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(Research Article)

Identification and analysis of microplastic abundance in the digestive tract of Baung fish (*Mystus nemurus* Valenciennes, *1840*) in the waters of the Musi River, Palembang City

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Abstract

The Musi River is the longest river in South Sumatra Province and plays a vital role as a major trade route, transportation corridor, and primary water source for local communities. The river is also utilized by various industries, including urea fertilizer manufacturing, rubber processing, and coal-related industries, as well as by densely populated residential areas along its banks, particularly in the city of Palembang. These anthropogenic and industrial activities contribute significantly to the pollution of the Musi River, including contamination by microplastics. This study identified a total of 356 microplastic particles, consisting of 27 fibers, 48 fragments, 251 films, and 30 foams. Film-type microplastics were the most dominant, primarily originating from the fragmentation of secondary plastics such as plastic bags and packaging materials commonly found in household waste. Analysis of Baung fish (*Mystus nemurus*) samples showed that all 30 specimens (100%) contained microplastics. These findings indicate a high level of microplastic contamination in the Musi River and demonstrate its potential adverse effects on aquatic ecosystems and human health.

Keywords: River; Fish; Microplastic; Public

1 Introduction

The Musi River is the longest river in South Sumatra Province. The existence of the Musi River plays a significant role as one of the main trade routes, a means of transportation, and the largest source of water supply for the people of South Sumatra (Trisnaini *et al.*, 2018). In addition, many industrial activities continue to utilize the river water, including the Pusri urea fertilizer industry, rubber processing factories, coal industries, and various other industrial sectors. Dense residential settlements are also located along the riverbanks in Palembang City, where the Musi River flows through highly populated areas. Consequently, human activities in and around the river remain relatively high, contributing to environmental pollution in the river ecosystem.

The high level of human activity in the river area can significantly affect river water quality and may even lead to water pollution. According to Agustiningsih *et al.* (2012), changes in land use, marked by increasing domestic, agricultural, fisheries, and industrial activities, can influence and deteriorate river water quality by contributing large amounts of pollutant inputs into the river system. The abundance of fishery resources and the diversity of fish species in the Musi River make the area an important fishing ground that is frequently visited by local fishermen.

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Plastic waste poses a serious threat to aquatic ecosystems. This issue is not only a concern in Indonesia but has also become a major global environmental problem that requires immediate attention. Eriksen *et al.* (2014) reported that more than 250,000 tons of plastic waste are floating in the oceans worldwide. Furthermore, according to Jambeck *et al.* (2015) in Ayun (2019) in its publication say that Indonesia ranks second among the countries contributing the largest amount of plastic waste in the world.

Plastic is widely used in everyday life because of its diverse functions and relatively low production costs (Geyer *et al.,* 2017). Along with continuous economic development, the use of plastic has increased significantly, leading to serious environmental impacts due to the accumulation of plastic waste. According to Cauwenberghe *et al*. (2013), approximately 10% of total plastic waste is discharged into rivers, where it is eventually transported and accumulated in the oceans. Various types of plastic can float in aquatic environments, allowing them to undergo degradation through exposure to sunlight and other environmental factors, resulting in the formation of microplastics.

The large amount of plastic waste in the Musi River may contribute to high concentrations of microplastics along the river, including in its estuary. Microplastics are plastic particles measuring ≤ 5 mm (Thompson *et al.* 2004). Based on research by Sugandi *et al.* (2021) on the analysis of microplastic abundance in the waters of Payung Island at the Musi River estuary, a microplastic abundance of 1.35 particles/m^3 was recorded. Three types of microplastics were identified, namely fragments, films, and fibers, along with several types of polymer materials. The detected polymers included polystyrene, polyethylene, polypropylene, and polyamide.

Microplastics do not only pollute seawater and rivers, but also contaminate fish species. A study by Aisyah (2019) found microplastics in the digestive tract of Baung fish (*Mystus nemurus*) in the Siak River, Pekanbaru. The microplastics identified consisted of fibers (85.5%) and fragments (14.5%). According to Puspita *et al*. (2022), various types of microplastics—such as fragments, fibers, films, and monofilms—have also been found in the digestive tracts of freshwater fish and shellfish.

The presence of microplastics can negatively impact aquatic biota, particularly fish, and may cause an unpleasant taste and false satiety, which can reduce feeding activity and appetite. In addition, microplastics can interfere with the digestive and metabolic systems of fish (Ryan *et al*., 1988). Furthermore, there is concern that microplastics may act as vectors for the transport of harmful chemical contaminants. These substances can pose risks to humans when consuming aquatic organisms that have been contaminated by various types of microplastics (Yudhantari *et al.,* 2019).

One fish that is commonly consumed by the people of Palembang is Baung fish (*Mystus nemurus*). This fish is an economically important species and is classified as a carnivorous catfish. It inhabits and reproduces in both large and small rivers, from upstream areas up to elevations of approximately 1,200 meters above sea level. Baung fish is a traditional food that is highly favored by the people of Palembang, particularly in local specialty dishes such as brined and stewed of Baung fish. However, due to environmental pollution, microplastics found in fish may pose potential risks to human health, including metabolic disorders, digestive tract disturbances, impaired liver and kidney function, cancer, and reproductive disorders.

2 Materials and Methods

2.1. Time and research location

This research was conducted from December 2024 to February 2025. Fish sampling was carried out in the Musi River area of Palembang City. Sample preparation and analysis were conducted at the Ecology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Sriwijaya University.

2.2. Tools and materials

The equipment used in this study included dissecting instruments, aluminum foil, Petri dishes, cool boxes, Erlenmeyer flasks, freezers, measuring cylinders, cameras, Whatman filter paper, microscopes, ovens, and vacuum pumps. The materials used in this study were 70% alcohol, distilled water, fish samples, and a 10% KOH solution.

2.3. Research method

Catfish sampling was conducted using a purposive random sampling method. Fish were collected from catches obtained by fishermen in the Musi River area, with assistance from local fishermen to ensure that the sampling locations were appropriate. A total of 30 fish samples was considered sufficient to obtain reliable results, as it was deemed representative of the Musi River area in Palembang City. All collected fish samples were placed in a cool box and subsequently transferred to a freezer to preserve sample quality, ensuring that the fish remained in good condition prior to microplastic analysis in the laboratory.

2.4. Procedure

2.4.1. Sampling

Catfish sampling was carried out using a purposive random sampling method, in which fish were collected from catches obtained by fishermen in the Musi River area, with the assistance of local fishermen to ensure appropriate sampling locations. A total of 30 fish samples was considered sufficient to obtain reliable results, as it was deemed representative of the Musi River area in Palembang City. All collected fish samples were placed in a cool box and subsequently transferred to a freezer to maintain sample quality, ensuring that the fish remained in good condition prior to microplastic analysis in the laboratory.

2.4.2. Sample preparation

Frozen fish samples were thawed at room temperature, after which their total lengths were measured. The fish were then dissected to separate the digestive tracts, which were subsequently measured. All equipment used in this study was sterilized with distilled water and 70% alcohol prior to use to prevent contamination.

2.4.3. Sample destruction

Microscopic identification was conducted at the Ecology Laboratory, Department of Biology. Microscopic analysis of the samples was performed using a microscope with a magnification of 4×10. The abundance of microplastics was calculated to determine their presence in each sample (Arisanti *et al.,* 2023). Microplastic abundance was determined based on the number of microplastic particles found per individual fish sample. Microscopic observations were carried out to identify the types of microplastics present in the samples. The results of the microplastic analysis in Baung fish (*Mystus nemurus*) from the Musi River were presented in the form of photographs, while abundance data were displayed using graphs and tables. The data were analyzed using a descriptive comparative method.

2.5. Data analysis

Based on previous studies (Boerger *et al.,* 2010 as cited in Yudhantari *et al.,* 2019), the t-test was used to examine the relationship between fish body length and intestinal length. In addition, the abundance of microplastics in this study was calculated using the following formula:

3 Results and Discussion

Based on fish catches obtained from local fishermen, sampling locations for Baung fish (*Mystus nemurus*) were identified in the Musi River area, particularly around the Kuto Besak Fort and 16 Ilir Market areas. Sampling was conducted using a small boat, and a total of 30 fish were randomly collected. The fish showed variation in body length and intestinal size.

Table 1 Body length and digestive tract of Baung fish (*Mystus nemurus*).

Fish Sample	Average	
	Body Length (cm)	Intestine Length (cm)
1	40	30
2	45	30
3	35	24
4	40	30
5	33	23
6	30	22.5
7	40	30
8	30	20
9	35	24

10	30	19
11	30	21
12	35	24.5
13	40	28
14	30	20
15	40	27
16	40	25
17	45	32
18	30	23
19	30	19
20	40	27
21	30	18
22	35	25
23	30	23
24	30	21
25	30	23
26	30	22
27	40	28
28	35	25
29	30	18
30	30	21
Average	**34.6 cm**	**24.1 cm**

Table 1 shows that fish caught around the Musi River near traditional market of Pasar 16 and Kuto Besak Fort were approximately 30–35 cm in length. Observations were conducted, including dissection and identification of microplastics in the digestive tract of Baung fish (*Mystus nemurus*). The classification of Baung fish can be determined based on stomach morphology and intestinal length. The stomach is elongated and shaped like the letter J, which is a characteristic feature of carnivorous fish (Affandie *et al.,* 2004). Baung is a carnivorous fish whose diet consists of fish, insects, shrimp, annelids, nematodes, detritus, plant remains, and other organic materials.

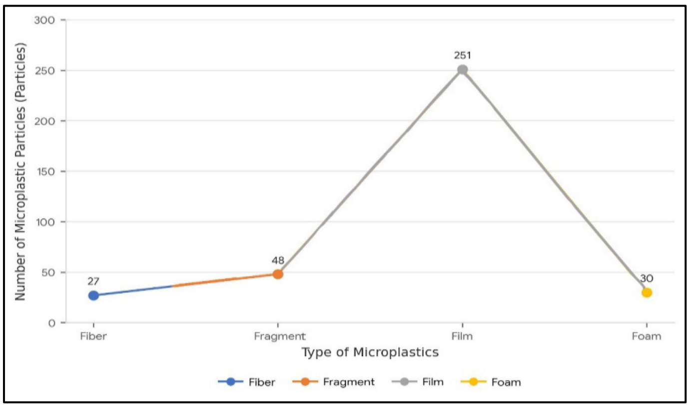

Figure 1 Type and number of microplastics

The microplastic sampling was conducted at one location, and a total of 356 particles were identified, consisting of 27 fiber particles, 48 fragment particles, 251 film particles, and 30 foam particles. The high abundance of film-type microplastics in the samples indicates that this type is the most dominant compared to other microplastic forms. Film microplastics are secondary plastic polymers derived from the fragmentation of plastic bags or packaging materials, which are commonly found in river areas with high levels of domestic waste.

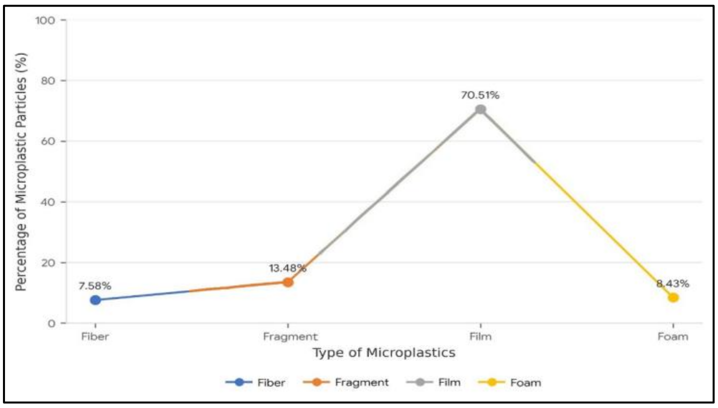

Figure 2 Type and percentage of microplastics

From the figure, it can be observed that the percentage of film-type microplastics is 70.50%, followed by fibers at 7.58%, fragments at 13.48%, and foams at 8.43%. Film-type microplastics show the highest proportion compared to other types. This is because film microplastics are secondary plastic polymers derived from the fragmentation of plastic bags or packaging materials. Film-type microplastics have a lower density than fibers, making them more easily transported in aquatic environments, and their size is generally larger than that of fragments.

The intestine of Baung fish (*Mystus nemurus*) is generally straight from the anterior part and may form a spiral arrangement. It is a tubular structure that is relatively long. In this study, the dissected parts of the fish included the stomach (*ventriculus*) and intestines. The observations showed that Baung fish (*Mystus nemurus*), a member of the Bagridae family, has a well-developed ventriculus as part of its digestive organ. This fish is scaleless, has a short dorsal fin, and possesses barbels. It also has an adipose fin on the back, and the anal fin is relatively large. The ventral surface of the head and abdomen is flat. The pectoral fins are equipped with barbels. The anterior and posterior nostrils are located close together, separated by a short nasal barbel. The body color is brown from the head to the dorsal region and whitish on the sides and ventral parts. The body is elongated, smooth, and scaleless. This species also has three pairs of barbels around the mouth and one additional pair near the respiratory opening. Based on the results of body length measurements, which are greater than intestinal length, Baung fish (*Mystus nemurus*) is classified as a carnivorous species. This classification is also supported by the presence of a relatively large mouth, which is a characteristic feature of predatory fish. Carnivorous fish are species whose primary diet consists of animal organisms. Their food sources include zooplankton, aquatic insects, shrimp, other fish, and various small aquatic animals, all of which form the main components of their diet.

4 Conclusion

The microplastic sampling was conducted at a single location, and a total of 356 particles were identified, consisting of 27 fiber particles, 48 fragment particles, 251 film particles, and 30 foam particles.

Baung fish (*Mystus nemurus*) is classified as a carnivorous species due to its relatively large mouth, which is a characteristic feature of predatory fish. Carnivorous fish are species whose diet mainly consists of animal organisms. Their food sources include zooplankton, shrimp, and aquatic insects.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have participated in the design, execution, and analysis of the research, and that they have approved the final version of the manuscript. Furthermore, the authors declare that there is no conflict of interest related to this research article, and that the material presented is not currently under consideration for publication or published elsewhere.

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