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Microplastic Content in the Stomach of Caru Fish (*Megalaspis cordyla*) in the Sea Waters of Dumai City, Riau Province

Kandungan Mikroplastik dalam Perut Ikan Caru (Megalaspis cordyla) di Perairan Laut Kota Dumai, Provinsi Riau

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Abstract

Microplastics are particles that have a size of <5 mm and their existence might be able to contaminate the biota in the aquatic environment, such as care fish. Caru fish was collected in the Dumai city fish landing base in September - December 2022 to determine the abundance of microplastics in caru fish. The method used in this study is a survey method; samples of caru fish were obtained from Fish Landing Base (PPI) Dumai, and the samples were analyzed for the microplastic content in the laboratory. The samples used were 90 caru fish divided into three size classes. The parameters measured included type of microplastic, microplastic abundance, microplastic colour and the relationship between care fish size and microplastic abundance. The abundance of microplastics from the three size class of fish shows that the size class 22.1-24 cm had a higher average abundance of microplastics with an average value of 5.7 particles/individual. The type of microplastics found in this study were fibre, film and fragment. The relationship between the length of the caru fish and the abundance of microplastics has not been influenced by the size of the carp fish.

Keywords: Microplastics, Abundance, Carnivores, *Megalaspis cordyla*

Abstrak

Mikroplastik adalah partikel yang memiliki ukuran <5 mm, dan keberadaannya mungkin dapat mencemari biota di lingkungan perairan, seperti ikan perawatan. Ikan caru dikumpulkan di pangkalan pendaratan ikan kota Dumai pada September - Desember 2022 untuk mengetahui kelimpahan mikroplastik pada ikan caru. Metode yang digunakan dalam penelitian ini adalah metode survei; sampel ikan caru diperoleh dari Fish Landing Base (PPI) Dumai, dan sampel dianalisis kandungan mikroplastik di laboratorium. Sampel yang digunakan adalah 90 ikan caru yang dibagi menjadi 3 kelas ukuran. Parameter yang diukur meliputi jenis mikroplastik, kelimpahan mikroplastik, warna mikroplastik dan hubungan antara ukuran ikan perawatan dan kelimpahan mikroplastik. Kelimpahan mikroplastik dari kelas 3 ukuran ikan menunjukkan bahwa kelas ukuran 22,1-24 cm memiliki kelimpahan rata-rata mikroplastik yang lebih tinggi dengan nilai rata-rata 5,7 partikel/individu. Jenis mikroplastik yang ditemukan dalam penelitian ini adalah serat, film dan fragmen. Hubungan antara panjang ikan caru dan kelimpahan mikroplastik belum dipengaruhi oleh ukuran ikan mas.

Kata kunci: Mikroplastik, Kelimpahan, Karnivora, *Megalaspis cordyla*,

1. Introduction

Dumai City's fisheries production mainly comes from marine fisheries. Dumai City's total fish production is 1,273 tons. A total of 931 tons (73%) came from marine fisheries and 342 tons (26.89%) from ponds and ponds (BPS, 2021). This means that the activity of capture fisheries in Dumai City is very high. The distribution of activities is spread across several areas of Dumai City, such as Tangkahan Pelintung, Basilam Baru, Tangkahan Guntung, Kemeli Besar, Bangsal Aceh, Tanjung Palas and the centre is at the Dumai Fish Landing Base (PPI) (Mardiah et al., 2022). High fishing activities and many community activities (anthropogenic) around Dumai waters produce pollutants (industrial and domestic waste), including organic and inorganic waste. Fishermen's activities, such as fishing and using nets to catch fish, are one factor in the presence of plastic waste, which later turns into microplastics because many unused nets are left around the beach. One type of marine fish caught in Dumai City waters is the caru fish (Firdaus et al., 2021).

Caru fish (*Megalaspis cordial*) is known by the common name the torpedo scad or known by various local names in Indonesia, such as the hardtail, tetengkek, cengcaru, kerogen, and cengkurungan. This fish is a pelagic fish from the Carangidae family and can grow to a maximum length of 80 cm with a weight of 4 kg, and its general length is 45 cm. This fish is a predatory fish and is one of the fisheries resources with ecological and economic value. Carnivorous fish are fish that fulfil their living needs by eating other fish. In connection with the feeding habits of predatory fish, which tend to eat their prey whole, they are vulnerable to consuming things that are not their food, including plastic waste.

Humans' increasing dependence on plastic use in various applications without realizing it has long-term impacts. Plastic waste humans produce will eventually be thrown back into the environment (Victoria, 2017). Thompson et al.(2009) stated that almost all types of plastic will float or float in bodies of water, causing the plastic to be torn apart and degraded by sunlight (photodegradation), oxidation and mechanical abrasion to form plastic particles. Plastic, including microplastic, can degrade into tinier plastic particles (Cole et al., 2011).

The effect of plastic particles accumulating in large quantities in the fish's digestive tract is that microplastics can clog the fish's digestive tract (Browne et al., 2013). Boerger et al.(2010) stated that marine organisms can ingest microplastics when one of the microplastic particles resembles food. If this continues, it will affect the area's food chain, economy and public health. Based on this background, the author is interested in studying microplastic content in the stomachs of carp fish (*M. cordyla*) in marine waters in Dumai City, Riau Province.

2. Material and Method

2.1. Time and Place

This study was carried out from September to December 2022, with samples taken in the sea waters of Dumai City, Riau Province. The samples were then analyzed at the Marine Chemistry Laboratory, Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau.

2.2. Methods

The method used in this study is a survey method. Sampling was carried out at PPI Dumai. Fish samples were obtained by buying them from fishermen when they were still fresh and then taken to the laboratory. The measured parameters include microplastic type, microplastic abundance, colour, and the relationship between caru fish length and microplastic abundance.

2.3. Procedures

2.3.1. Sample Collection

The sampling technique was conducted at Dumai City fish landing base, West Dumai District. Fish samples were obtained from fishermen from the waters of Dumai City and its surroundings. They were fresh and immediately stored in a coolbox containing ice cubes so that the samples did not rot during the journey to the laboratory. The samples were taken to the Aquatic Biology Laboratory and Marine Chemistry Laboratory, Faculty of Fisheries and Marine, Universitas Riau will continue with further analysis. Microplastic analysis was carried out in the laboratory on 90 carp fish, which were divided into three size classes, namely small (18-20 cm), medium (20.1-22 cm) and large (more than 22 cm).

2.3.2. Microplastic Analysis

Fish samples that will be identified for their microplastic content are carried out through several stages, namely (a) surgery, (b) separating the entire digestive tract, (c) soaking the digestive organs in 10% KOH solution with a ratio of 1 :3, (d) incubation for two weeks, (e) observation of microplastics using a Sedgewick Rafter Counting Cell under an Olympus CX 23 Microscope by taking 1% of the total amount of liquid. Then, the microplastic samples are classified into several types, namely fibre, film and fragments. The abundance of microplastics was obtained by counting the number of microplastics in one individual fish. To calculate the abundance of

microplastics based on a study conducted by Boerger et al. (2010), the abundance of microplastics in this study was calculated using the following formula:

$$\text{Abundance of microplastic per individual} \frac{\text{Number of Microplastics}}{\text{Number of Fish}}$$

3. Result and Discussion

3.1. General Condition of Study Location

Dumai City is a municipality in Riau Province with seven sub-districts, including Sungai Sembilan. Geographically, the city of Dumai is located at 1'23"- 1'24" N latitude and 101'23'37-101'28'13 E longitude with an area of 1727.38 km2. The Dumai City area has a tropical climate with rainfall between 100-300 cm and an air temperature of 24-30 °C with peaty swamp soil conditions. The city of Dumai partly consists of lowlands in the north and partly highlands in the south. The maritime climate strongly influences the city of Dumai. The rainy season falls from September to February, and the dry period starts from March to August with a wet tropical climate, which is influenced by the nature of the maritime environment, with rainfall ranging from 1500 mm to 2600 mm for 75 to 130 rainy days per year. This condition is supported by an average temperature of 26– 32oC with humidity between 82-84%. The wind acceleration rate ranges from 6-7 knots, making Dumai the most climate and weather-friendly area.

Dumai Waters is one of the small straits in the Malacca Strait and is geographically located between the Coast of Dumai City and Rupat Island, which has a length of ±72.4 km and a width of 3.8–8 km. In general, anthropogenic activities in Dumai City greatly influence the environmental conditions of Dumai Waters. The reduction can be seen in the number of fish catches and the decrease in the number of mangroves found around the Coast of Dumai City and the islands close to Dumai City (Ariani, 2016).

3.2. Microplastic Analysis

The abundance of microplastics Based on type, only three types of microplastics were found: film, fibre, and fragment. The types and abundance of microplastics found can be seen in Figure 2 and Figure 3.

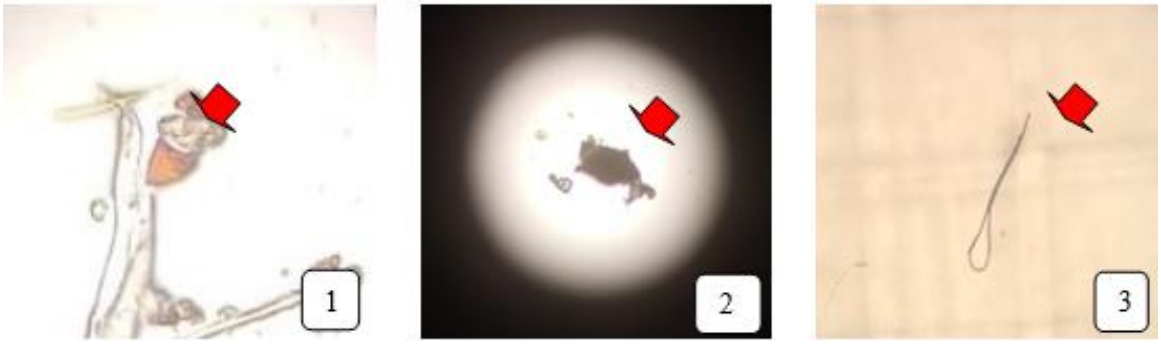

Figure 1. Types of Microplastics: 1. Film; 2. Fragment; 3. Fiber

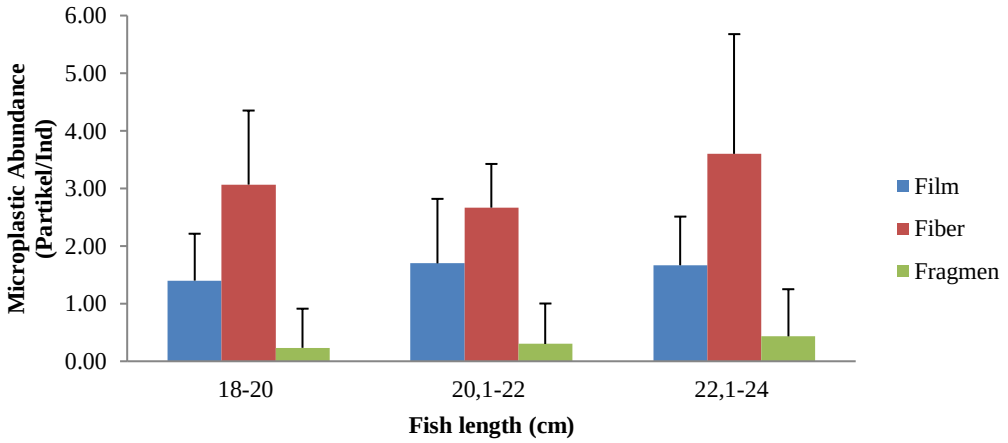

Figure 2. Average abundance of microplastics based on type in each size class

Figure 1 shows that three types of microplastics are found in the digestive tract of this fish: film, fibre, and fragment types. The types of microplastics found in this study are commonly found in marine waters. Figure 2 shows fiber is the type most commonly found in all size classes. Fiber-type microplastics were most commonly found in the 22.1-24 cm size class with an average value of 3.60 particles/individual.

Fishing activities carried out by fishermen around the study location using fishing nets made of plastic are also suspected to contribute to microplastic waste in the waters. Nor et al. (2014) stated that fibre microplastics originate from degradation from various fishing activities, both from fishing gear and from ropes from ships, which decompose into the water and accumulate in the bodies of biota. One fishing gear widely used around the Dumai City Fish Landing Base (PPI) is the Gill Net fishing gear (Djunaidi, 2021). According to GESAMP (2015), fibre has a thin shape and size, which often causes the fibre to float on the water's surface. Fish caught in waters close to residents ingest more microplastics than fish caught in areas far from residential areas (Brate et al., 2016).

The analysis of the abundance of microplastics based on size class in this fish. The abundance of microplastics from the three lengths of fish observed shows that the class 22.1-24 cm station had a higher average of microplastics, namely 5.7 particles/individual (Figure 3).

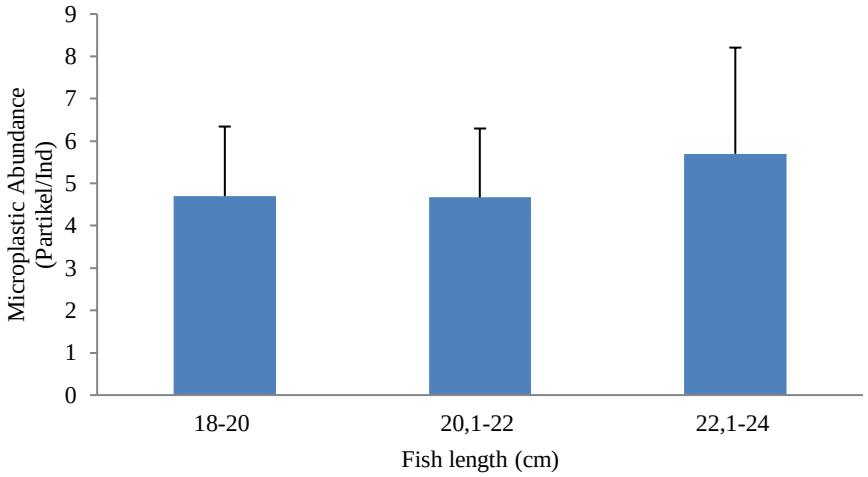

Figure 3. Average abundance of microplastics in each size class

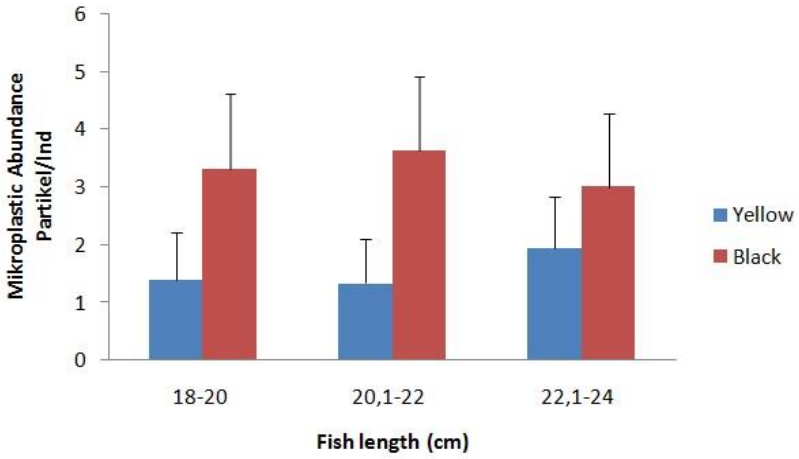

Figure 4. Average abundance of microplastics based on color in each size class

Based on Figure 3, it is known that the abundance of microplastics from the three size classes observed in the 22.1-24 cm size class had a higher average abundance of microplastics, namely 5.7 particles/individual compared to the 18-20 cm size class and 20.1-22 cm with an abundance of microplastics of 4.7 particles/individual and 4.67 particles/individual. The high and low abundance of microplastics in the digestion of fish species is thought to be related to location characteristics. The marine waters of Dumai City are water areas influenced by anthropogenic activities such as residential areas, fishing activities and the ship and oil industry.

Dumai City is also one area directly bordering the Strait of Malacca, an international shipping route. A study conducted by Guven et al. (2017) showed that habitat had a more significant influence on the likelihood of microplastics being ingested, while the trophic level of each species did not influence the amount of microplastics ingested by fish. Plastic waste density strongly correlates with the number of people in an area. Dumai Port can serve export-import activities for domestic and foreign goods and passengers. The Rupat Strait is the gateway to the East coast of Sumatra Island with the Dumai-Batam and Dumai-Penang Malaysia shipping routes (BPS, 2019).

Several types of microplastic colours can appear due to the influence of the surrounding environmental conditions and climate, seen from the influence of rubbish and waste in the environment that does not only consist of one colour. In this study, the colour data obtained on all care fish samples in all sizes were black and yellow.

The results of the analysis of microplastic abundance based on colour are presented in Figure 4; the most dominant colour found was black, with an average value of 3.6 particles/individual in the 20.1-22 cm size class.

The condition of Dumai City Sea waters, filled with pollutant loads, is thought to cause the most dominant colour in this study to be black. Ariani et al. (2020) stated that the Index Pollution (IP) shows that the quality status of Dumai waters at several study locations is moderately polluted. Factory waste continuously entering Dumai waters can cause pressure on the environment, which can be seen in the high pollution load that occurs, which is in line with its quality status.

The black indicates that microplastics have absorbed many contaminants and other organic particles. According to Hiwari et al. (2019), the black colour means that microplastics absorb many pollutants because microplastics can change colour to black due to their ability to absorb high amounts of contaminants.

3.3. Relationship Between Microplastic Abundance in Caru Fish (M. cordyla) with Different Lengths

The results of the linear regression analysis between the abundance of microplastics with different lengths can be seen in Figure 5, with the determination coefficient value R2 = 0.021 and the correlation coefficient r = 0.144914 with the regression equation Y = 0.198x + 0.836. The regression test results for the length of the caru fish and the abundance of microplastics showed no influence on the number of microplastics. This is possible because the size of the catfish used as the study object is not too different; apart from that, the nomadic life of the catfish means there is a possibility that the catfish-sized ones caught at study stations come from other waters where there is still little presence of microplastics.

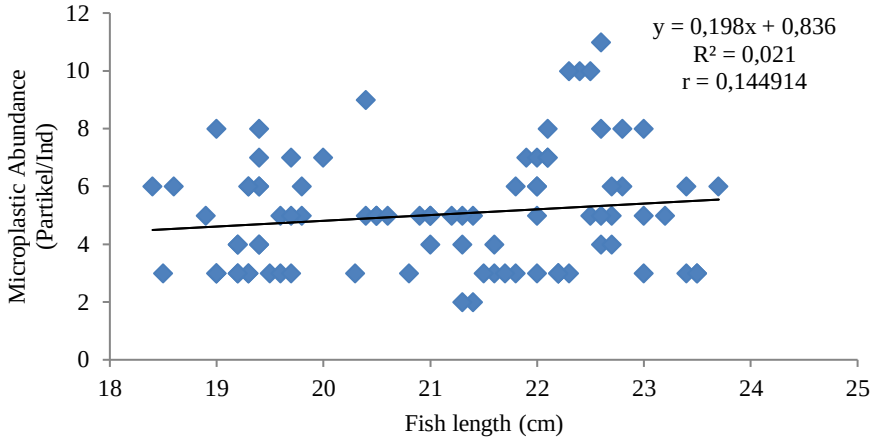

Figure 5. Relationship between microplastic abundance and length of fish *M. cordyla*

The relationship between the number of microplastics in fish and the length of the fish with negative or low results is likely due to being influenced by the fish samples used to have different sizes. Still, these results cannot be further confirmed. However, this result differs from the statement by Barus (2017), where the larger the size of the biota, the higher the age of the biota. Hence, the accumulation time of pollutant materials lasts longer than that of biota with a smaller size.

4. Conclusions

In the digestive tract of carp fish in the sea waters of Dumai City, microplastics have been found; the types of microplastics found consist of three kinds, namely fibre, film, and fragments, with the dominant type found being fibre. The microplastics found were two colours, namely black and yellow, with the dominant colour found being black. Based on the linear regression analysis test, the relationship between the length of the caru fish and the abundance of microplastics has not been influenced by the total length of the caru fish. Then, the two variables, the total length of caru fish and the abundance of microplastics, have a weak relationship.

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