Catching Plastics: Which Species of Algae Can Best Catch Microplastics

Research Question

Question

How does the type of algae affect the number of microplastics that can be collected?

Variables

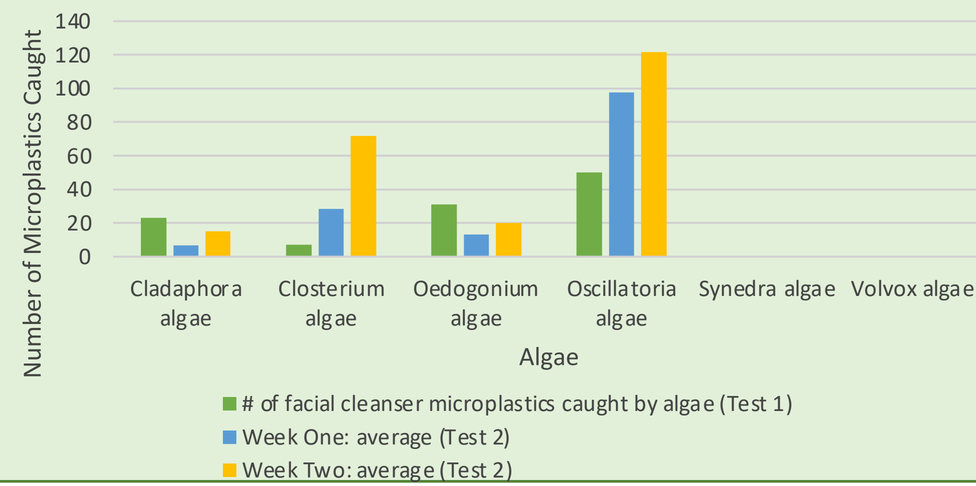
Independent The type of algae

Dependent The number of microplastics collected

Controlled The amount of time the algae grew and the conditions that they grew in

Data Analysis and Results

Number of Microplastics Caught vs. Algae



Procedure

Algae was grown in indirect sunlight and algae growing medium for seven days

Microplastics were mixed in and settled for algae for 7 days

Algae was analyzed Under a microscope at 2x and amount of microplastics that clearly have algae under and over them were counted;

Steps were repeated with 4 most promising types of algae

Data was recorded and presented

Conclusion

- Oscillatoria algae is the most effective at catching microplastics
- This is due to the fact that the algae grows along surfaces, so it is able to anchor the microplastics to the bottom of the petri dish/ flask
- This is applicable in real life where Oscillatoria algae grows along rocks and can catch microplastics along shorelines of lakes and rivers
- Cladophora, Closterium, and Oedogonium algae are all capable of catching microplastics
- Synedra and Volvox algae are incapable of catching microplastics used, because they are smaller

Algae

What is it?

- A water based plant that can grow similarly to any other type of plant
- Many forms, and a large range in type and form
  - Some algae can also be toxic to breath
- Are very interwoven coming in many formed some connected to a central root system and others winding along rocks and growing along what ever they can sit on top of as long as they are exposed to the proper nutrients.(algaebase.org)

Classifications (algaebase.org)

- Green Algae
  - Cladophora
  - Oscillatoria
  - Volvox
  - Closterium
  - Oedogonium
- Diatoms
  - Synedra

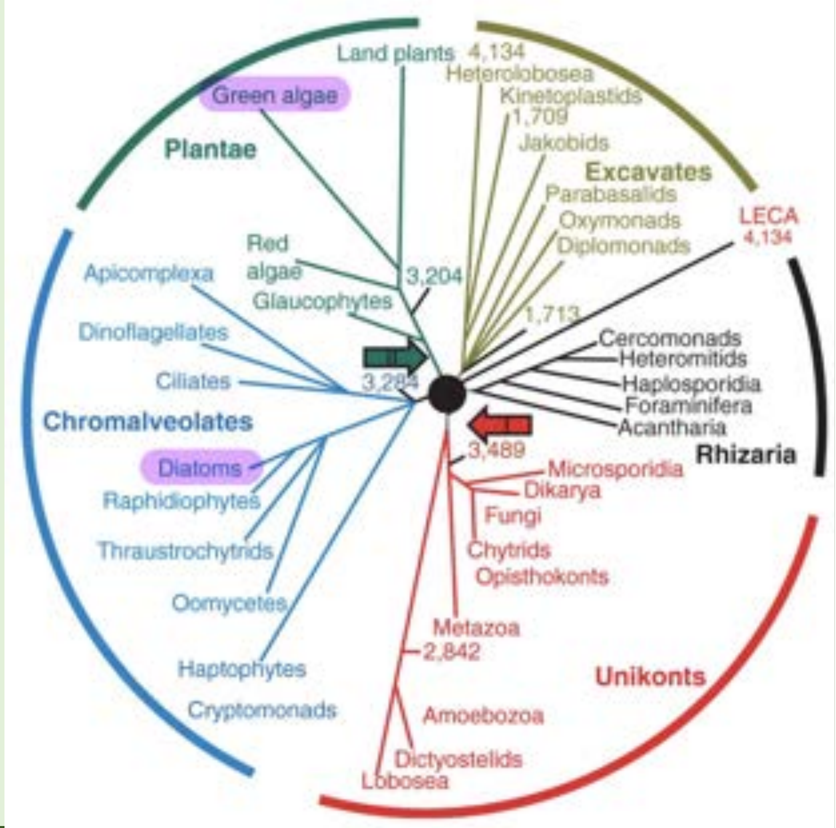


Photo credit:
https://genomebiology.biomedcentral.com/articles/10.1186/gb-2010-11-5-209

Microplastics

How they come about

- Any plastic that is less that 5 mm in width
  - Are broken off from larger pieces
- This break off occurs when an erodent is present
  - Water, sand / soil, or anything that can erode

Where they are

- These are everywhere
- Breaking down in water they are then put into the ecosystem
  - Eaten by fish than humans eating that fish has caused microplastics to be found in the human body (Parker, 2022)
- microplastics are also found everywhere
  - Polyester fibers contain microplastics and there are small microplastics in the sand as well (Parker, 2022)

What harm they can do

- In soil microplastics can release toxic chemicals thus hurting the sounding flora and fauna (UNEP, 2018)
  - The same is applied in water, where the toxicity can be more dispersed (UNEP, 2018)
- There is currently no conclusive evidence of what microplastics can do in humans

Photo credit:
National Geographic

Combination of Algae and Microplastics

Great Lakes

- In the Great Lakes, Cladophora algae is ubiquitous
  - During an algae collection scientists noticed that there were microplastics in the algae (Peller et al. 276).
- This same phenomena was observed with Oscillatoria algae where the algae growing along rocks had started growing around microplastics thus keeping them in one place(Initiatives rivers).
- More collection of Cladophora and Oscillatoria algae, started to take place with scientists noticing that they can remove these microplastics from them, thus allowing the team to properly dispense of the plastics (Peller et al. 275).
- Catching microplastics with algae is untenable seeing as the toxicity of them can kill the algae, they could be used to temporarily hold them until a better solution can be found (Zhang et al. 1287).

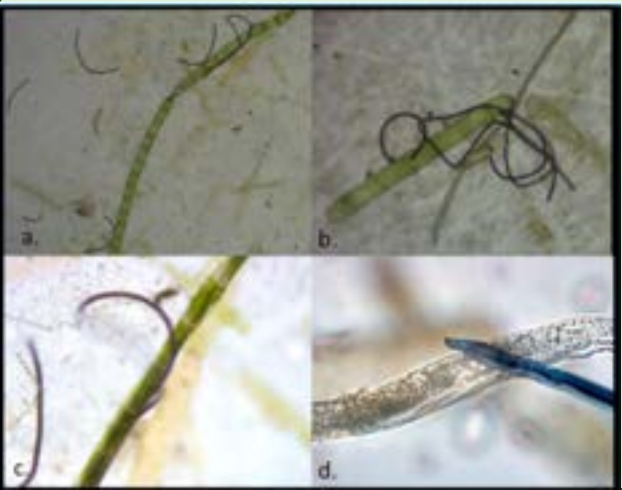


Photo Credit:
Peller, Julie, et al. "Sequestration of Microfibers and Other Microplastics by Green Algae, Cladophora, in the US Great Lakes." *Environmental Pollution*, vol. 276, 2021, p. 116695., https://doi.org/10.1016/j.envpol.2021.116695.

Research Question, Hypothesis and Variables

Research Question

How does the type of algae affect the number of microplastics that can be collected?

Hypothesis

Cladophora algae will collect microplastics the best because it is a very long algae and is easily entangled making It more able to catch microplastics.

Variables

Independent Variable

The type of algae

Dependent Variable

The number of microplastics collected

Controlled Variable

The amount of time the algae grew and the conditions that they grew in

Procedure

1. All caps were loosened on algae on the same day as received
2. All algae was placed in indirect sunlight (preferably north facing window
3. All equipment (except Erlenmeyer flasks) were placed in boiling water for 15 min to be sterilized
4. Erlenmeyer flasks were covered with tin foil and placed in an oven for 3 hours
5. 50 facial cleanser microplastics and 75 white microplastics were placed in each Erlenmeyer flask and left to settle for 7 days
6. White microplastics were run through a coffee grinder to make them as small as possible
7. Microplastics from social cleanser were separated from one another by watering down the facial cleanser then running it through two coffee filters placed over a cup to make sure that all microplastics are caught
8. 5ml from original container of algae was combined with 100 ml of Ala grow medium in Erlenmeyer flasks
9. Algae and microplastics were removed from the Erlenmeyer flasks and placed in Petri dishes to see under microscope
10. All microplastics were counted under a microscope and were removed as counted to make sure a proper count was conducted
11. Steps 1-10 were repeated with the four most successful algae with exception that grown algae were separated into 3 petri dishes and 125 micro plastics were added to each one to make sure the results have the lowest margin of error. Sone changes did occur such as in the first week the microplastics were not removed from the petri dishes.
12. The count was recorded and made into data tables

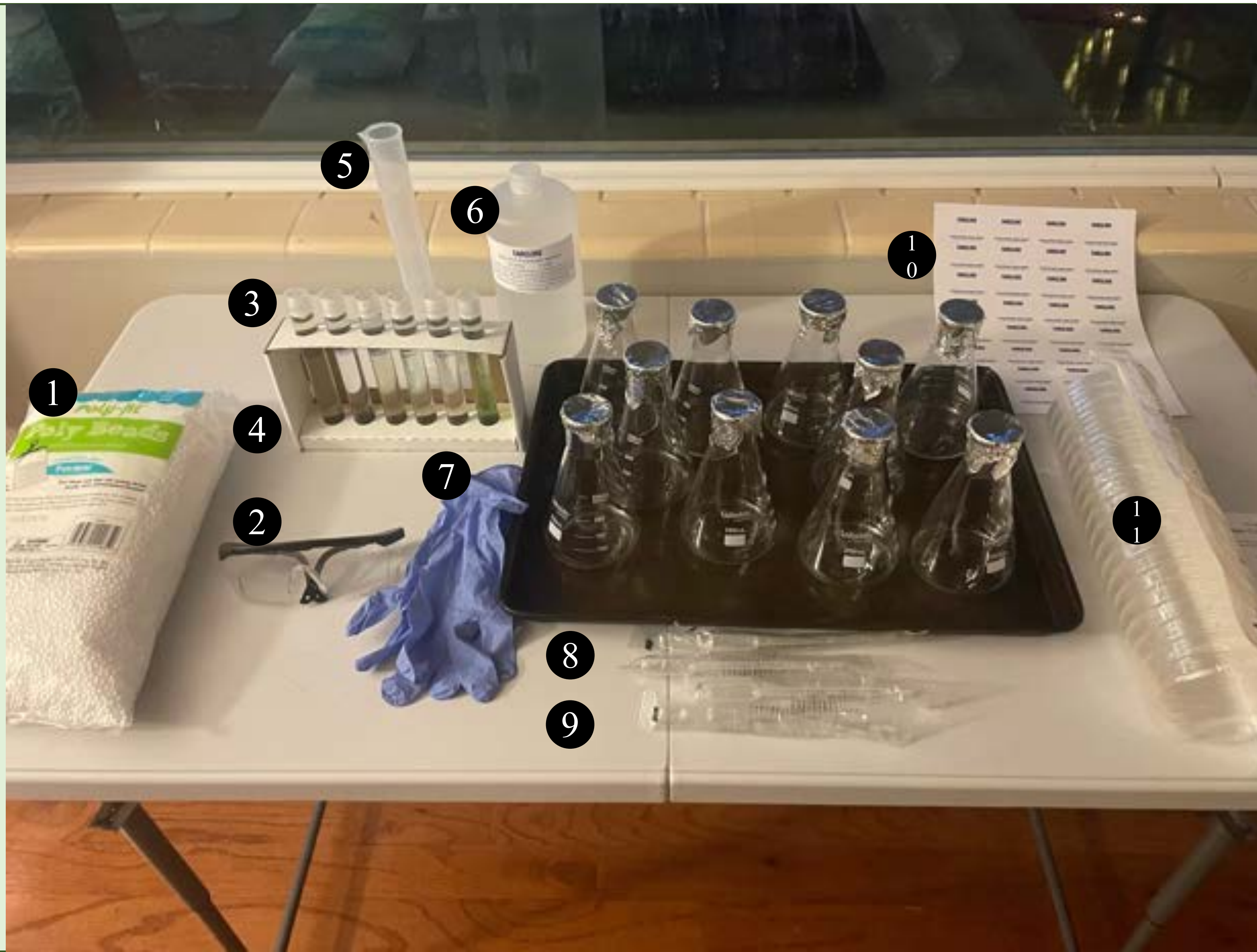
Materials

1. Polystyrene beads
2. Goggles
3. Test Tube Rack
4. Test Tubes with Algae
5. Graduated Cylinder
6. Ala-grow
7. Gloves
8. Erlenmeyer Flasks with Tin Foil
9. Pipets
10. Labels
11. Petri Dishes

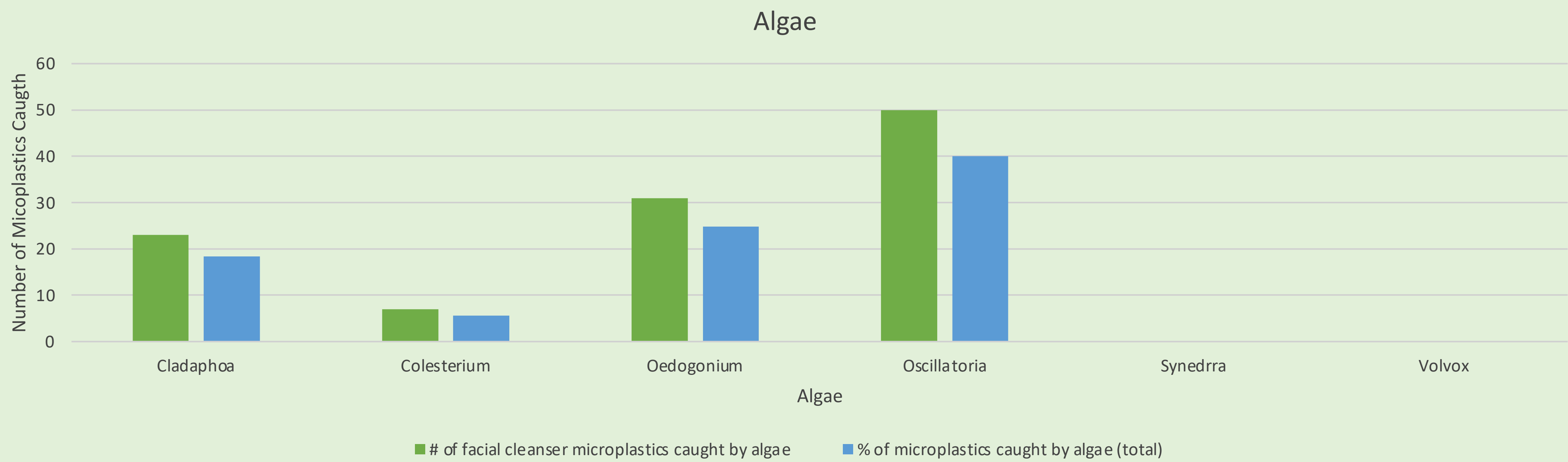
Not Pictured.

1. Facial cleanser with microplastic beads
2. Microscope
3. Tweezers
4. Coffee filters

Photo Credit:
S.Rezende Tsao



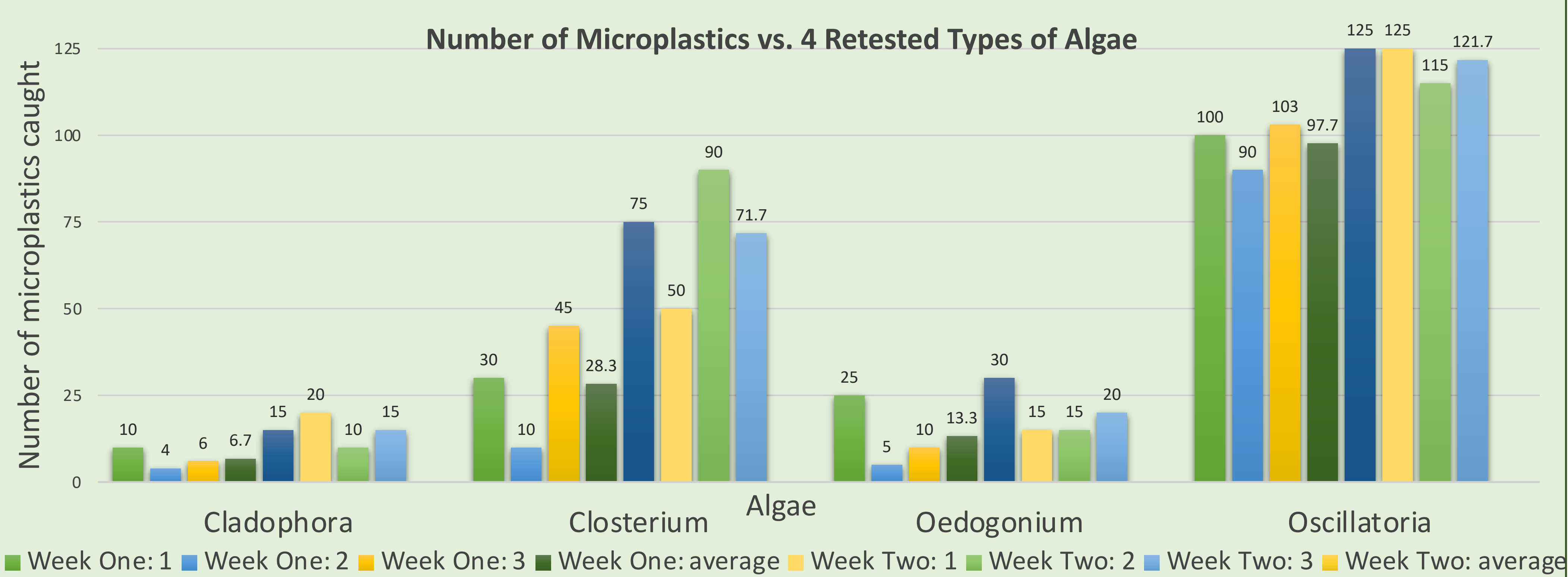
Test One



This is from the first trail run showing that the Synedra and Volvox algae were unable to catch any microplastics, and that Oscillatoria caught the most, and others such as Oedogonium, Closterium, and Cladophora were able to catch microplastics.

Algae Type	Cladophora algae	Closterium algae	Oedogonium algae	Oscillatoria algae	Synedra algae	Volvox algae
# of facial cleanser microplastics placed in algae and water mixture	50	50	50	50	50	50
# of polystyrene microplastics placed in algae and water mixture	75	75	75	75	75	75
# of facial cleanser microplastics caught by algae	23	7	31	50	0	0
% of microplastic caught by algae (total)	18.4%	5.6%	24.8%	40%	0%	0%

Test Two



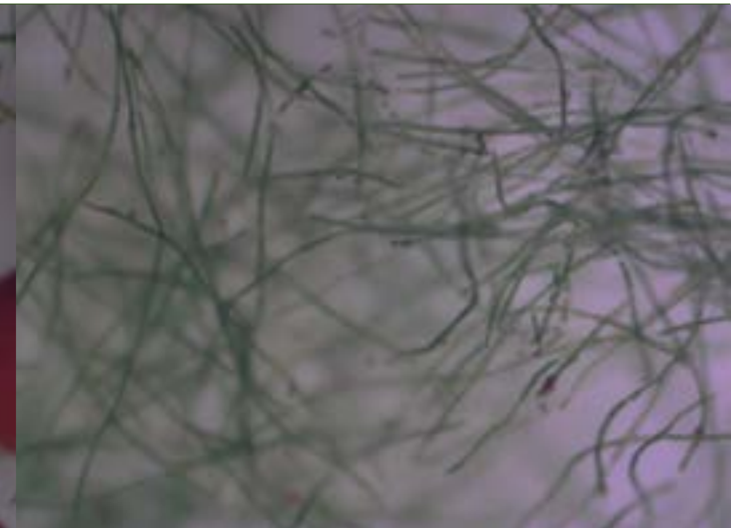
This re-test was to make sure that there were no unknown factors or glitches in the experiment that caused there to be different results. There were three groups used to ensure that there would be the smallest margin of error possible. The data shows the the Oscillatoria algae was by far the most effective in catching algae, with Closterium algae coming in not far behind.

	Cladophora	Closterium	Oedogonium	Oscillatoria
Week One: 1	10	30	25	100
Week One: 2	4	10	5	90
Week One: 3	6	45	10	103
Week One: average	6.7	28.3	13.3	97.7
Week Two: 1	15	75	30	125
Week Two: 2	20	50	15	125
Week Two: 3	10	90	15	115
Week Two: average	15	71.7	20	121.7

Test1

Photo Credit: S. Rezende Tsao

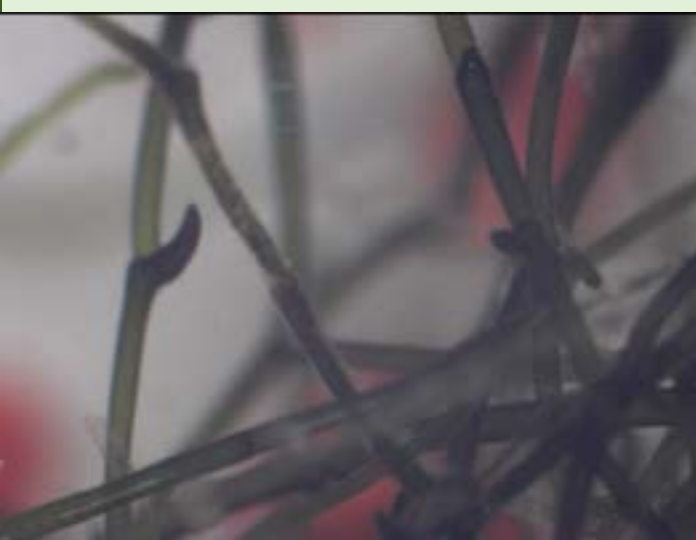


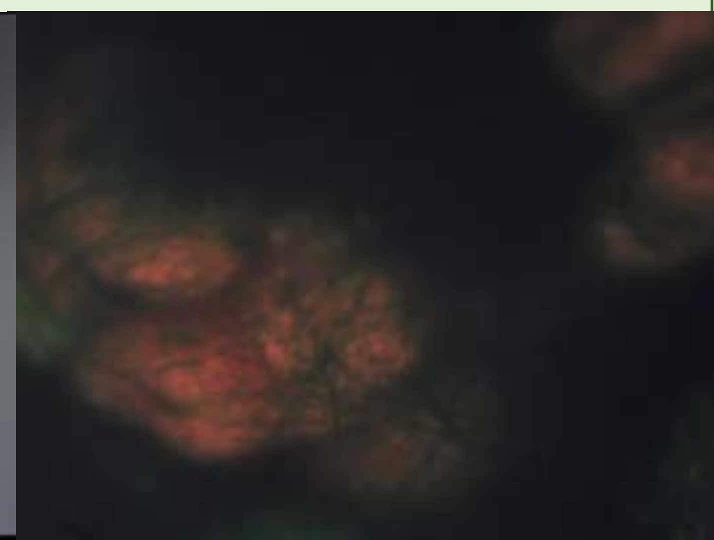


Top: Synedra
Bottom: Cladophora

Top: Closterium
Bottom: Volvox

Top: Oedogonium
Bottom: Oscillatoria





Images Week 1

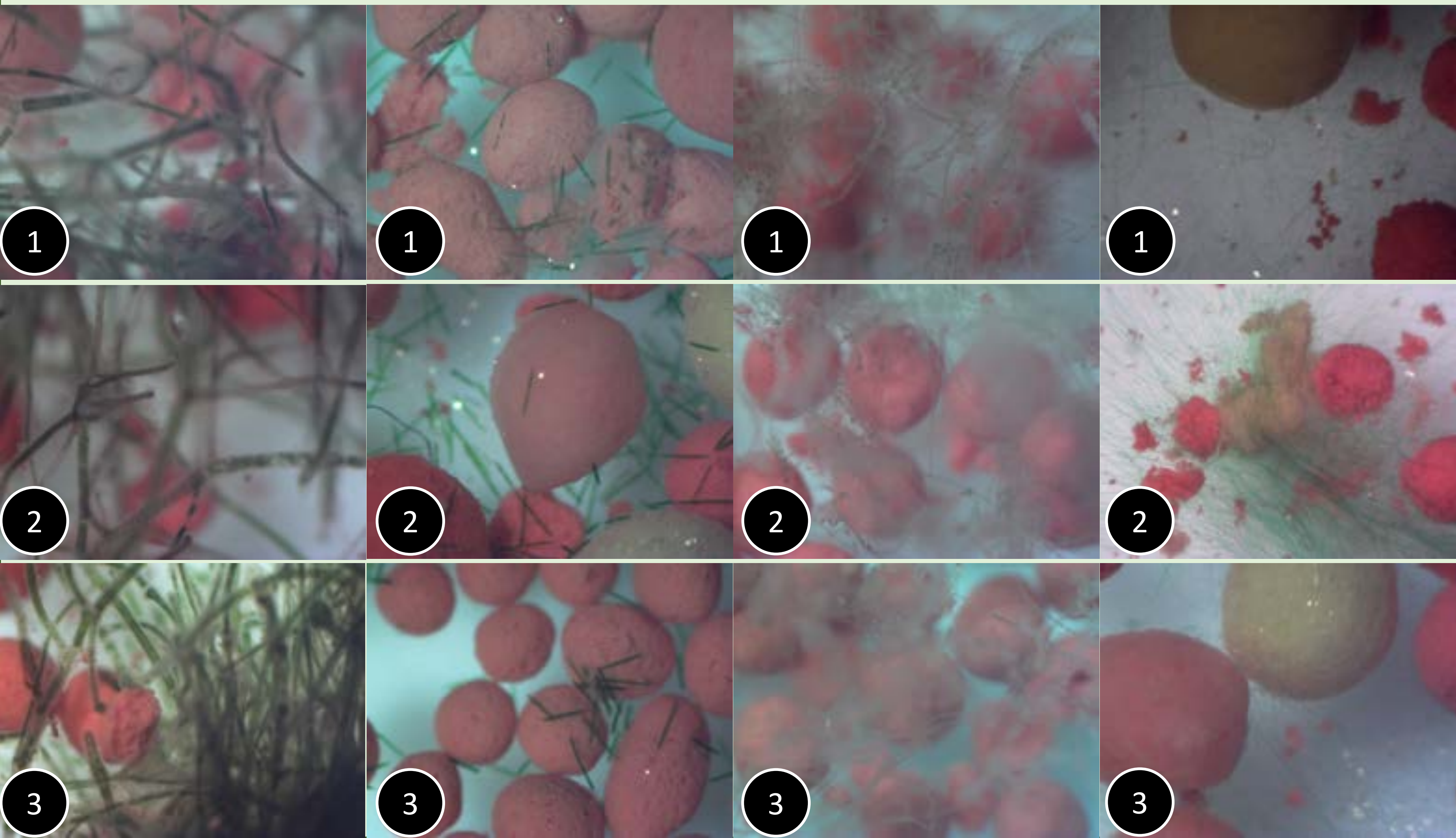
Photo Credit: S. Rezende Tsao

Cladophora	Closterium	Oedogonium	Oscillatoria

Images Week 2

Photo Credit: S. Rezende Tsao

Cladophora	Closterium	Oedogonium	Oscillatoria



Results

Claim

- The Oscillatoria algae is the most capable of catching microplastics
- Volvox and Synedra algae are incapable catching microplastics
  - Other algae of the same size or smaller as these could possibly render the same results

Evidence

- Oscillatoria algae was able to catch all of the microplastics in three of the four trials
- Cladophora, Closterium, and Oedogonium, were all capable of catching microplastics just not as effectively as Oscillatoria
- Volvox and Synedra algae were smaller than the microplastics, meaning that they are incapable of catching microplastics

Reasoning

- Oscillatoria algae mats meaning that it grows along the bottom or side of what ever surface it is on
- The algae as able to stick the microplastics to the bottom
- The other three algae were able to attach themselves in some way to the microplastics securing them together

Discussion

Algae Growth

- Cladophora algae might not have caught as many because of its growth
  - There was much more growth in all other forms of algae
  - This algae might not have grown as much because the other forms of algae are micro algae there for can grow at a faster rate
  - The decrease in the growth time could have affected the amount of microplastics it was able to catch

Unpredicted Factor

- Similar to a natural environment life the microplastics used in this experiment continued to break down through the experiment
  - This caused there to be more microplastics in the algae than was counted
  - Was counteracted by only counting major microplastics or the ones that contain a semi spherical shape

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