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Analysis of Microplastic Abundance in Lake Siombak, Medan Marelan, Medan

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Abstract

Microplastics are one of the pollutants that threaten aquatic ecosystems and have become the focus of research in recent years by environmentalists worldwide. In addition to harmful base materials, microplastics have hydrophobic characteristics, so chemicals such as Persistent Organic Pollutants can stick to microplastics and cause chemical pollution in aquatics. Siombak Lake is located in the coastal area of Medan City, and it is predicted to be a microplastic distribution channel to the aquatics. This study aimed to analyze the Abundance of microplastics in water, sediment, and fish in Siombak Lake. Sampling was conducted from November 2021 – January 2022 at Siombak Lake. Water samples to be analyzed were added with 90 g NaCl, then filtered and separated visually using a microscope. Microplastic in the sediment is separated by drying, volume reduction, density separation, filtration, and visual sorting. Fish samples were dissected, and then the digestive tract content of fish was diluted with 10 ml of saturated NaCl. The Abundance of microplastics obtained in waters ranged from 93-519 particles/m^3, and the Number of microplastics in sediment ranged from 521-1481 particles/kg dry sediment, while the Abundance of microplastics in fish samples ranged from 0-6 particles/individual.

Keywords: Microplastic, Abundance, Coastal, Pollutant, Siombak Lake

INTRODUCTION

Plastic products are indispensable materials in everyday life and are widely used in food packaging, the medical industry, and many others (Hu et al., 2020; Mao et al., 2020; Winkler et al., 2019). In 2017-2019 Plastic Europe (2020, 2019) recorded global annual plastic production reaching 348 million tons in 2017, while 2018 it was 359 million tons in 2019, recorded 368 million tons. Unfortunately, the increase in output is not balanced with the management and mitigation of plastic handling to prevent waste from polluting the aquatic environment; this pattern of use indicates that the production of plastics and the amount of plastic (microplastics) in the marine environment is likely to continue to increase over time (Felismino et al., 2020; Anderson et al., 2016; Andrady, 2011). Plastic pollution is a global problem that is highly developed and has received intense attention (Xu et al., 2019; Anderson et al., 2017).

It has been estimated that microplastics are distributed worldwide (e.g., in surface water, bottom waters, sediments, water columns, and organisms) (Zhang et al., 2020; Pan et al., 2019; Galloway et al., 2017). Plastics in water tend to be divided into smaller particles until they reach micro and nano sizes (Pinto da Costa et al., 2016). Microplastics are plastic particles less than 5 mm long (Costello & Ebert, 2020; Hidalgo-Ruz et al., 2012).

Microplastic research, in general, only focuses on the marine environment, whereas the terrestrial and river environments are the main transportation routes for microplastics to the sea (Horton et al., 2017). Rivers, lakes, and estuaries become pathways for microplastic pollution in coastal areas, especially areas

that cross residential areas. The results of research in recent years show that microplastics have become widespread in almost all aquatic environments, spreading in river waters (Hastuti, 2019; Rachmat et al., 2019; Manalu, 2017), mangrove sediments (Zhang et al., 2020; Bangun, 2017; Nor & Obbard, 2014; Hastuti, 2014), and lake waters (Costello & Ebert, 2020; Felismino et al., 2020; Hu et al., 2020; Anderson et al., 2017).

This research was intended to be carried out in Siombak Lake, a tidal lake located on the coast of Medan City, North Sumatra Province because some reasons, namely: first: Siombak Lake has a unique contour since the river flows into the lake through the Belawan watershed along 12 km from the sea (the Malacca Strait) affected by tides thus making area of this lake up to 28 ha with an average depth of 4.38 m at low tide and 6.25 m at high tide (Muhtadi et al., 2017). Secondly, the history of this lake was formed from land dredging activities for the Belawan-Medan-Tanjung Morawa (Belmera) toll road construction in 1980 (Muhtadi et al., 2016), which means this lake was incidentally human-made. Third, the territory around the lake is also surrounded by mangroves, a habitat for aquatic organisms, including high commercial fish. Four, the Siombak Lake area has important economic values such as fisheries, agriculture, tourism, and cottage industries. In certain regions, there is housing for residents, so this area is under pressure from anthropogenic and industrial activities. Not far from Siombak Lake, there is also a TPA (Final Disposal Site), "Terjun," which is an area where the city of Medan is dumped.

Therefore, this novel study involved a unique characteristic of Siombak Lake. The existence of activity along the vicinity of Siombak Lake and the lake inlet and outlet is thought to be the distribution route of the widespread presence of microplastics in the waters and the bodies of aquatic organisms. This study aimed to quantify the Abundance of microplastics in sediment, water bodies, and fish samples derived from Siombak Lake.

RESEARCH METHODS

Research location and time

The research was conducted from November 2021 to January 2022 at Siombak Lake, Medan Marelan District, Medan City, North Sumatra Province. Sediment drying was carried out at the Integrated Laboratory of the Agricultural Engineering Study Program, Faculty of Agriculture, Universitas Sumatera Utara. Microplastics were analyzed and identified at the Integrated Laboratory of the Food Technology Study Program, Universitas Sumatera Utara.

The determination of stations for sampling is based on the environmental baseline by using the "Purposive Sampling" method in determining 6 (six) observation points. Point 1 is a station near tourist destinations and fishponds for fishing and cultivation. Point 2 is an area that is used as a tourist destination. Point 3 is an area that has the shallowest depth, and this is due to trapped sediment carried by currents. Point 4 is a residential area with a variety of activities. Point 5 is an inlet and outlet area on Lake Siombak, dominated by Nipah vegetation. Point 6 is a station in the middle of Siombak Lake. The location map can be seen in Figure 1.

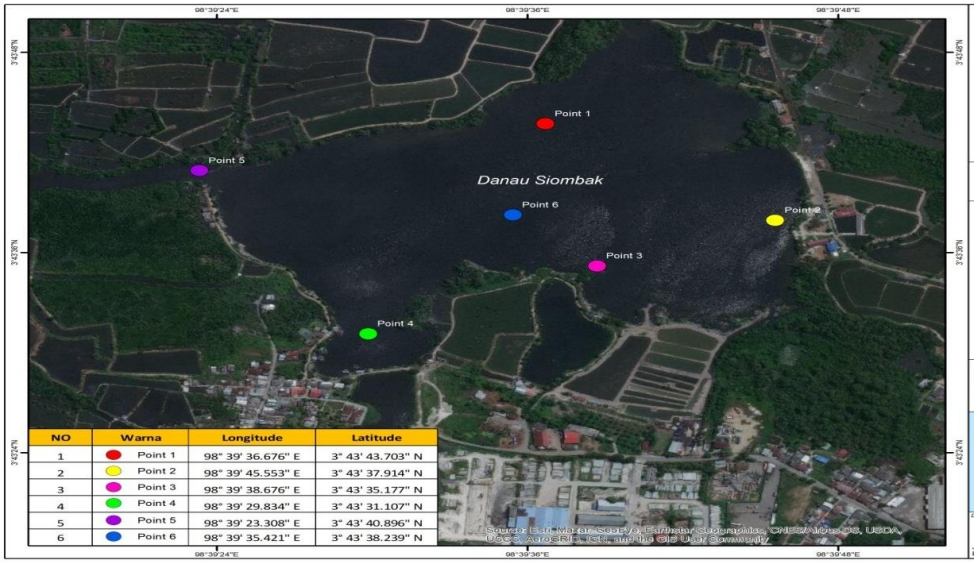

Figure 1. Research sites

Research tools and materials

The tools used in this study were the Global Position System (GPS), fishing boats, plankton net (mesh size 30 m), sample bottles, Eckman grabs, fishing nets (1-inch mesh size), cool box, surgical instruments, cup petri dish, ruler, caliper, scales, measuring cup, sieve no 4 (mesh size 5 mm), sieve no 12 (mesh 1.68 mm), sieve no 18 (1 mm mesh), oven, monocular microscope, camera, and stationery. The materials used in this study were water samples, sediment samples, fish samples, saturated NaCl solution, NaCl, 70% alcohol solution, tissue, label paper, rubber bands, plastic bags, and duct tape.

Sampling

The data to be collected is primary data. This preliminary data was obtained by direct observation in the field (in situ) and sample handling in the laboratory (ex-situ). These primary data include an abundance of microplastics from water, sediment, and fish digestive tract. Water samples were taken using a plankton net (diameter 30 cm and mesh size 30 µm), placed in the water column horizontally at a depth range of 0 cm, 50 cm, and 100 cm, and pulled slowly using a boat as far as 10 m. Water samples that have been taken are put into sample bottles that have been labeled and brought to the laboratory for analysis. Sediment sampling was carried out using an Eckman grab. Many sample volumes were taken, put into a plastic bag, and brought to the laboratory for analysis. Sample fish was taken using a tool catch net with a mesh size of 1 inch. Tool catch net installed in surface waters and given weights for yields no drift away. Every station installed one tool catch net with a long net ± 50 meters. Net fishing gear is installed simultaneously on water and sediment sampling, and then the net is left 3-4 hours after that conducted withdrawal net. All types of fish caught were limited by using a sample of 10 fish at high and low tide and then stored in a cool box at four °C and brought to the laboratory for analysis.

Laboratory Analysis

The 200 ml water samples to be analyzed were first given 90 g of NaCl for density separation. Plastics with a large size (1.68-5 mm) can be separated by filtering with mesh No. 12 (mesh size 1.68 mm) or visual separation. In contrast, smaller-sized microplastics are separated using a monocular microscope. (Magnification 4 x 10). This method applies to the determination of many common plastics, including PE (0.91 -0.97 g/ml), P.P. (0.94 g/ml), PVC (1.4 g/ml), and P.S. (1.05 g /ml) (Masura et al., 2015).

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Separation of microplastics from sediment is carried out in the following stages: (a) drying, (b) volume reduction, (c) density separation, (d) filtration, and (e) visual sorting (Hildago-Ruz et al., 2012). Sediment samples were dried using an oven at 105°C for 72 hours, depending on the sediment conditions (Manalu, 2017). The dried sediment is then pulverized using a mortar (Nor and Obbard 2014), and the sediment volume reduction is carried out with sieve no 4 (mesh size 5 mm); thus, sediment above 5 mm will be retained in the sieve. The next step is to separate the density by mixing the saturated NaCl solution (3L) into the sediment (1 kg), then stirring for 2 minutes (Claessens et al., 2011). After starting, light-sized plastic will be on the surface; the general type of microplastic is P.E. and P.P. (Hildago-Ruz et al., 2012). Separation was carried out with the help of a sieve (5 mm, 1.68 mm, and 1 mm). Large samples (1.68-5 mm) can be separated by visual separation, while smaller microplastics are separated using a monocular microscope (10 x 10 magnification).

Microplastics in fish digestion can represent microplastic pollution in the waters (Horton et al., 2018). Biological sampling is an examination of many microplastics that can be digested by aquatic biota (Cole et al., 2011), so this study was carried out on the digestive system of the sample. Digestive contents in the stomach and intestines were taken from each piece and placed in an alcohol solution—70% for further analysis (Fu et al., 2020; Jantz et al., 2013). Dilution of the contents of the intestines and stomach (digestive tract) of fish was carried out with 10 ml of saturated NaCl. Visible microplastic particles are separated from the rest of the intestinal contents. In contrast, particles that are difficult to see by the eye are identified using a monocular microscope (10x10 magnification) (Boerger et al., 2010).

Microplastics Abundance Analysis

Analysis of the Abundance of microplastics was calculated using the formula.

$$K = \frac{n}{v} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

(Masura et al., 2015).

$$K = \frac{\text{Number of microplastic particles}}{\text{Number of fish}} \quad \ldots\ldots\ldots (2)$$

(Boerger et al., 2010).

Information:

K : Abundance of microplastics (particles/m^3)/(particles/kg dry sediment) (particles/individual)
N : Number of microplastic particles (particles)
V : sample volume

RESULTS AND DISCUSSION

Microplastics in Aquatic Environments

Research on microplastics in freshwater environments has been widely carried out recently (Hu et al., 2020). The river area is one of the entry routes for microplastics into the aquatic environment (Stolte et al., 2015) and is identified as the main pathway for microplastics from terrestrial sources (Zbyszewski et al., 2014; Fischer et al., 2016) originating from community activities around rivers.

The Abundance of microplastics in this study ranged from 93 - 519 particles/m^3. The value obtained is greater than that done by (Hu et al., 2020) in Dongting Lake, China, with an abundance value of 0.62-4.30 particles/m^3; (Alimi et al., 2020) in Lake Naivasha, Kenya, with an abundance value of 0.407-0.135 particles/m^3. Different things are shown in the research of (Su et al., 2016) in Taihu Lake, China, with greater abundance values ranging from 3400-25800 particles/m^3; (Yuan et al., 2019) in Poyang Lake, China, with an abundance value of 500-3400 particles/m^3 and (Manalu, 2017) in Jakarta Bay with an abundance value of 2881-7472 particles/m^3. The difference in

abundance values shown in each study is caused by differences in methods and tools and the size of the mesh size used (Zhao et al., 2014). In addition, the location of water bodies, namely rivers, lakes, and reservoirs close to big cities, has the potential for high microplastic pollution (Fu and Wang, 2019). The results of the Abundance of microplastics in the aquatic environments of Siombak Lake are presented in Table 1.

Table 1. The Abundance of microplastics in the aquatic environments of Siombak Lake

Stations	Microplastics Abundance (particles/m^3)		
	November (2021)	December (2021)	January (2022)
1	170	359	165
2	127	168	112
3	130	158	103
4	392	519	359
5	177	255	136
6	93	168	96

Source: Data Processing (2022).

The highest abundance value of microplastics in aquatic environments of Siombak Lake was found at station 4, with the highest value in December 2021, namely 519 particles/m^3. Station 4 is a residential area where most people around the lakeside work as fishermen, and visually at station 4, there is a lot of floating garbage that dominates plastic waste. Table 1 shows the highest Abundance of microplastics in December 2021 because there was a fairly tall and evenly distributed rainfall intensity in the city of Medan in that month before sampling. There was also a peak tide (highest), so the Siombak Lake area visually saw a lot of garbage and was dominated by plastic waste. This is in line with the research conducted by (Alimi et al., 2020), namely, in the rainy season, the concentration of microplastics has a high increase compared to the dry season because the intensity of waste entering Siombak Lake is influenced by river activity that passes through the city of Medan and according to a field survey, the community said that during the rainy season, a mountain of garbage enters the body. The waters are thought to have come from the TPA "Terjun," which is very close to the lake.

The lowest abundance value was found at station 6 in November 202 1 of 93 particles/m^3 with a description at station 6 is an area in the middle of Siombak Lake; it appears from visual observations very little trash in the middle of the lake and more in the area lakeside. In January 2022, there was no rain before sampling; at that time, it was also the smallest tide (dead), so there was not too much garbage like in the rainy season or big waves. This is in line with the statement of (Ballet et al., 2012), namely that the value of the Abundance of microplastics is influenced by physical strength originating from the influence of tides. Flow velocity, depth, bottom topography, and seasonal variability of water currents can affect the Abundance of microplastics in water (Simpson et al., 2005).

Microplastics Type

In the aquatic environment samples, only three types of microplastic were found: fiber, film, and fragments. This form can affect the possibility of being swallowed because biota organisms cannot digest microplastics (Boerger et al., 2010). The type of microplastic in aquatic environments is presented in Figure 2.

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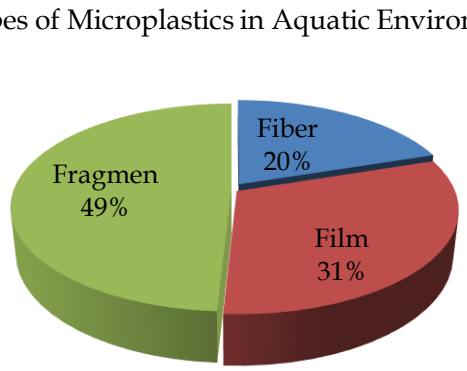

Figure 2. Types of microplastics in aquatic environments

The results of the overall analysis of microplastic types in 6 sampling locations in November 2021 - January 2022 in the waters of Siombak Lake showed that the fragment was the type with the highest percentage value of (49%) or 1812 particles/m^3. The film is in the second position with a value percentage of (31%), or 1140 particles/m^3 and fiber is in the third position with a percentage value of (20%) or 737 particles/m^3. The type of microplastic in aquatic environments is presented in Figure 2.

The dominant type of microplastic obtained in this study was different from the results found by (Hu et al., 2020) in Dongting Lake (Hunan, China), with the dominant type of fiber (65%) (Anderson et al., 2017) in Winnipeg Lake (Manitoba, Canada) with the dominant type of fiber (71%), Su et al., (2016) in Taihu Lake (Jiangsu, China) with the predominant type of fiber (48-84%), but different from the study conducted by (Bertoldi et al., 2020) in Guaiba Lake (the Rio Grande do Sul, Brazil) found a dominant type of fragment (70%), (Manalu, 2017) in Jakarta Bay (Jakarta, Indonesia) found a prevalent kind of fragment (50-80%), (Eriksen et al., 2013) in the Laurentian Great Lakes (Canada and the United States) found the dominant type of fragment, which was 382232.5 km^2 particles.

Even though the several studies that have been carried out have an abundance of different types, the results of observations in the field show that the condition of the lake at the time of conducting the research was filled with plastic waste and was dominant (plastic bags, containers, bottles, etc.) around Siombak Lake. This type of plastic waste is the main source of microplastics in the fragment and film types (Desforges et al., 2014). Fragment and film types are some of the microplastics from secondary sources which are often associated with areas with high population density (Manalu, 2017); this is in line with Siombak Lake, which is in Medan City which is one of the most densely populated cities in Indonesia and produces a lot of secondary plastics as the forerunner of many types of fragments.

Microplastics in Sediment

Observations were made on Siombak Lake with observed microplastic abundance values showing different results at each station, ranging from 521-1481 particles/kg dry sediment. The value obtained is greater than the previous study conducted by (Bagheri et al., 2020) in the Caspian Sea with the highest Abundance of 695 particles/kg dry sediment, (Felismino et al., 2020) in Simcoe Lake (Ontario, Canada) with an abundance value of 8-1070 particles/kg dry sediment,

(Yuan et al., 2019) in Poyang Lake (Jiujiang, China) with an abundance value of 54-506 particles/kg dry sediment, (Jiang et al., 2018) in Dongting Lake (Hunan, China) with an abundance value of 200-1150 particles/kg dry sediment, (Su et al., 2016) abundance values in Taihu Lake (Jiangsu, China) have an abundance value of 11-234.6 particles/kg dry sediment. Different things are shown in Manalu's research (2017) in Jakarta Bay (Jakarta, Indonesia) which offers a higher microplastic abundance value of 18405-38790 dry sediment particles.

The characteristics of the different research locations caused the difference in abundance values shown in each study. Siombak Lake is a research location that is influenced by tides and anthropogenic activities, including densely populated settlements, tourism, and fishing activities that have the potential to produce waste that is freely disposed of into the environment as well as the effects of tidal influences that carry waste from the river to Siombak Lake (Muhtadi et al., 2016; 2017). The relationship between the Abundance of microplastics with anthropogenic activities and densely populated settlements has been demonstrated in various studies (Vanapalli et al., 2020). The results of visual observations show that the sediment in Siombak Lake has a soft and muddy texture. (Watters et al., 2010) stated that deposits with a smooth surface have a high potential to trap garbage compared to rocky and gravel habitats. The results of the Abundance of microplastics in sediments in Siombak Lake are presented in Table 2.

Table 2. Microplastic Abundance in Sediments in Siombak Lake

Stations	Microplastic Abundance (particles/kg dry sediment)		
	November (2021)	December (2021)	January (2022)
1	1157	1273	1095
2	978	1179	901
3	756	993	817
4	1261	1481	1362
5	1023	1105	1003
6	541	637	521

Source: Data Processing (2022).

The highest Abundance of microplastics in Siombak Lake was found at station 4, with the highest value in December 2021 of 1481 particles/kg dry sediment, while the lowest Abundance was found at station 6 in January 2022 of 521 particles/kg dry sediment. Table 2 shows the significantly highest Abundance of microplastics in December. This is because in December, before sampling, the area around Medan City was raining, causing a lot of garbage to enter the water body of Siombak Lake; at the time of selection, there was a peak tide (highest), resulting in a lot of garbage entering and the dominating was garbage. Plastic, this statement is reinforced by the answers to a questionnaire distributed to the community around the outskirts of Siombak Lake.

The results show that the Abundance of microplastics shows the same pattern; namely, the highest abundance value is found at station 4, describing that this station is a residential area with various activities. It appears from the visual observation that there is a lot of garbage in water bodies, and the

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dominant one is plastic waste, as well as the many small fishing boats that dock close to the area. According to community recognition in the questionnaire conducted, a lot of trash at station 4 was obtained from the entry of garbage from the Siombak Lake inlet/outlet, namely the Belawan River, because they were prohibited from throwing rubbish into water bodies by the environmental head. The lowest value of microplastic Abundance was found at station 6, with a description of the area being a station in the middle of Siombak Lake which can be seen from visual observations that there is very little trash in the middle of the lake and more in the outskirts of the lake. Environmental conditions and sources of pollution influence the difference in the Number of microplastics (Azizah et al., 2020).

Microplastic Type

Based on the type, microplastics can be in the form of films, fibers, fragments, and pellets and are sourced from the primary in the form of pellets (cosmetic material) and secondary in the form of plastic which is fragmented into small/micro parts (Vanapalli et al., 2020). Sediment samples in Siombak Lake found microplastic types, namely fiber, film, fragments, and pellets. Microplastic in each type sinks and accumulates at the bottom of the sediment (Claessens et al., 2011). The kind of microplastic in deposition is presented in Figure 3.

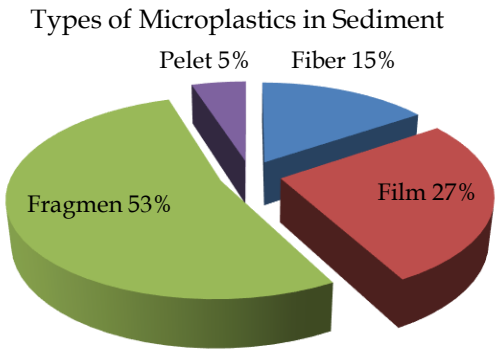

Figure 3 . Types of microplastics in sediment

The results of the overall microplastic type analysis of 6 sampling locations in November 2021 – January 2022 on sediments in Siombak Lake show that fragments are the type with the highest percentage value of (53%) or 9572 particles/kg dry sediment. The film is in the second position with a percentage value of (27%) or 4817 particles/kg dry sediment. Fibre is in the third position with a percentage value of (15%) or 2808 particles/kg dry deposition, while the Abundance of pellets is in the fourth position with a percentage value (5%) or 898 particles/kg dry sediment. The type of microplastic in the deposition is presented in Figure 3.

The dominant type of microplastic found in this study has similarities with what was done by (Manalu, 2017) in Jakarta Bay, with the kind of fragment that dominates. However, in a survey conducted by (Nor and Obbard, 2014) in Singapore's mangroves, (Su et al., 2016) in Taihu Lake (Jiangsu, China); (Jiang et al., 2018) in Dongting Lake (Hunan, China); (Yuan et al., 2019) in Poyang Lake (Jiujiang, China); and (Bagheri et al., 2020) in the Caspian Sea, that the type of microplastic commonly found in sediments is fiber.

Different results are shown in the research conducted by (Alomar et al., 2016) in the Mediterranean Sea with 3 locations that became the focus of observation, namely Andratx, Es Port, and Santa Maria, which showed mixed results. At the Andratx location, the dominant type is fiber, but at the Es Port and Santa Maria locations, it shows that the fragments are an abundant type.

A study conducted by (Alomar et al., 2016) explained that the fiber found in Andratx came from waste from the manufacture of synthetic clothing produced by the textile industry, while at the Es Port and Santa Maria locations, more fragments were found because, at the time of sampling in this study, many macroplastics were found floating on the body. Waters. According to (Kingfisher, 2011; Wagner et al., 2014; Azizah et al., 2020) they explained that microplastics are formed from the fragmentation of larger plastics. Based on the description above, the possibility of the same thing happening in this study was due to visual observations made at the time of sampling; there was a lot of plastic / macroplastic waste floating in the water body of Siombak Lake.

Microplastic particles generally found in sediments are of high density, which has a thickness greater than the density of water. In contrast, low-density microplastics are dominantly found on the water's surface. In certain cases, low-density microplastics can also reach the bottom of the sediment by modifying the density through a biofouling process by prokaryotic, eukaryotic, and invertebrate organisms that increase the density of these microplastics, causing low-density microplastics to sink to the bottom of the water (Andrady, 2011; Reisser et al., 2013; Zettler et al., 2013; Jorissen, 2014; Manalu, 2017).

Microplastics in Fish

Siombak Lake is a tidal lake located in the coastal area of Medan City, North Sumatra, with an average depth of 5-10 m. It is categorized as a small lake < 100 ha, which is connected to the river flow that enters the lake through the Belawan River Basin and is an artificial lake resulting from the dredging of the Belawan-Medan-Tanjung Morawa toll road (Muhtadi et al., 2016; Muhtadi et al., 2017). The area around the lake is surrounded by mangroves which are the habitat of aquatic organisms, including highly commercial fish. Based on the results of research conducted in November (2021) - January (2022) found as many as six species of fish. The scientific names of fish and the distribution of species based on the time of collection are presented in Table 3.

Table 3. Distribution of fish species by the time of collection

No	Species	Local Name	Research Sampling		
			November (2021)	December (2021)	January (2022)
1	Channa Striata	Gabus	-	-	✓
2	Cichlasoma Rimaculatum	Lohan	✓	✓	✓
3	Clarias Batrachus	Lele	-	✓	-
4	Megalops Cyprinoides	Bulan-bulan	✓	✓	✓
5	Oreochromis Mossambicus	Mujair	✓	✓	✓
6	Oreochromis Niloticus	Nila	✓	✓	✓

Source: Data Processing (2022).

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The spread of microplastics in the water column and extensive sediments with high abundance values, size, and color that resembles prey increases the potential for microplastics to be consumed by various aquatic organisms (Fossi et al., 2012; Lusher et al., 2013; Manalu, 2017). In this study, the value of the Abundance of microplastics in both the water column and sediment was higher than in other research locations. This situation can affect organisms that live around the research location, such as fish in the water column and fish that live on the bottom of the waters. The colors of microplastics that resemble natural prey have the potential to be consumed by aquatic organisms (Andrady, 2011). The graph of the Abundance of microplastics in fish is presented in Figure 4.

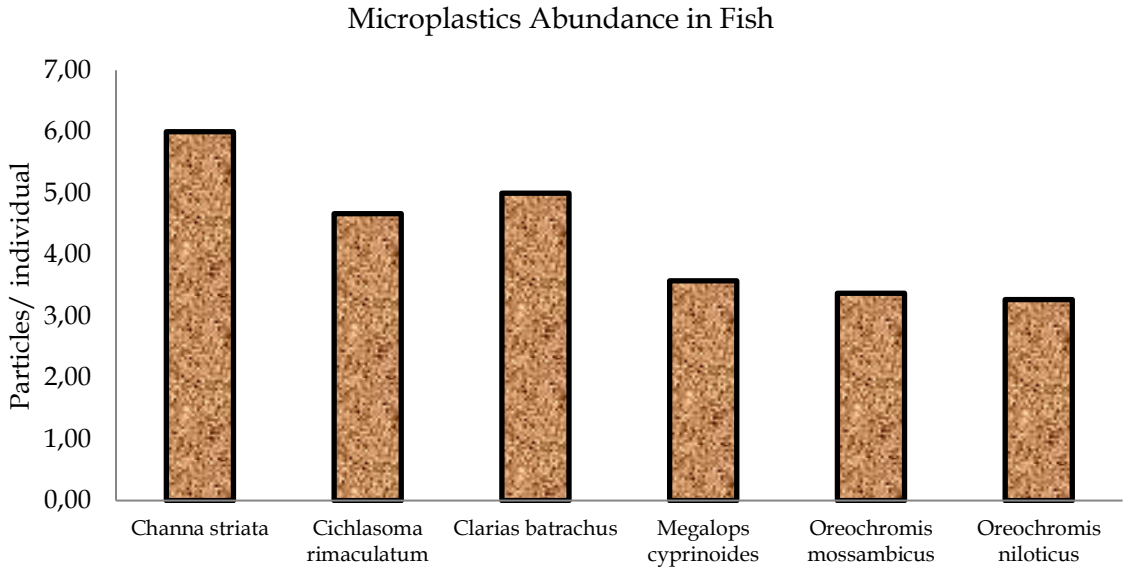
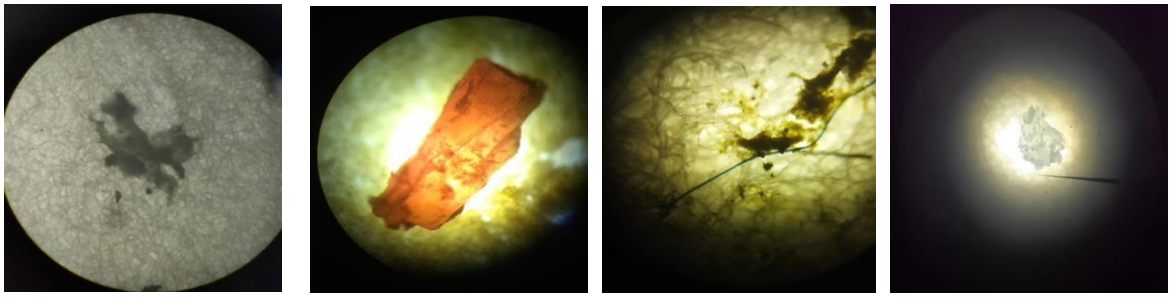


Figure 4 . Microplastics Abundance in Fish

The results of the Abundance of microplastics in fish in Lake Siombak in November 2021-January 2022 with six stations are very diverse. The highest quantity was found in Channa striata species with as many as six particles/individual, Clarias batrachus with as many as five particles/individual, Cichlasoma rimaculatum with as many as 4.67 particles/individual, Megalops cyprinids with as many as 3.57 particles/individual, Oreochromis mossambicus as many as 3.37 particles/personal and Oreochromis niloticus 3.27 particles/individual.

A study conducted by (Septiana et al., 2021) showed that microplastic content was also found in Channa striata species in Samarinda City (Sandra and Radityaningrum, 2021), showing the Abundance of microplastics in Oreochromis niloticus species in brackish waters of 1.47-7 particles/individual, and (Hasibuan et al., 2021) showed an abundance of microplastic 4.06-18.46 particles/individual in the Oreochromis mossambicus species. The main factor that supports microplastics entering the digestive tract is thought to be wrong in identifying prey, and this is microplastic similar to plankton, a natural fish food (Setala et al., 2014). In addition to misidentifying wild game, carnivorous fish can indirectly eat microplastics at higher trophic levels due to eating fouling organisms attached to plastic or organisms that previously ate microplastics (Nadal et al., 2016).



(Fragment) (film) (Fiber) (Pellet)

Figure 5. Types of microplastics in Siombak Lake (4x10 magnifications)

CONCLUSION

The Abundance of microplastics in sediments ranged from 521–1481 kg dry sediment particles, the Abundance of microplastics in water bodies ranged from 93–519 particles/$m^{3,}$ while the number of microplastics in fish samples ranged from 0–6 particles/individual.

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