

Microplastic Accumulation in Macroalgae: A Species-Specific Study in the Indian River Lagoon

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Abstract

Microplastics are an emerging pollutant in marine environments and can accumulate in a wide range of organisms, including macroalgae. Due to their widespread distribution and ecological importance, macroalgae may function as sinks for microplastics and facilitate their transfer through marine food webs. This study examined the concentration of microplastics in different macroalgal phyla to better understand patterns of microplastic accumulation in coastal ecosystems. The results did not support the original hypothesis; contrary to predictions, red macroalgae exhibited a higher concentration of microplastics than green macroalgae, with mean values of approximately 5.4 and 2.8 microplastic particles per gram, respectively. These findings indicate that red macroalgae accumulate greater amounts of microplastics, which may have significant ecological implications, as the ingestion of contaminated macroalgae by marine organisms can promote trophic transfer and ultimately increase the risk of human exposure through seafood consumption.

Keywords: microplastics; macroalgae; bioaccumulation; marine pollution

1 Introduction

Each year, 8 to 11 million metric tons of plastics enter the ocean each year, and 14 million tons were also estimated on the seabed (United Nations Environment Programme, 2022, February 16). Microplastic abundance in seawater has been doubling over the course of 11 years. These microplastics are harming marine life, especially macroalgae, which is a valuable food source for aquatic life because they are rich in vitamins, proteins, minerals, bioactive compounds, and dietary fibers. This is a problem because humans eat fish, and can digest about 123 microplastics from eating a singular fish. An average human consumes the equivalent of about 12 grocery bags each year (Environmental Working Group, 2024). In the Indian River Lagoon, there are 3 major phyla of macroalgae, green, brown, and red. My project is studying the concentration of microplastics in the different phyla's of macroalgae. Understanding the interaction between microplastics, and macroalgae, can help recognize the toxic effects of pollution.

2 Literature review

2.1 Project Summary

This project measures the concentration of microplastics in different phylas (red, green) of macroalgae. Macroalgae was collected from the Indian River Lagoon all from different locations including the beach, and different doc locations that I had permission to collect from. Then macroalgae was placed in a glass pans, and then put into a drying oven that is 59 degrees celsius. From there, I scraped the dried seaweed debris, and placed it on a scale, and measured the amount of grams it was. I labeled the petri dish of the amount of grams the seaweed was, and which site the seaweed was collected from. I placed the debris in a beaker with 50% Hydrogen peroxide in it. 50% Hydrogen Peroxide is one Hydrogen atom combined with two Oxygen atoms. Parafilm (flexible film) was placed over the beaker, and it sat like that for 24 hours until it was dissolved. I attached a vacuum hose to a funnel, and then put a coffee filter in the burner funnel. The vacuum hose helped to suck out all of the air from the funnel. I sprayed water into the funnel to help filter out the microplastics from the water. Tweezers will then help remove the coffee filter from the funnel, and I will place the coffee filter under a microscope to count the amount of microplastics. The project will be completed over many months. The Indian River Lagoon is 1609.344 meters long, and it is a combination of the Banana River, Indian River, and Mosquito Lagoon. It is considered an estuary, which is when freshwater from inland places combines with salty water from the ocean. It is home to over 4,400 species of both plants and animals (St. Johns River Water Management District). There are many diverse, and even endangered species in the Indian River Lagoon.

2.2 The Gap

There has been no other experiment done of the concentration of microplastics in different phylums of macrolage in the Indian River Lagoon. There have been past projects of the amount of microplastics in macroalgae, however the seaweed was not collected from the Indian River Lagoon like my project.

2.3 Microplastics

A microplastic is a very small piece of plastic that is under 5mm (.005 meter) in size (U.S. Environmental Protection Agency, 2025). Microplastics are even smaller than a nanoplastic. Microplastics can be classified into two major different types, such as primary microplastics, and secondary microplastics. Primary microplastics are manufactured plastic particles that are very small in size. Examples of primary microplastics include microbeads, nurdles, and synthetic fibers. On the other hand, secondary microplastics are smaller plastic items from large plastic debris. Some examples of secondary microplastics include small bits of glass bottles, and plastic pieces from plastic bags. Wind, storms, and sunlight help contribute to the breakdown of these plastics (Kumari, S., 2025). To be more specific, there are names for the different types of microplastics that fall into these two categories. Some examples include fragments, nurdles, films, microbeads, tire wear particles, and microfibers. Fragments are smaller pieces of large plastic items. Fragments make up 22% of microplastics in marine life's environment. Nurdles are tiny plastic pellets that are used for manufactured products. They are around 1-5 mm (.001-.005 meter) in diameter. They are often spilled or lost during the manufacturing process while moving. They can be leaked anywhere because they are constantly moving while manufacturing. They often end up on beaches, and in the water. Films are also known as microfilms, and they are tiny pieces of flexible plastics. They come from plastic grocery bags, and plastic food wrappers. Microbeads are tiny pieces of plastics that are made from polyethylene plastics. They come from detergents, toothpaste, and personal care items. Tire wear

particles are microplastic debris that come from the rubbing off of a tire and a road. This is a major source of microplastic debris. Not only does it contaminate the environment, it contaminates the air. The debris can potentially let off toxic chemicals that are released into our air. Microfibers are very thin synthetic fiber, and they are less than 10 micrometers. Microfiber is used to make towels, cloth, knits, mats, cycling shirts. They are used for athletic wear because it evaporates water, and sweat very easily, so it dries quickly. They are estimated to be one fifth of the diameter of human hair (Knowing Fabric). Around 10 to 40 million metric tons (10,000-40,000 kilograms) of plastic have been reported to be on Earth, and that number continues to increase each year. It has been estimated to even double in the next 15 to 20 years (Savchuk, 2025).

2.4 Effects of Microplastics on Humans

Humans ingest about 24 pounds (10.88 kilograms) of microplastics by the time they are 39 years old (Kristopaitytė, 2025). However, much microplastics that are ingested do not fully stay in your system, for example a 10 year old may only remain about .11 of a gram of a microplastic (Viale, A. 2025, July 23). As you get older, that number does increase by a significant amount. Studies have shown that microplastics have been detected in lots of different organs and tissues. These organs include the brain, heart, kidneys, liver, lungs, and in blood. The brain has a very high amount of microplastics inside of it, and the brain's concentration is 13 times more than the amount of microplastics in the kidneys (Dury, 2025). The brain accumulates such a large amount of microplastics from the environment, and everyday objects such as tires, containers, and clothing. Microplastics' main ways of getting into our body is by the food that we consume, the beverages that we drink, and environmental factors (Harvard Medicine Magazine, 2023). Adults ingest the equal amount of microplastics to a credit card each week. Humans ingest dozens to 100,000 particles of microplastics each day. All of these microplastics in our body do come with a cost of being there. It is not possible to not consume microplastics because they are everywhere, and they are located in about everything. It has been shown that the microplastics in our body can affect our cardiovascular health, our hormones, and our brain developments (Savchuk, 2025). Some studies have shown that microplastics are linked to human vessels, and this leads to an increase in heart attacks. Microplastics entering our bloodstream can lead to other severe cardiac issues, inflammation, cancer risk, and stress. Microplastics can affect our hormones because they carry chemicals that mimic or block hormones, and this leads to an imbalance of hormones. An imbalance of hormones can lead to weight changes, and other issues. Our bodies' brain developments can be affected by microplastics because very high levels of microplastics can lead to a correlation of dementia. This has not been directly shown, however there is a trend of people with dementia having 10 times the amount of microplastics in their brain than people that do not have dementia. Babies have microplastic in their bodies as soon as they are born. Microplastics can cause severe problems to human health, and more microplastics keep on entering our Earth, environment, and body each day at an alarming fast rate.

2.5 Goals for the Future

There are many ways to help prevent the rising amount of microplastics that are produced, and that enter our environment. Using non plastic containers, and water bottles can help prevent the production. Buying non synthetic materials can also help because they give off microplastics (Sustainability Global Team, 2025). Small changes can help make a huge difference. Plastic containers release microplastics into the food when they are put in the microwave. There are some microwave safe plastic containers, however they still let out microplastics into the food. Studies show that when plastic containers are put in the microwave, and heated around 4.22 million microplastics per square centimeters of the containers area released. Using alternative options such as glass, silicone, stainless steel,

ceramics, and bamboo are a much better option to help prevent microplastics production. Around 50 billion water bottles are used each year in the United States, and only 23.2% of that amount is recycled. Most of the plastic water bottles end up getting littered. The water bottles that are not recycled end up in the ocean, and they take 1,000 years to fully decompose. 14 million tons of plastic end up in the ocean each year. The issue with plastic water bottles is that around 2 million people count on plastic water bottles as their safe source of water. Not everyone has access to safe filtered drinking water. Microplastics are contaminated into the drinking water from the plastic bottle, and it is not considered safer than tap water. Bottled water is very convenient, and it is a necessity. There is no way to eliminate the usage of plastic water bottles because they provide a sustainable drinking method for many people around the world, however there is a way to help reduce the amount of plastic water bottles being used. Using glass water bottles, and Stainless Steel water bottles are a great alternative option to help reduce microplastic creation. Bottled water brands such as Fiji Water, Smartwater, and Poland Spring are completely microplastic free. Synthetic materials are human made substances that are created through chemical processes. The chemical process turns natural resources into usable products. Some examples of synthetic materials include Polyester, Spandex, Acrylic fiber, Microfiber, Fake fur, and other materials. Polyester is a synthetic fiber that is very durable. It is very light weight, and it dries quickly. It is often used for sportswear. It is over 50% of global textile production because of its affordable cost, and great quality. Spandex is synthetic fiber that is used for activewear. It is flexible, and stretchy. It is worn skin tight. It is used in swimsuits, leggings, t-shirts, and tracksuits. Acrylic Fiber is a synthetic polymer. Its properties are similar to wool. It is a warm, durable, lightweight material. It is used for warmth, and it is used in jackets, socks, sweaters and blankets. Microfiber is a synthetic fabric that is a mix of polyester, and nylon. It has very thin fibers that are very absorbent. It is used in towels, and bedding. All of these materials are synthetic materials. When synthetic fibers are washed, tons of microfibers are released. Around 8% of the total microplastics found in the ocean are from washing synthetic textiles (Stanley-Jones, M., & Obote, C. E. 2025, July 25). Around 200,000 to 500,000 tons of microplastics from textiles enter our Earth each year. The microplastics are released through each wash of clothing items, however the most microplastics are released during the first few washes of the new clothing item. When washing textiles, microplastics end up in our environment, air, and in our soils. To help this issue, wash clothes in large loads, use cold water when washing clothes, dry clothes on a low intensity setting, or air dry clothes, and use a microfiber filter. Washing clothes in bigger, fuller loads helps to stop the amount of friction between each clothing item, and this helps it give off less microplastics. The filters can help stop microplastics before they enter our environment. All of these are ways to help reduce the production of microplastics through synthetic fibers.

2.6 Macroalgae

Macroalgae is found in marine life, and there are three different phylas based on their different pigmentations. There is brown macroalgae, green macroalgae, and red macroalgae. Macroalgae is also known as seaweed. It is a type of algae that is significantly larger, and multicellular. The scientific name for brown macroalgae is Phaeophyceae (Sharma, 2025). The scientific name for green macroalgae is Chlorophyta. Finally, the scientific name for red macroalgae is Rhodophyta. The bulk of macroalgae is located in Southeast Asian, and Pacific countries. China, Philippines, Indonesia, and the Republic of Korea, and Japan also contain large amounts of macroalgae. The different pigments of each phyla of macroalgae absorb different wavelengths of light for photosynthesis. This makes them primary producers, because they provide food for other organisms.

Macroalgae provides food for marine animals as well as habitat. It provides sea urchins, and different fish species food, and then energy is transferred up the food chain.

Macroalgae also helps prevent coastlines from eroding. Macroalgae is heavily used in the kitchen, and it is used in sushi, jams, gelatin, soups, and fruit juice. Humans have increased their overall aquatic consumption drastically over the years, and this involves the intake of seaweed. Macroalgae is a healthy food as it contains many different minerals such as magnesium, iodine, iron, calcium, and potassium (Wu, 2023). These minerals help strengthen our bones, help maintain a healthy blood pressure, and help support our immune system. In addition to these minerals that macroalgae provides, it also contains a numerous amount of vitamins. The vitamins include D vitamins, and vitamin K. These vitamins help prevent blood clots, improve energy levels, and help promote brain functions. It is also very high in dietary fiber. Seaweed is very healthy, and nutritious. Macroalgae has a more complex structure than algae, however its structure is not that complex. It is unique because it does not have roots, leaves, and stems. The cells can be seen underneath a microscope (MicrobeNotes). When macroalgae tears apart, and decomposes it gives off nutrients to the seafloor. Seaweed can also be used as fertilizers, and this helps with plant growth. It can live for months, years, and even decades depending on its environmental factors. Macroalgae dies from a variety of factors such as environmental stress, harsh temperature, disease, large amounts of underwater pressure, and nutrient imbalances. Nutrient imbalances may come from sewer water, or runoff being mixed with the saltwater or freshwater. When the nutrients get imbalanced, the macroalgae is more open to catch diseases. Large kelp lives for many years, however the smaller species may not live as long. Brown macroalgae is found in cold waters of the Northern Hemisphere. There are between 1,500 to around 2,000 different types of brown macroalgae located throughout the entire world. Some examples of kelp species include Laminara, Macrocystic, and Nereocystics. Brown macroalgae composition is made up of cellulose, and alginic acid. It reproduces sexually, and asexually. Its pigment comes from Fucoxanthin. Kelp is the largest species of brown macroalgae. Some other species of brown macroalgae include Sargassum, and it floats in large mats in the Sargasso sea.

Fucus is another species that is found along rocky shores. It is a crucial species because it helps stabilize sentiments underwater. Macrocystis is a very large species of brown macroalgae that can grow up to 60 meters long. There has even been a kelp that was measured at 710 feet long (California Department of Fish and Wildlife). It has a root connection to the seafloor that keeps it from being carried away by the current. Brown macroalgae can form underwater forests, and these forests are mainly from the species, kelp. Brown macroalgae grows at a very fast rate, it averages about two feet of macroalgae per day. Its rapid growth creates a renewable source of biofuel. Kelp grows in deep waters of about 100 feet. Kelp grows best in water that is between 5.5 to 22.2 degrees Celsius. Although Kelp is a very large type of brown macroalgae, there are tiny species of macroalgae. It is about a few inches long, and it is feathery. Brown macroalgae does not have tissues, and organs. Green Macroalgae is another main type of macroalgae. It is located in marine environments, and it is green because of chlorophyll (Moreira, 2021, September 27). There are about 1,800 different species of green macroalgae, and it also produces organic matter through photosynthesis, similar to brown macroalgae. Green macroalgae is composed of cellulose, and pectin (Galoustian, 2023). It reproduces by fragmentation, asexual spore formation, and it also reproduces sexually. Fragmentation is when a parent's organism's body breaks into two pieces, and each fragment grows individually into an organism identical to the parent. Examples of fragments are animals, plants, and fungi. Some examples of green macroalgae include Ulva Lactuca, and Chara. There are many different variations of species of Ulva. The last major species of macroalgae is red macroalgae. Red macroalgae gets its pigment from phycoerythrin. Red macroalgae is primarily found in Florida, and it is similar to seagrass. It is found drifting in the water. Red macroalgae is composed of cellulose, agar, and carrageenan. It produces sexually, and asexually. Red macroalgae is provided to the marine web by providing food for fish (Adarshan, S. 2023).

3 Methodology

This project started by first collecting macroalgae from the Indian River Lagoon in 3 different locations. Two different kinds of phyla of macroalgae were collected, red and green. After macroalgae was collected, it was brought to the classroom in a bucket filled with water. The Macroalgae was placed into gallon sized ziplock bags, labeled, and placed in the refrigerator. Macroalgae was placed into eight by eight glass pans, and covered in aluminum foil. The aluminum foil was labeled with what kind of phyla the macroalgae was. The covered, and labeled glass pans were placed into a drying oven for at least 2 days, until the macroalgae was fully hardened. About 5 pans could fit into the drying oven at a time. Once the seaweed was dried, it was removed from the drying oven, and it was scraped from the bottom of a pan with a scalpel. The large bits of macroalgae that was scraped off of the pan was placed into petri dishes that were labeled. This process was repeated for each pan until there were no more pans left to be scraped. The petri dishes with the large bits of macroalgae were ground using a mortar and pestle. Then a coffee grinder was used to also help grind up the macroalgae to make it into debris. The macroalgae debris were placed back into their petri dishes. The macroalgae debris that was placed into the petri dish was measured by one gram on a scale, and put into a glass measuring cup. Then, gloves and safety goggles were put on, and 50% Hydrogen Peroxide was poured over the macroalgae debris into the glass cups. The glass cups were stirred until the 50% Hydrogen Peroxide stopped rising. Parafilm was placed over the top of the glass measuring cup. The glass measuring cup was also labeled using a piece of tape on the side of the measuring cup. This process was repeated until there were 20 trials worth of glass measuring cups for green macroalgae, and 10 trials worth of glass measuring cups filled with macroalgae debris and 50% Hydrogen Peroxide for red macroalgae. The glass measuring cups with the 50% Hydrogen Peroxide and macroalgae had to sit for at least 24 hours. After 24 hours, a funnel was set up with a beaker underneath it. The beaker with the funnel on top was connected to a vacuum pump. The purpose of the vacuum pump was to provide suction, and help filter out the 50% Hydrogen Peroxide quicker. A coffee filter bottom was cut out, and put on top of the funnel. The measuring cup was poured into the funnel, and the 50% Hydrogen Peroxide was filtered out of the solution.

Once all of the liquid was no longer in the funnel, and instead in the beaker below it, the vacuum pump could be turned off, and the coffee filter could be removed. The coffee filter was removed using tweezers, and the filter was placed into a petri dish that was labeled with which location the macroalgae came from, the trial number, and the type of phyla the macroalgae was. This process was repeated for each measuring cup. The coffee filter had to sit for 24 hours in the petri dish to fully dry before it could be placed under a microscope. After 24 hours, the coffee filter could be placed under a microscope. The microscope used was a standard compound brightfield microscope. The microscope has a 10x eye piece. When observing microplastics, the microscope was always fully zoomed in. The amount of microplastics were counted for each coffee filter, and the amount of microplastics was labeled on the petri dish. The data was also recorded on a data table on google docs. This process was repeated for each coffee filter, for a total of 30 total trials.



Figure 1.
Macroalgae microplastic analysis workflow

4 Results and Discussion

4.1 Results

In this experiment, red macroalgae had a higher concentration of microplastics than green macroalgae. The red macroalgae came from site D, and the green macroalgae came from both site A and B. The average concentration of the red macroalgae was around 5.4 pieces of microplastics per gram of macroalgae, as shown on Table 1 and 2. This is about 5- 6 pieces of microplastics per gram of macroalgae. There were only 10 trials of red macroalgae tested because the red macroalgae came from one location. The largest value of microplastics per 1 gram from the red macroalgae was 8 pieces of microplastics. This was in Trial 1, and the only trial that had 8 pieces of microplastics. The smallest value of microplastics per 1 gram from the red macroalgae was 4 pieces of microplastics. This was from both Trial 6 and 9. The average concentration of microplastics in green macroalgae was 2.8, as shown on Table 2. This is about 2-3 pieces of microplastics per gram of green macroalgae. There were 20 total trails of green macroalgae tested because the green macroalgae came from 2 different locations. Green macroalgae that came from site A had an average of 3.6 microplastics per gram of macroalgae, and green macroalgae that came from site B had an average of 2 microplastics per gram of macroalgae. This is seen on Table 1 and 2. Macroalgae that came from site A had a higher concentration of microplastics than macroalgae that came from site B. The largest value of microplastics per 1 gram from the green macroalgae was 7 pieces of microplastics. This was from site A, Trial 7. The smallest value of microplastics per 1 gram from the green macroalgae was 1 piece of microplastic. This was in many trials from both site A and site B. The P value of the total experiment was .00019, as shown on Table 3.

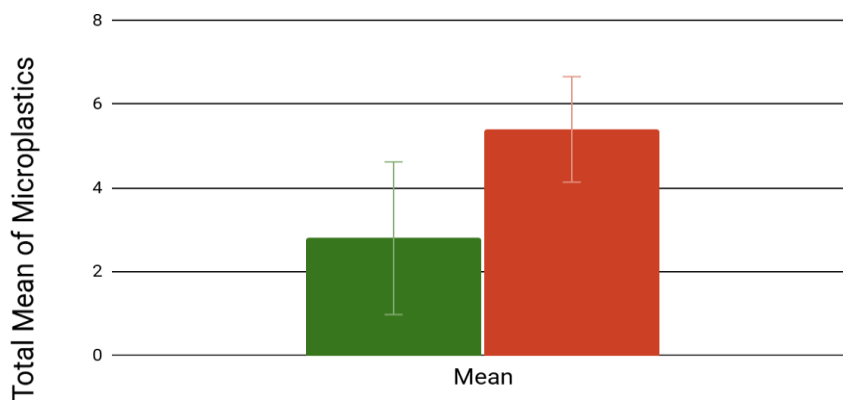


Figure 2.
Phyla of Macroalgae

Figure 2 illustrates the difference of the concentration of microplastics in red and green macroalgae.

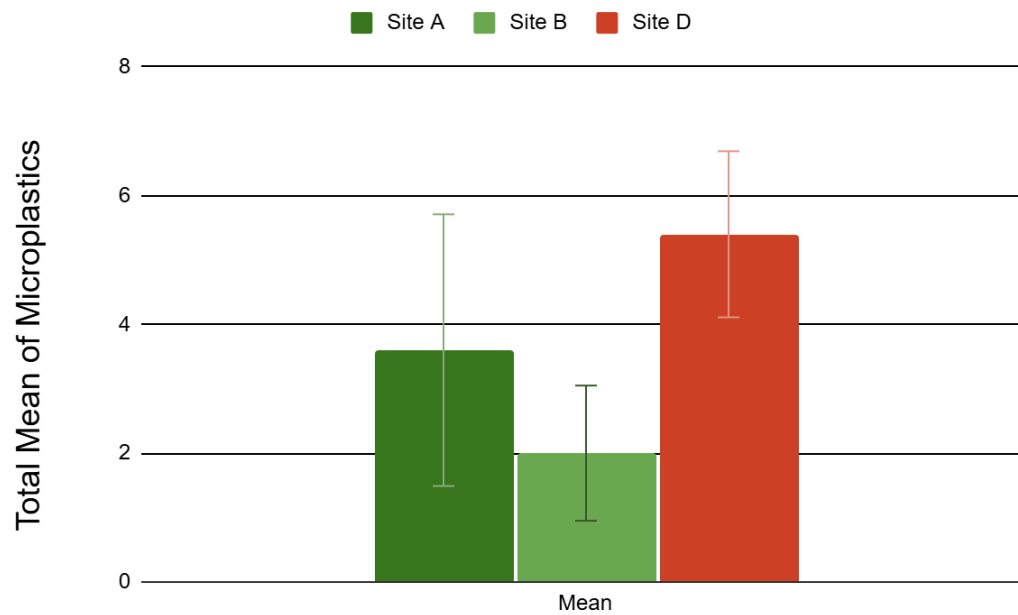


Figure 3.
Different locations

Figure 3 demonstrates the difference of the concentration of microplastics from the 3 different locations.

Table 1.
Microplastic analysis I.

Amount of Microplastics/grm			
	Site A	Site B	Site D
Trials			
1	2	2	8
2	4	1	7
3	5	1	5
4	2	2	6
5	1	3	5
6	1	2	4
7	7	1	5
8	3	3	5
9	6	4	4
10	5	1	5
Trials	Site A	Site B	Site D
Mean	3.6	2	5.4
STDEV	2.118699811	1.054092553	1.264911064

This conveys how many microplastics were in each trial for each phyla of macroalgae.

Table 2.
Microplastic analysis II.

Amount of Microplastics/grm		
Trials	Green	Red
1	2	8
2	4	7
3	5	5
4	2	6
5	1	5
6	1	4
7	7	5
8	3	5
9	6	4
10	5	5
11	2	
12	1	
13	1	
14	2	
15	3	
16	2	
17	1	
18	3	
19	4	
20	1	
Trials	Green	Red
Mean	2.8	5.4
STDEV	1.823819012	1.264811064

Table 3.
Statistical testing I.

t-Test: Two-Sample Assuming Equal Variances			
		Green	Red
Mean		2.8	5.4
Variance		3.326315789	1.6
Observations		20	10
Pooled Variance		2.771428571	
Hypothesized Mean Difference		0	
df		28	
t Stat		-4.032513904	
P(T<=t) one-tail		0.0001925510443	
t Critical one-tail		1.701130908	
P(T<=t) two-tail		0.0003851020886	
t Critical two-tail		2.048407115	

Table 4.
Statistical testing II.

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
Site A	9	31	3.444444444	4.777777778		
Site B	9	19	2.111111111	1.111111111		
Site D	4	26	6.5	1.666666667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	53.34343434	2	26.67171717	9.724655941	0.001235144525	3.521893261
Within Groups	52.11111111	19	2.742690058			
Total	105.4545455	21				

These tables reveal the statistics and P-Value for the different phyla of macroalgae.



Figure 4.
Filtering setup

This image shows how the microplastics were filtered after using the vacuum pump, beaker, funnel, and coffee filter.



Figure 5.
Red macroalgae in a glass pan

This image illustrates red macroalgae in a glass pan before it was covered in aluminum foil, and placed in the drying oven for over 24 hours.



Figure 6.
Green macroalgae in a glass pan

This image reveals green macroalgae in a glass pan before it was covered in aluminum foil, and placed in the drying oven.



Figure 7.
Green macroalgae Site A

This is the location of where green macroalgae from Site A was collected from. It is located near a marina.

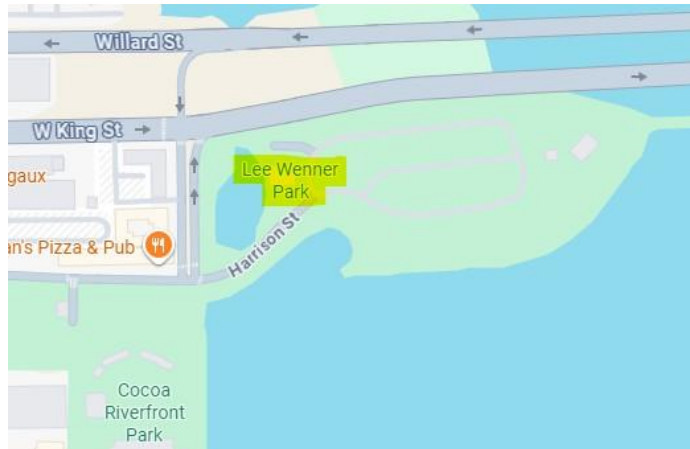


Figure 8.
Green macroalgae Site B

This is the location where green macroalgae from Site B was collected from. Lee Warner Park is a community river park with 4 boat ramps. The location on Photo 4 is about 804.672 meters apart from the location on photo 5.

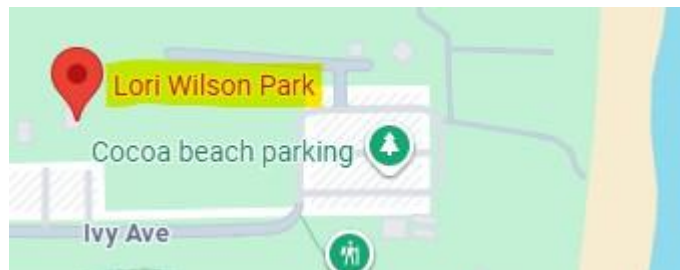


Figure 1.
Red macroalgae site

This is the location of where red macroalgae was collected from. This is a public beach attraction.

4.2 Discussion

The hypothesis was when comparing the 2 major phyla of microplastics (green, and red), then green algae will have the highest concentration of microplastics. I predicted green macroalgae to have a higher concentration of microplastics than red macroalgae because I encounter more green macroalgae when I am by the Indian River Lagoon, and some green macroalgae species also grow closer to the shore. There is more human action closer to the shore, so that is why I predicted green macroalgae to have a higher concentration of microplastics than red macroalgae. The results contradict the hypothesis. The green macroalgae that came from site A had a larger concentration of microplastics than macroalgae that came from site B. Macroalgae from site A contained approximately two more microplastics per gram than macroalgae collected from site B. Site A was located near a marina, while site B was not, so this explains the difference in microplastic accumulation in the green macroalgae. The difference in microplastic accumulation in green macroalgae from site A and site B could also reflect local environmental conditions, such as higher pollution levels, increased human activity, or water circulation patterns. One possible explanation for the higher microplastic concentration in red macroalgae is the structure and composition of their cell walls. Red macroalgae cell walls are composed of complex polysaccharides, such as agar and carrageenan, which may provide more binding sites for microplastics. These materials could allow microplastics to adhere more easily or become trapped within the algal tissue, leading to higher concentrations than those observed in green macroalgae. These findings emphasize the importance of local pollution sources in influencing microplastic distribution within marine ecosystems and highlight how microplastic contamination can vary significantly even between nearby locations. Macroalgae from Site D also came from the beach. The beach is a highly populated area, with more human movement. The microplastics observed under the microscope appeared like a black squiggly line. I did see a couple of red microplastics as well. The size of the microplastics differed, but the average size for the microplastics observed in this experiment under a standard compound brightfield microscope was about 0.1 millimeter. Macroalgae is at the base of the marine food webs, and understanding the concentration of microplastics in macroalgae can help give insight on trophic level transfer. Microplastics being on macroalgae can reduce the ecosystem's health and function in a few different ways.

Photosynthesis can be reduced, due to blocked light, and toxic additives are introduced to other marine organisms, and humans as well. When microplastics accumulate on or within macroalgae, they can be transferred to herbivorous marine organisms that consume them. These microplastics can then move up the food web, eventually reaching higher trophic levels, including fish consumed by humans. This project finding can be used to help many different projects outside of this one particular experiment.

Microplastics are everywhere, including places that would not be expected to hold a large amount of microplastics. There were no flaws in the experimental design. Less macroalgae should have been collected in future studies. Also, more 50% Hydrogen Peroxide could have been poured in the measuring cups over the macroalgae debris. This would have helped with clumping on the coffee filter, making it easier to look under the microscope, and count microplastics. Overall, this research raises serious concerns about the increasing abundance of microplastics in marine environments. The presence of a high number of microplastics in just one gram of macroalgae highlights the widespread nature of this pollution. Microplastics are accumulating at a concerning rate, even in locations where high concentrations might not be expected, underscoring the urgency of addressing plastic pollution on a global scale. The high number of microplastics found in just one gram of macroalgae highlights the widespread and growing nature of plastic pollution, underscoring the urgent need for global action to address this environmental issue.

5 Conclusion

In this experiment, red macroalgae had a higher concentration of microplastics than green macroalgae. The red macroalgae came from one location, site D, and the green macroalgae came from two different locations, site A and B. Graph 1 shows that red macroalgae had a higher mean of microplastics. Its mean was 5.4, averaging about 5 microplastics per each sample. Each sample that was measured was one gram of

macroalgae debris. Green macroalgae had a mean of 2.8, averaging around 3 microplastics per sample. The P-value of the total data is .00019, as shown on Table 3 and 4, highlighted in yellow. This project conveys the large amount of microplastics that are in a very small amount of marine life. Public awareness should be brought to this topic because plastic production continues to rise each year, and it is harming and disrupting our ecosystem. If microplastics in the marine environment continue to increase, then over time, humans will be affected by it as well. Human exposure to microplastics are extremely harmful because it can cause inflammation, cellular damage, and it can lead to increased risks of cardiovascular damage.

References

- Stanford Medicine. (2025, January). Microplastics in the body: Polluted by tiny plastic fragments. Stanford Medicine News Center. <https://med.stanford.edu/news/insights/2025/01/microplastics-in-body-polluted-tiny-plastic-fragments.html>
- Adarshan, S. (2023). Understanding macroalgae: A comprehensive exploration of macroalgal species and their significance. Marine macroalgae are generally safe to consume and contain numerous bioactive compounds. PMC. <https://pmc.ncbi.nlm.nih.gov/articles/PMC10780804>
- Stanley-Jones, M., & Obote, C. E. (2025, July 25). Tackling microplastic pollution from synthetic textiles through rebuilding natural fibre markets. UNU-INWEH. <https://unu.edu/inweh/article/tackling-microplastic-pollution-synthetic-textiles-through-rebuilding-natural-fibre>
- Sustainability Global Team. (2025, July 10). Top 10 ways to remove microplastics from the environment. Sustainability Global. <https://sustainabilityglobal.org/article/top-10-ways-to-remove-microplastic>
- U.S. Environmental Protection Agency. (2025, July 2). Microplastics research. <https://www.epa.gov/water-research/microplastics-research>
- Kumari, S., Yadav, D., Yadav, S., Selvaraj, M., Sharma, G., Karnwal, A., & Yadav, S. (2025). From macro to micro: The key parameters influencing the degradation mechanism and the toxicity of microplastics in the environment. Polymer Degradation and stability. <https://www.sciencedirect.com/science/article/abs/pii/S0141391025000059>
- Harvard Medicine Magazine. (2023, Spring). Microplastics everywhere: The tiny particles are even in our bodies. What might this mean for our health? Harvard Medicine Magazine. <https://magazine.hms.harvard.edu/articles/microplastics-everywhere>
- Knowing Fabric. (n.d.). What is microfiber fabric? A comprehensive guide. KnowingFabric.com. <https://knowingfabric.com/what-is-microfiber-fabric-a-comprehensive-guide/>
- United Nations Environment Programme. (2022, February 16). World leaders set sights on plastic pollution. UNEP. <https://www.unep.org/news-and-stories/story/world-leaders-set-sights-on-plastic-pollution>
- MicrobeNotes. (n.d.). Brown algae (Phaeophyceae): Characteristic, classification, importance. MicrobeNotes. <https://microbenotes.com/brown-algae-phaeophyceae/>
- California Department of Fish and Wildlife. (n.d.). Kelp and other marine algae — The species. <https://www.marinespecies.wildlife.ca.gov/kelp/the-species/>
- Moreira, A., Cruz, S., Marques, R., & Cartaxana, P. (2021, September 27). Green macroalgae aquaculture and its underexploited potential. Responsible Seafood Advocate. Microplastic Accumulation in Macroalgae: A Species-Specific Study in the Indian River Lagoon | Brevard Intracoastal Science and Engineering Fair <https://www.globalseafood.org/advocate/green-macroalgae-aquaculture-and-its-underexploited-potential/>
- Environmental Working Group. (2024, September 18). The invisible threat: EWG analysis shows you could be eating as many as 12 plastic bags a year. EWG.

- <https://www.ewg.org/research/invisible-threat-ewg-analysis-shows-you-could-be-eating-many-12-plastic-bags-year>
- St. Johns River Water Management District. (n.d.). Fast facts about the Indian River lagoon. SJRWMD. <https://www.sjrwmd.com/waterways/indian-river-lagoon/facts/>
- Viale, A. (2025, July 23). Understanding microplastics: Exposure, health and prevention MD Anderson Cancer Center Cancerwise. <https://www.mdanderson.org/cancerwise/understanding-microplastics-exposure-health-and-prevention.h00-159778023.html>
- Kristopaitytė, E. (2025, April 29). We ingest 50 pounds of microplastics in our lifetime. <https://wellnesspulse.com/research/microplastics-in-body-organs/>
- Wu, J. Y., Tso, R., Teo, H. S., & Haldar, S. (2023). The utility of algae as sources of high value nutritional ingredients, particularly for alternative/complementary proteins to improve human health. *Frontiers in Nutrition*, 10, 1277343. <https://www.frontiersin.org/journals/nutrition/articles/10.3389/fnut.2023.1277343/full>
- Galoustian, G. (2023, December 5). Green macroalgae has replaced seagrass in the Indian River Lagoon. Florida Atlantic University News Desk. <https://www.fau.edu/newsdesk/articles/seagrass-study-lagoon.php>
- Sharma, N. (2025, July 2). Brown algae (Phaeophyceae): Characteristics, classification, importance. *Microbe Notes* <https://microbenotes.com/brown-algae-phaeophyceae/>
- Dury, J., & Lawler, D. (2025, August 10). Microplastics are infiltrating your brain. What are the effects? *ScienceAlert*. <https://www.sciencealert.com/microplastics-are-infiltrating-your-brain-what-are-the-effects>