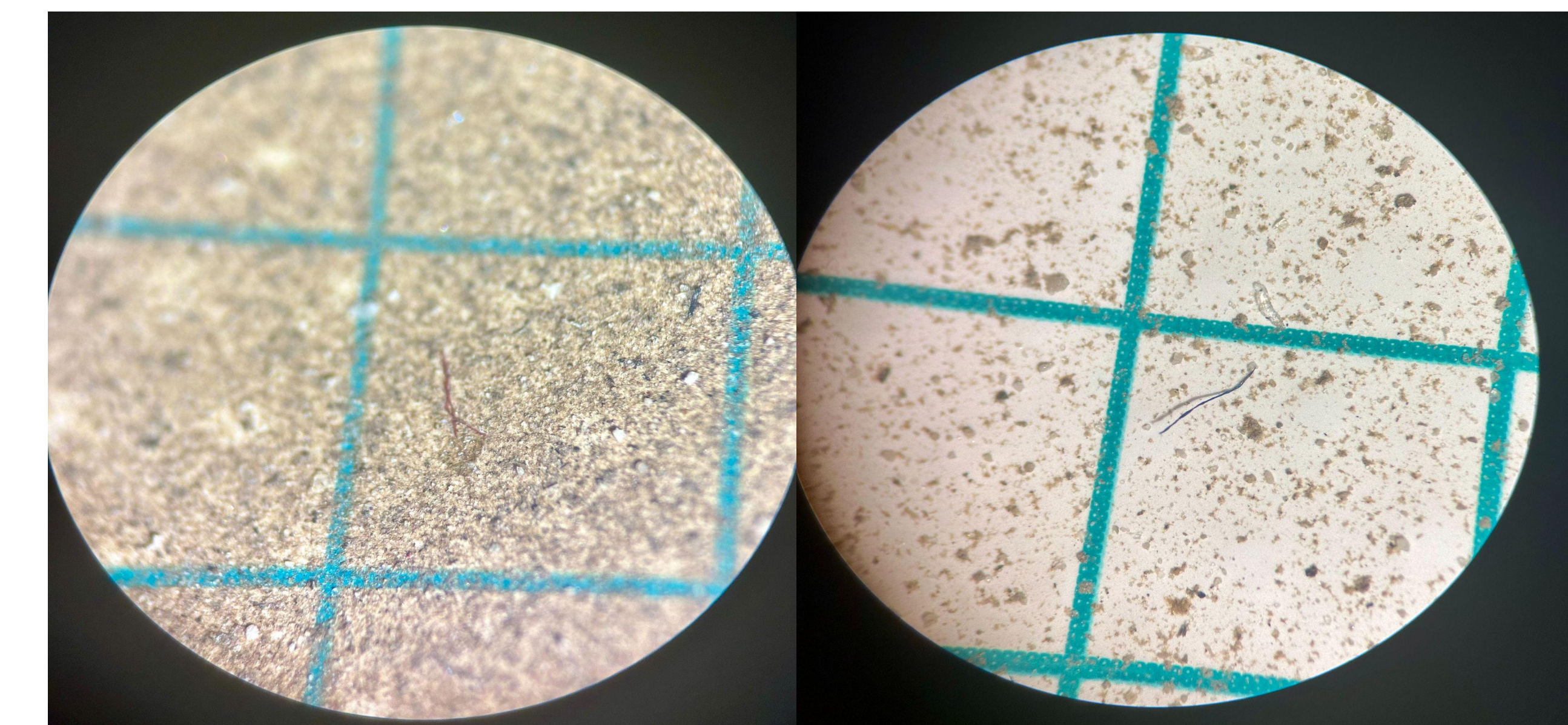


Figure 5: Microplastic fibers found in water samples from the Naab (left) and the Lech (right)

## Conclusions

- Higher numbers of microplastic particles in Danube tributaries are potentially due to the smaller mesh size when filtering samples
- The lack of secondary microplastics in the Danube River watershed indicates that microplastics are not being produced from the breakdown of macroplastics
- Recommended further research includes using 30-micron filters on samples from the Cumberland River to confirm whether or not this would result in a higher level of microplastics in the Cumberland River when compared to tributaries of the Danube River

## References

Martin Albert Knoll, M.C. Morgan, S.J. Freedman, V. Hudspeth and A. Fath, 2022, Detection of microplastics in bottom waters of the Tennessee and Cumberland Rivers and their tributaries in Tennessee, USA, Conference: Impacts of microplastic on freshwater and terrestrial ecosystems, Ascona, Switzerland.