



Characterization of Microplastics in the Atmosphere

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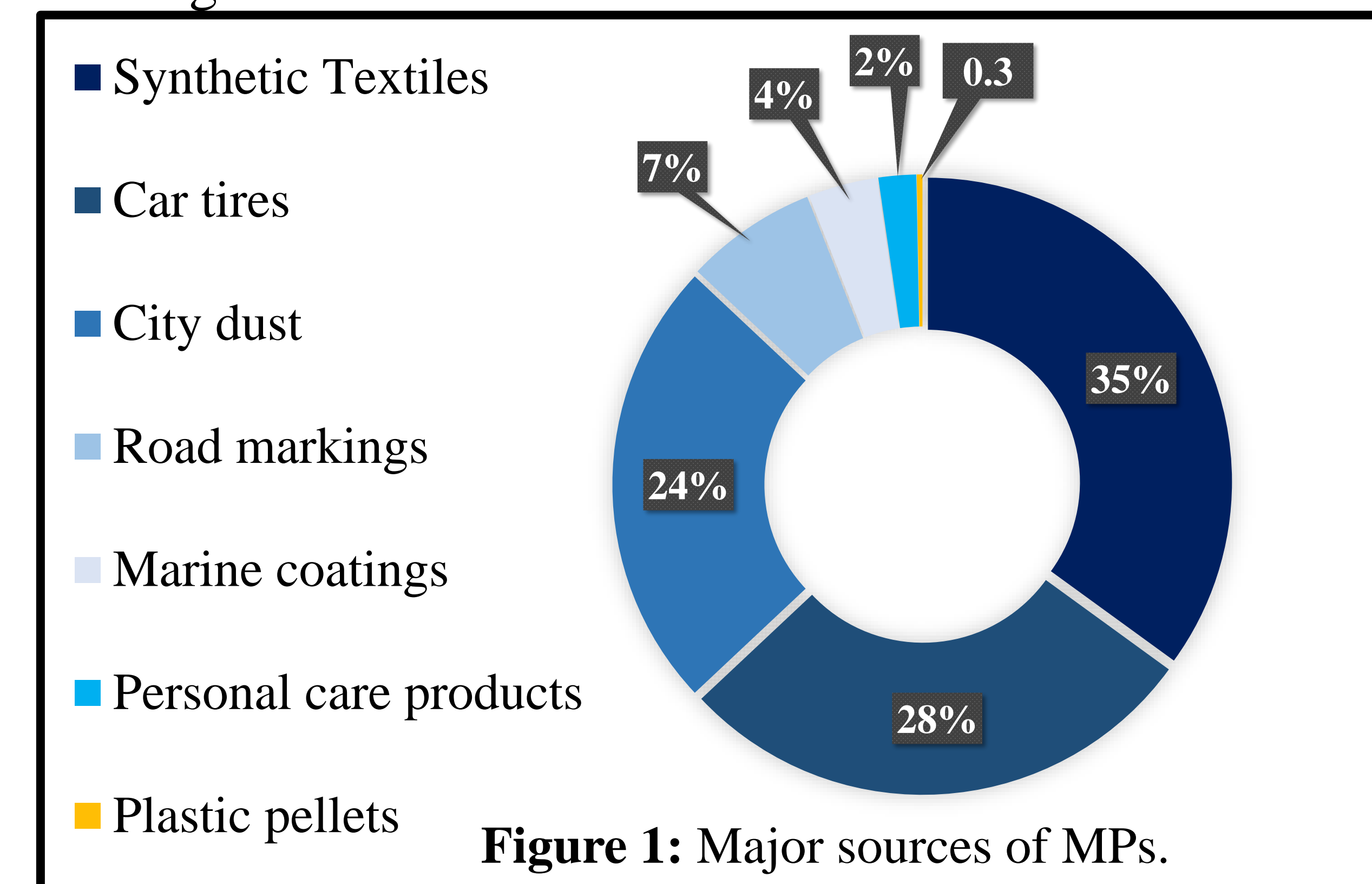


Introduction

Microplastics (MPs) are defined as small fragments of plastic or synthetic polymer material that are less than 5mm in size ⁽¹⁾.

There are two types of MPs (Figure 1):

- Primary MPs: plastic pellets, beads, nurdles, fibers, personal care and cleaning products additives.
- Secondary MPs: created from the breakdown of larger items.



<https://www.statista.com/chart/17957/where-the-oceans-microplastics-come-from/>

Human health impacts⁽²⁾: MPs are durable and tend to persist in the lungs. The health risks that this poses includes:

- Respiratory irritation
- Interstitial lung disease
- Dyspnea
- Coughing

A study conducted in 11 national parks found that over 1,000 metric tons of MPs precipitate annually through wet and dry deposition in the U.S. This is equivalent to ~120 to 300 million plastic water bottles⁽³⁾.

Objective

Goal: identify the composition and origin of MPs in the atmosphere.

Motivation: Currently, the study of atmospheric MPs is limited, it is critical to conduct more field work to characterize MPs in the atmosphere.

Methodology

Site Selection

This study is conducted at a suburban area i.e. Embry-Riddle Campus in Daytona Beach, Florida. This site was chosen due to diverse atmospheric pollution source including transportation as well as other urban sources.

Sampling: MPs are collected on glass fiber filters.

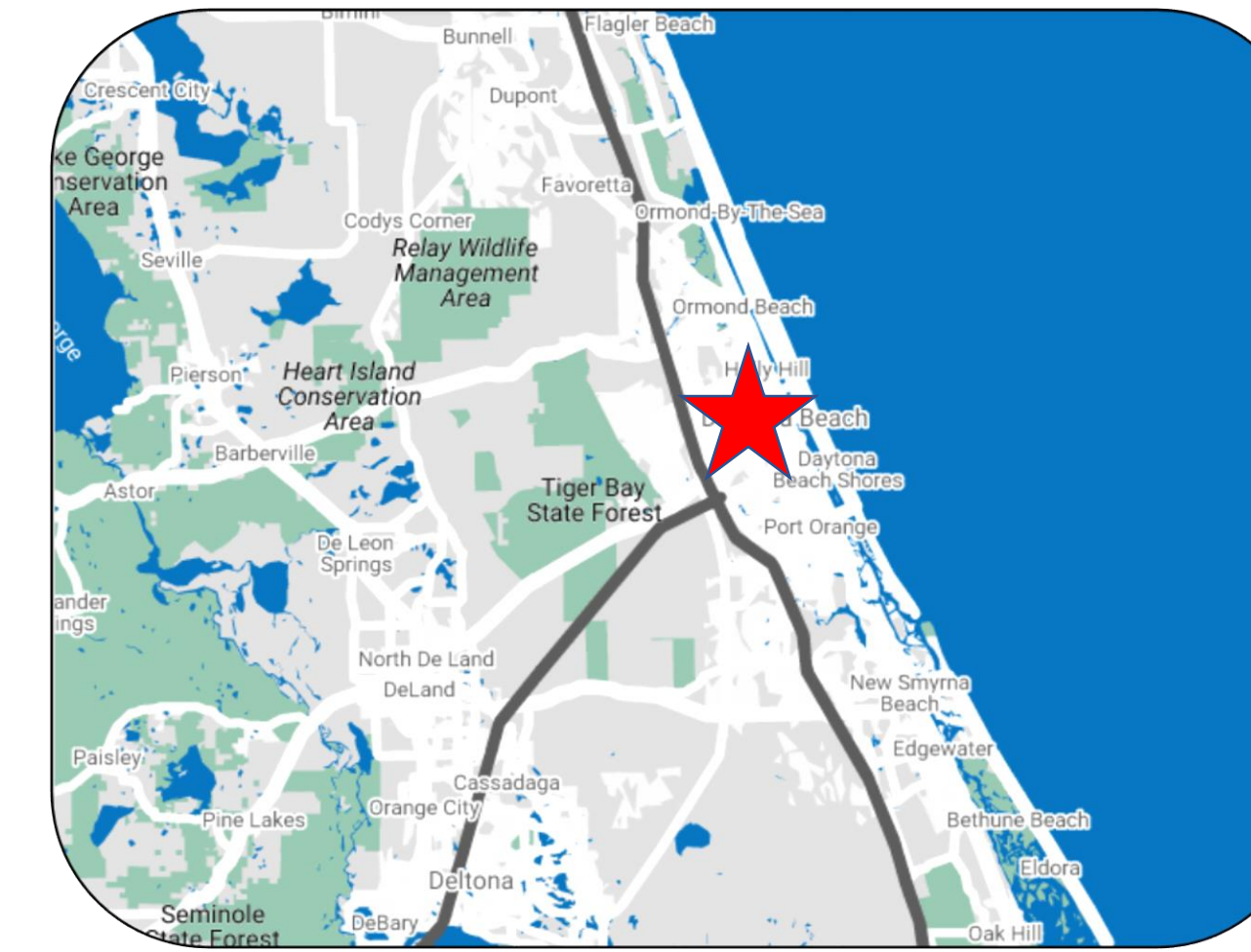


Figure 2: Site location.

Active Sampling

- Entails using a Tisch High Volume Air Sampler to collect MPs daily (Figure 3).
- The concentration of MPs is measured in units of number of MPs per unit volume.



Figure 3: Active sampling setup.

Passive Sampling

- Utilizes a setup devised to hold the filter for the collection of MPs on a weekly basis (Figure 4).
- The deposition rate of MPs is measured in units of number of MPs/unit rate.



Figure 4: Passive sampling setup.

Optical Characterization

Filters are isolated and analyzed under a ZEISS Axioscope 7 compound microscope to determine the size of MPs.



Figure 5: ZEISS Axioscope 7 compound microscope.

Chemical Characterization

Before Fourier transform infrared (FTIR) spectroscopy, filters are immersed and sonicated for 2 hours in a solution of 10%, 15%, and 30% H_2O_2 at 25°C and 60°C, respectively. This process removes the organic material and ensures sampling of MPs only.



<https://www.thermofisher.com/>
Figure 6: FTIR setup.

Results and Discussion

- MPs were collected through active and passive sampling since October 15th, 2020.
- Sampling will be conducted seasonally to characterize the effect of weather conditions on MPs in the atmosphere.
- Three types of MPs were identified, including fragments and

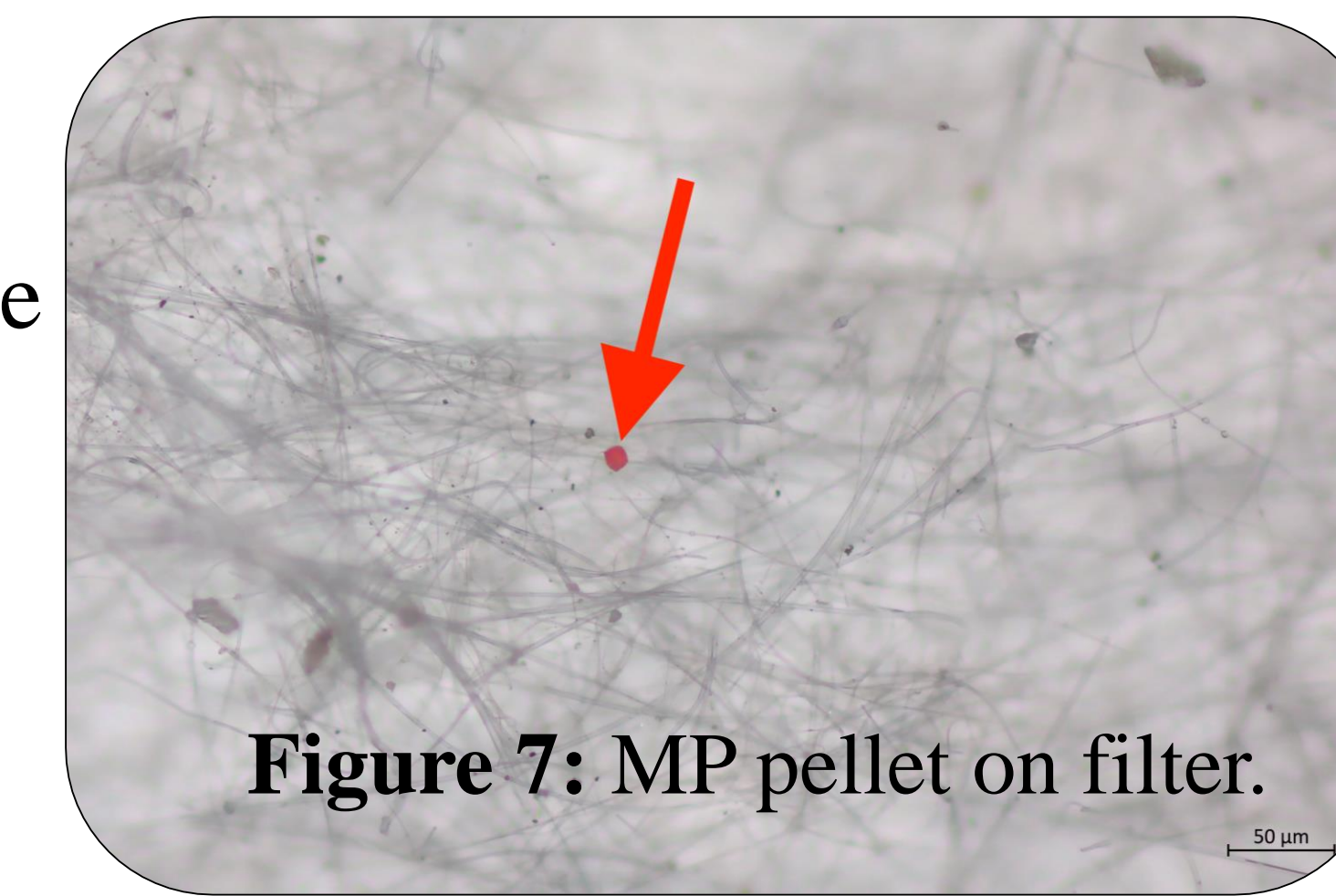


Figure 7: MP pellet on filter.

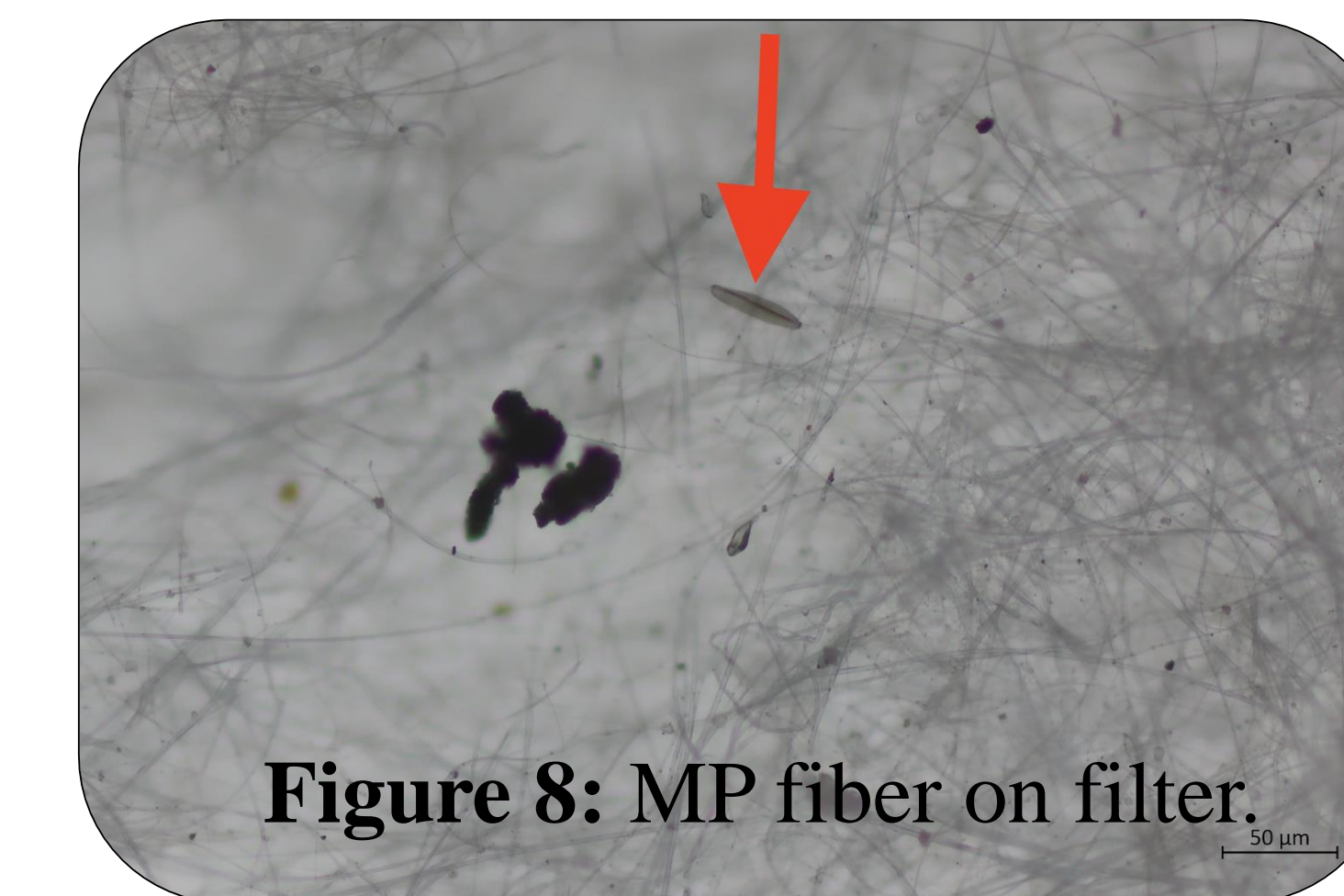


Figure 8: MP fiber on filter.

Conclusions & Future Work

- MPs were detected through active and passive sampling at ERAU campus.
- Using a light microscope, the count and size of microplastics will be determined.
- FTIR will be used to investigate the chemical properties of MPs.

References

1. Frias, J., & Nash, R. Microplastics: Finding a consensus on the definition. (2018, November 22).
2. Gasperi, J. et al. Microplastics in air: Are we breathing it in?. Current Opinion in Environmental Science & Health. Volume 1, (2018).
3. Brahney, J. et al. Plastic rain in protected areas of the United States (2020, June 12)

Acknowledgements

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