Microplastics in Water Bodies

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Microplastics

- What are they?
- In the water cycle…
- Why are they dangerous?

Our Investigation

Investigating the impact of …

- human activity
- different weather conditions

on microplastic concentrations in rivers

AND

- how they differ from microplastic concentrations in river sediment

Variables

Independent

- Area: with or without human activity
- Sediment VS Water
- Weather conditions (rainy, cloudy, snowy)

Dependent

- Microplastic concentrations

Control

- V(water) of each sample: 100L
- Amount of sediment for each sample: 1 teaspoon, diluted with 100mL of water
- Storage: jars, fridge
- Day of collection
- Fenton reagent concentrations & volumes
- Light microscope, magnification 100X

Procedure

Plankton Net

a. Rivers

- Find speed of water
- Determine how long to keep net in water to get approx. 100L

b. Lakes

- Find area with high human activity
- Find distance to walk with net to get approx. 100L
- 2 more samples in same location = replicates
- Repeat for area with low human activity

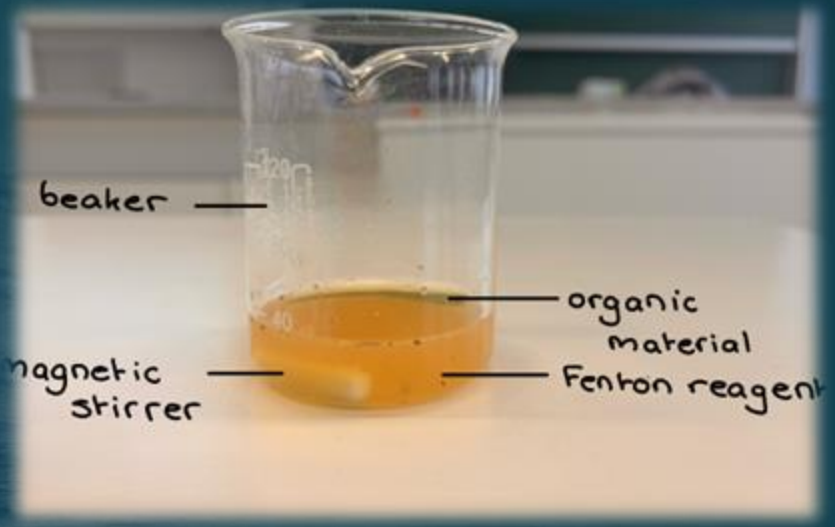
c. Both: microplastics stuck in bottle at end. Rinse with distilled water, transfer into a labelled glass jar

- Repeat all steps in 3 distinct locations for each experiment

Procedure

Fenton Reagent

- 0.278g of hydrated FeSO4 at 0.1M, dissolve in 8mL of distilled water
- Adjust pH = 3 using H_2SO_4 at 0.02M
- Dilute solution to 100mL with distilled water



- Sediment: place 1 teaspoon of it & dilute with 100mL of distilled water
- Pour solution into beaker with stir bar, onto hot plate. T = 50 degrees, RPM = 300
- Make sure pH is still at 3, add 1mL FeSO solution
- Add 3.5mL H_2O_2, 30%
- 25 mins
- Neutralise with NaOH 0.1M
- Put samples into jars, do not fully close lids

Procedure

Filtering & Identification

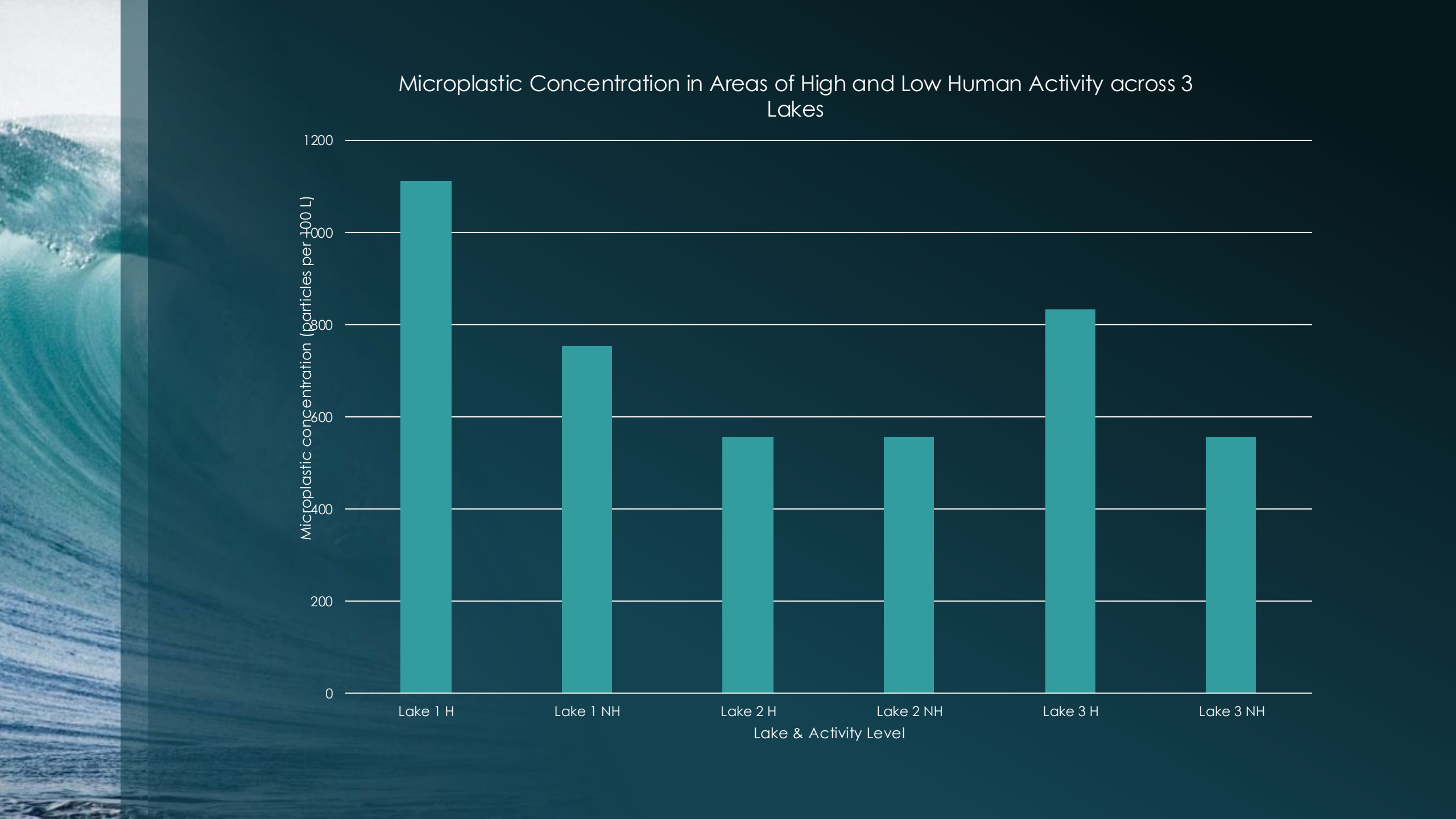
- Filter each sample using filter paper & vacuum
- Cut out 5 randomly selected 1cm^2 cubes
- Observe under 5 fields of view with a light microscope at 100X
- Count & note number of microplastics per field of view
- Measure field of view size, calculate how many fit into 1 filter paper, estimate how many microplastics are present in entire sample

Results

Human Activity

Lake	Activity	Replicate 1	Replicate 2	Replicate 3	Average
1	H	1111.11	1111.11	1111.11	1111.11
1	NH	555.56	873.28	833.33	754.06
2	H	0	555.56	1111.11	555.56
2	NH	555.56	555.56	555.56	555.56
3	H	1666.67	277.78	555.56	833.33
3	NH	277.78	277.78	1111.11	555.56

- Higher amount of microplastics in human activity areas (Lakes 1 & 3)
- Reasons for higher in H (Lakes 1 & 3):
  - Direct input of plastics by humans
  - Disturbance of sediments from swimming
- Reasons for no difference in Lake 2:
  - Influenced by other factors: e.g. water currents, wind, …


Microplastic Concentration in Areas of High and Low Human Activity across 3 Lakes
1200
1000
800
600
400
200
0
Microplastic concentration (particles per 100 L)
Lake 1 H
Lake 1 NH
Lake 2 H
Lake 2 NH
Lake 3 H
Lake 3 NH
Lake & Activity Level

SD & SE & t-test results

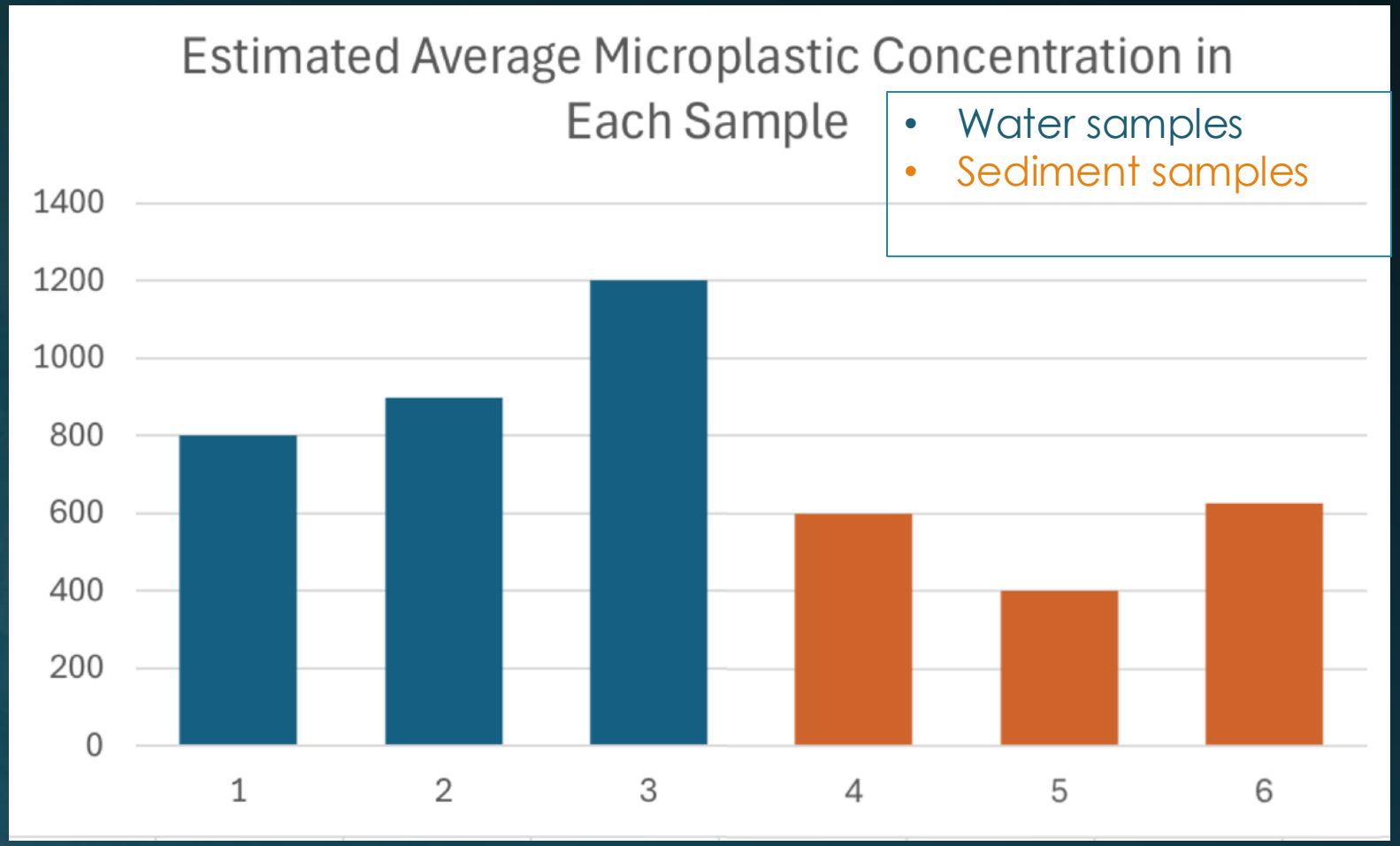
- Average # of microplastics per filter paper range: 0 – 0.667
- SD range: 0 - 1.12
- SE range: 0 – 0.373
- SD > average # microplastics: high variability in each filter paper
- T-test results:

Lake	p-value	Significance
1	0.0702	No significant difference
2	1.00	No significant difference
3	0.617	No significant difference
All lakes	0.301	No significant difference

Sediment VS Water

	Av. #MP per 1 FOV	Av. #MP per 25 FOVs	Av. #MP per 2500 FOVS
Water 1	0,32	8	800
Water 2	0,36	9	900
Water 3	0,48	12	1200
Sediment 1	0,24	6	600
Sediment 2	0,16	4	400
Sediment 3	0,25	6,25	625

- Less microplastics found in sediment compared to water
- Reasons:
  - Microplastics tend to stay flowing in the surface water rather than sinking into the sediment
  - Factors preventing microplastics sinking: wind, water currents, …

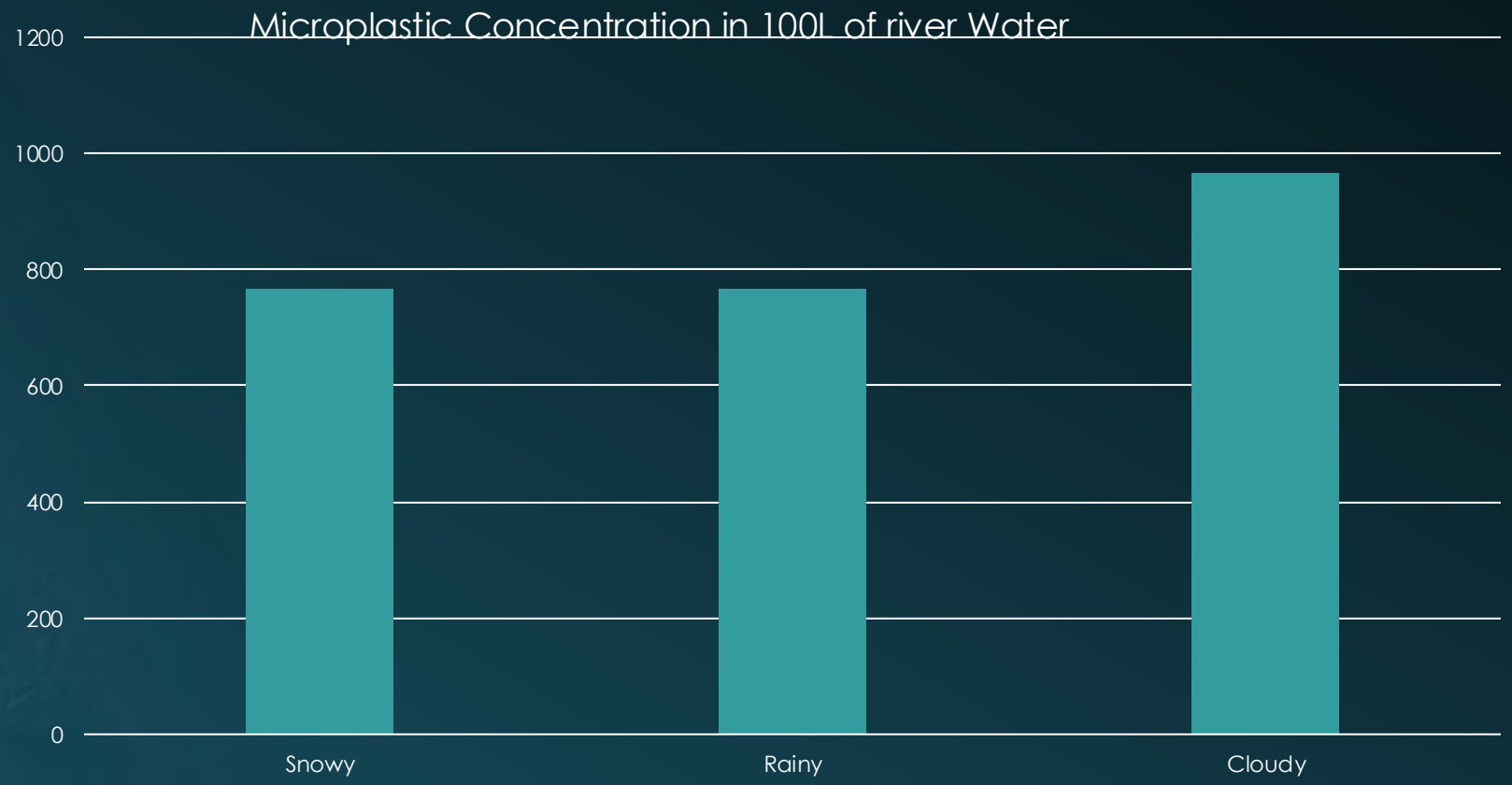


- Average # of microplastics per filter paper range: 0.16 – 0.48
- SD range: 0.374 – 0.557
- SE range: 0.0748 – 0.111
- SD values > average # microplastics: microplastics spread out unevenly
- SE approximately 0.09: relatively precise average microplastic concentrations

Different Weather Conditions

	Av. #MP per 1 FOV	Av. #MP per 25 FOVs	Av. #MP per 2500 FOVs
Snowy Water	0,30667	7,6667	766,67
Rainy Water	0,29333	7,3333	733,33
Cloudy Water	0,38667	9,6667	966,67

- Highest # microplastics in water samples on cloudy day
- Lowest # of microplastics in water samples on rainy day
- Reasons:
  - Microplastics can be pushed deeper from snow and rain, hence staying more at the surface on cloudy days
  - More rainfall & snow: more water not containing microplastics in river



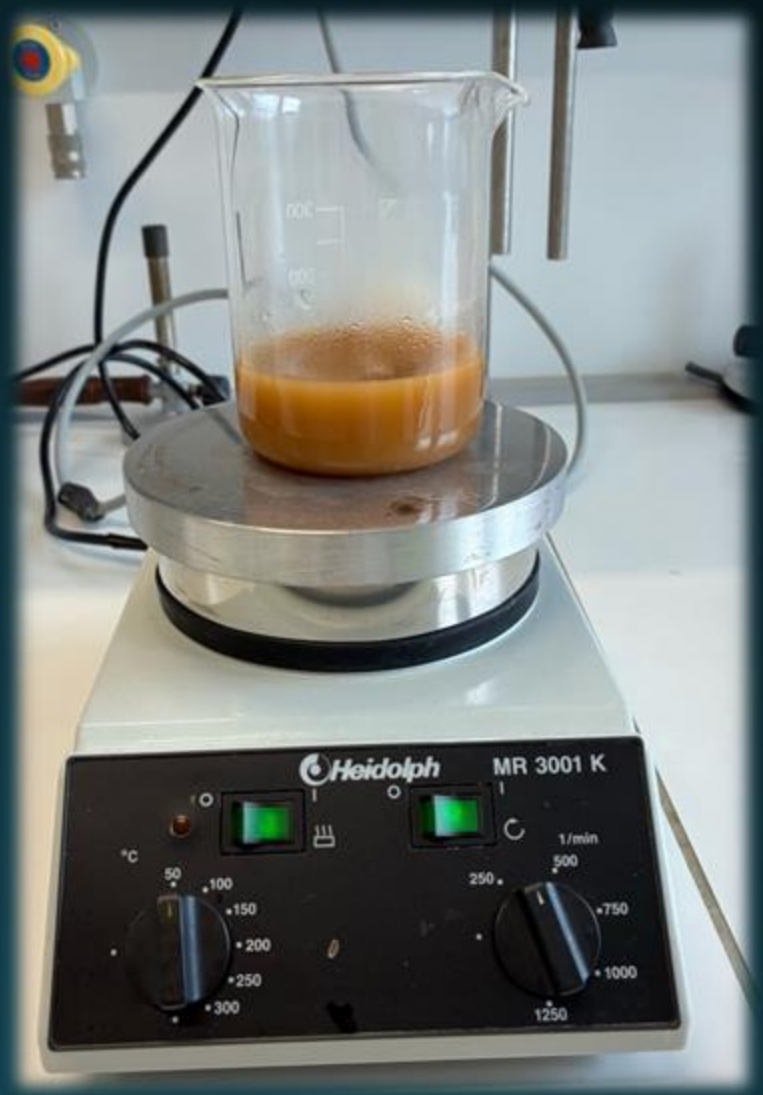
- Average # of microplastics in each filter paper range: 0.12 – 0.48
- SD range: 0.332 – 0.557
- SE range: 0.0872 – 0.111
- SD > average # microplastics: high variability between filter papers
- SE shows that averages are precise

Strengths

- Plankton net: large volume of water for each sample
- Many fields of view: more accurate representation of concentration in entire sample
- 3 experiments: exploring different aspects of microplastics in water bodies

Limitations

- Only 3 repeats for each experiment: less statistically significant results
- Not using turbidity sensor
- Fenton reagent + soil
- Contamination: net + clothes
- Identification method



Extensions + Solutions

Extensions

- Different regions of water body/cycle
- Filtering + cleaning

Other solutions

- Wastewater treatments
- Point-of-use devices
- Plastic-eating organisms
- Lower plastic consumption
- More recycling, less littering


Thank you for
your attention