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# MICROPLASTICS ABUNDANCE IN ANCHOVY (STOLEPHORUS INDICUS) AND GULAMO FISH (JOHNIUS BELANGERII) IN THE MUSI RIVER ESTUARY, SOUTH SUMATERA PROVINCE, INDONESIA

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**Abstract**. Microplastic pollution in all parts of the ocean has become a global problem; therefore, we aimed to determine the amount and form of microplastics found in anchovies (*Stolephorus indicus*) and Gulamo (*Johnius belangerii*) in the mouth of the Musi River, South Sumatra, Indonesia. This study consisted of four stations: 12 anchovy and gulamo samples were collected from fishermen catches using fishing nets. To degrade organic matter and enable detection of microplastic particles, both anchovy and gulamo gastrointestinal contents and gills were subjected to hydrogen peroxide digestion, followed by the addition of NaCl to separate the organic matter from microplastics so can be see more clearly. There were 3 types of microplastics were found in anchovies and gulamos: fiber, the most common type (91,54% in anchovies; 97,87% in gulamos), followed by films (5,03% in anchovies; 1,6% in gulamos) and fragments (3,43% in anchovies; 0,53% in gulamos). In anchovies, the greatest abundance of microplastics was observed at station 4 with 141±6.42 particles/individual and 828 particles/g. In Gulamo, a large abundance of microplastics was found at station 4 with 422±6.03 particles/individual and 111 microplastics/g. Descriptive statistical analysis was performed using withe Spearman test and the Kruskal-Wallis test. The Spearmaan test showed no correlation between anchovy and body mass, whereas in gulamo, the correlation to body weight was directly proportional. The Kruskall-Wallis test showed no significant difference in the number of microplastic particles in anchovies, whereas the gulamo had a significant difference.

## 1. Introductions

Sungsang Village is a very dense settlement with a population of 46,575 people, where settlements were built throughout Musi River Estuary [1]. Located in the coastal area of the Musi River estuary, making Sungsang Village known as a capture fisheries area in South Sumatra Province. Anchovy (*Stolephorus*

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*spp.*) and gulamo's (*Johnius belangerii*) are the most caught fishery captures commodities in the waters of the Musi River estuary, Sungsang Village [2]. Fisheries statistics from Department of Marine Affairs and Fisheries of Banyuasin Regency from 2016 – 2020 state that the highest catch of pelagic fish is 43.7 tons/year were anchovies, besides that the dominant fish found in the Musi River Estuary waters are gulamo's [3].

As the population increases, human activities starting from households, industry, and fisheries will also grow and multiply. These activities, especially those along the rivers, will increase pollution in rivers and estuaries, one of which is plastic waste [4]. As much as 10% of plastic waste produced will be disposed through rivers and ends up in the sea [5]. The plastic waste will float in the water column and over time it will undergo degradation, mechanical abrasion, and oxidation to form smaller plastic particles such as microplastics (1 m – 5 mm) [6].

Microplastics as pollutants in the ocean has become problem on a global scale. Along the coast of Sumatera itself, many microplastic pollutants have been found. Several studies have been carried out related to microplastics on the coast of Sumatra. The waters in the Sembilang National Park found microplastics abundance with an average of 151 particles/kg [22], 41 mps particles were found in the waters of southwest Sumatra, 342 – 793.8 particles/l of microplastics were found along the Musi River waters [23].

The small size of microplastics makes microplastics become pollutant in the sea that can be consumed by marine biota. This has been shown in several studies that have been done [7-10]. As in anchovies and gulamo, the content of microplastics in both types of fish has been investigated in various regions in Indonesia. abundance of microplastic was found in anchovy at Talisayan, East Kalimantan as much as 366±3.51 particles/ind of microfiber type and also in East Lombok as much as 13±4.58 particles/ind [10], in gulamo's in the waters of the Musi River Estuary also found an abundance of microplastic as much as 68 micrcoplastic particles [24].

Therefore, this study aims to analyze and identify the type, and abundance of microplastics present in anchovies, gulamo's, where the information obtained can be used to assist in waste management policies and the development of sustainable coastal areas [11].

## 2. Methods

This study uses a quantitative descriptive method to explain the type, abundance and distribution of microplastics in capture fisheries commodities in the Musi River estuary (anchovy and gulamo's) with microplastics in the Musi River estuary. This research was conducted from May – October 2021 which includes the preparation, sampling, analysis in the laboratory and the data that were obtained. The sampling location (Figure 1) is in the Musi River estuary which consists of 4 stations for capturing biota (anchovy and gulamo's) which were determined based on the purposive sampling method. At each station 12 samples of anchovy and gulamo's were taken from the catches of fishermen using fishing nets. Preparation of tools and analysis of microplastics was conducted at the Laboratory of Oceanography and Marine Instrumentation, Department of Marine Science, Sriwijaya University.

The preparatory steps of microplastic samples in biota is based on [12]. To degrade organic matter and enable detection of microplastic particles, both anchovy and gulamo's gastrointestinal contents and gills were digested with hydrogen peroxide, then do the addition of NaCl for the process of separating organic matter with microplastics so can be see more clearly. After that the results of the sample repair were analyzed under a microscope with a magnification of 40 times. And then the abundance was calculated using the formula [13]. The data were then analyzed by descriptive statistics and correlation test using the Spearman correlation coefficient to determine the correlation between the number of microplastic particles in anchovies and gulamo's on body weight. The Kruskal Wallis test was also carried out to determine the distribution of the number of microplastic particles in the anchovy and gulamo's samples, whether they had significant similarities or differences. Data analysis was carried out using Microsoft Excel and SPSS 20 applications.

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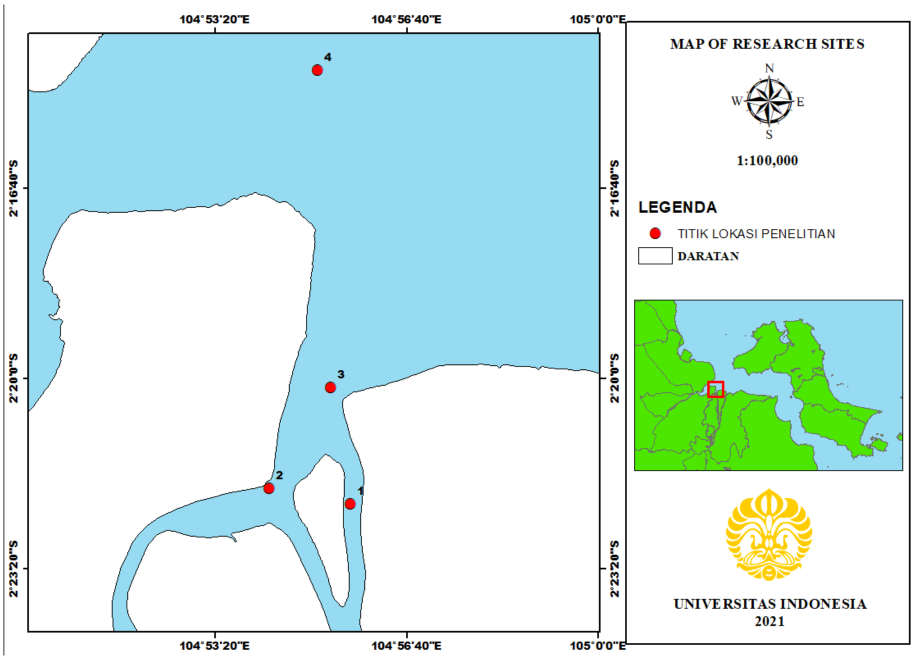


**Figure 1.** Map of research location at Musi Estuary, Sungsang Village, South Sumatera.



## 3. Results and discussion

### *3.1. Microplastics abundance*

A total of 48 samples from Anchovy (Table 1) and Gulamo (Table 2) were analyzed to determine the microplastics contamination. The results of the calculation of the microplastics abundance in anchovy and gulamo's were using units of particle/g and particle/ind. The results indicate the presence of microplastic contamination in the anchovy and gulamo samples. In anchovies, the greatest abundance of microplastics was shown at station 4 as many as 141±6.42 particles/individual and 828 particles/g with total weight are 25.62 g. In Gulamo's, a large abundance of microplastics was also found at station 4 as many as 422±6.03 particles/individual and 111 microplastics/g with total weight of gastointestinal and gills are 167 g. The enormity of the abundance of microplastics at station 4 because the area is a fishing area, so that many fishing activities carried out by fishermen occur.

Total microplastic/individual on this research supassingly high, the total microplastic/individual in anchovies at musi river estuary are 1430±6.12 microplastic/individual and gulamo's are 1500±9.63 microplastic/individual. For comparisson anchovies (*Stolephorus* spp.) from Talisayan ingested up to 366±3.51 [10], from Alor ingested up to 24±6.51 microplastic/individual [25], from East Lompok ingested up to 13±4.58 microplastic/individual [26], and from Balikpapan ingested up to 37±2.89 microplastic/individual [25]. Another fish beside anchovies like *Sardinella lemuru* from Bali Strait ingested up tp 15 microplastic/individual [27]. Tuna fish ingested up to 90 microplastic/individual, milkfish ingested up to 85 microplastic/individual [28].

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**Table 1.** The length, weight and total microplastics found on anchovies collected from Musi River Estuary, Sungsang Village, South Sumatera.

| Fish | n | Station | Length (cm±SD) | Wet Weight (g±SD) | Total MPs/Individual | Total MPs/g |
|---|---|---|---|---|---|---|
| *Stolephorus Indicus* | 12 | 1 | 41.7±0.18 | 0.55±0.05 | 336±3.29 | 610 |
| | | 2 | 41.6±0.33 | 0.55±0.04 | 329±7.16 | 598 |
| | | 3 | 42±0.29 | 0.54±0.05 | 351±5.73 | 650 |
| | | 4 | 36±0.18 | 0.50±0.02 | 414±6.42 | 828 |

**Table 2.** The length, weight and total microplastics found on gulamo's collected from Musi River Estuary, Sungsang Village, South Sumatera.

| Fish | n | Station | Length (cm±SD) | Wet Weight (g±SD) | Total MPs/Individual | Total MPs/g |
|---|---|---|---|---|---|---|
| *Johnius belangerii* | 12 | 1 | 187.4±1.97 | 852.36±6.77 | 434±11.82 | 114 |
| | | 2 | 166.9±0.8 | 780.8±4.24 | 345±8.79 | 109 |
| | | 3 | 164.8±1.66 | 765.63±6.15 | 299±7.04 | 102 |
| | | 4 | 195.7±1.11 | 857.89±4.35 | 422±6.03 | 111 |

*3.2. Microplastics type*

Three types of microplastics found in samples of anchovies and gulamo's, there is film, fiber and fragments. The distribution of microplastics type can be seen below (figure 2 and 3)

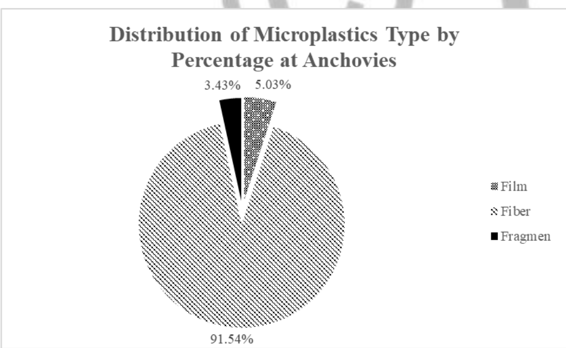


**Figure 2.** Distribution the types of microplastics on anchovies collected from Musi River Estuary, Sungsang Village, South Sumatera.

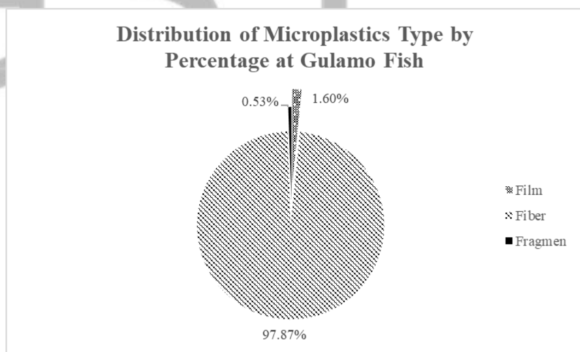


**Figure 3.** Distribution the types of microplastics on gulamo's collected from Musi River Estuary, Sungsang Village, South Sumatera.

The most common types of microplastics were found in both anchovy and gulamo's samples are fiber. Several studies [14-16] found that the abundance of fiber-type microplastics in the studied area reached more than 90%. The composition of microplastic types in anchovies and gulamo's are also similar, where the most dominating type is the type of fiber then followed by film and finally fragments. Many types of fiber microplastics are obtained from the degradation of activities from fishermen such as fishing gear and boat ropes that break down into the waters [17].

Film is the second most common type of microplastic found in anchovy and gulamo's samples. Film type microplastics have a very low density and tend to float. Film-type microplastics originate through degradation from plastic bags [18]. While Fragment are the fewest types of microplastics to be found. The fragments come from the degradation of plastic waste such as broken Parallon pipes, plastic bottles

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and all kinds of household appliances made of plastic. The small number of fragments-type microplastic is due to having a large density so that most of them tend to sink and get deposited in sediments, so it is unlikely, especially to be ingested in anchovies that live in the water column. Fragments also have a rough texture which may be difficult for fish to consume [19].

The percentage of microplastic type found in anchovies are 91.54% microfiber, 5.03% microfilm, and 3.43% fragmen, while in gulamo's are 97.87% microfiber, 1.6% microfilm, 0,53% fragmen. These type of microplastics possibly come from fishing litter and domestic waste [10]. For comparison, anchovies (*Stolephorus* spp.) from talisayan harbour 50% microplastic ingested was microfilm and 29.59% was microfiber [26], another kind of fish like *Sardina pirchadus* and *Engraulis encrasicolus* 83% microplastic ingested was microfiber [29].

*3.3. Spearman correlation*

The relationship or correlation between anchovies and gulamo's with its body mass is shown through the spearman correlation (Table 3 and 4).

**Table 3.** The Correlation between the amount of microplastic particles with body mass on anchovies using *spearman correlation*

**Correlations**

| | | | Body Mass | MPs Amount |
|---|---|---|---|---|
| Spearman's | Body Mass | Correlation Coefficient | 1 | -,343* |
| | | Sig. (2-tailed) | . | ,017 |
| | | N | 48 | 48 |
| | Microplastics Amount | Correlation Coefficient | -,343* | 1 |
| | | Sig. (2-tailed) | ,017 | . |
| | | N | 48 | 48 |

*. Correlation is significant at the 0.05 level (2-tailed).

**Table 4.** The Correlation between the amount of microplastic particles with body mass on gulamo's using *spearman correlation*

**Correlations**

| | | | Body Mass | MPs Amount |
|---|---|---|---|---|
| Spearman's | Body Mass | Correlation Coefficient | 1 | ,392** |
| | | Sig. (2-tailed) | . | ,006 |
| | | N | 48 | 48 |
| | Microplastics Amount | Correlation Coefficient | ,392** | 1 |
| | | Sig. (2-tailed) | ,006 | . |
| | | N | 48 | 48 |

**. Correlation is significant at the 0.01 level (2-tailed).

There was no correlation to be found between anchovy and its body mass, while in gulamo's the correlation to body weight is directly proportional. Negative correlation was found between the abundance of microplastics and fish body mass, which indicates that fish with a smaller body mass will have a greater abundance of microplastics [20]. Aquatic biota is able to digest microplastics either directly (through the water column or benthos) and indirectly through the tropic level. In addition, it is not known the proportion of the amount of microplastic ingested into the fish's body and there are also internal factors from fish digestion that can affect the retention of microplastics contained in it. explaining the abundance of microplastics in the water column cannot be used as the main predictor for the abundance of microplastics in fish bodies. This is because microplastics in the waters are not the main source of microplastics that are leached into the body [21].

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### *3.4. Kruskal Wallis test*

The Kruskal Wallis test was carried out on the number of microplastic particles in samples of anchovy and gulamo's to determine whether there were similarities or differences in the distribution of microplastics in each biota (Table 5 and 6).

**Table 5.** The Kruskal Wallis test at the amount of microplastics particle on anchovies

| Test Statistics[a,b] | |
|---|---|
| | Microplastics |
| Kruskal-Wallis H | 4,619 |
| df | 3 |
| Asymp. Sig. | ,202 |

a. Kruskal Wallis Test
b. Grouping Variable: Station

**Table 6.** The Kruskal Wallis test at the amount of microplastics particle on gulamo's

| Test Statistics[a,b] | |
|---|---|
| | Microplastics |
| Kruskal-Wallis H | 13,022 |
| df | 3 |
| Asymp. Sig. | ,005 |

a. Kruskal Wallis Test
b. Grouping Variable: Station

The results of the Kruskal Wallis test on the number of microplastic particles in the anchovy samples showed that the distribution of the number of microplastic particles in each biota was the same or did not have a significant difference ($H_0$ was accepted). Habitats that contain a lot of microplastic particles will increase the consumption of microplastic particles [22]. An abundance of microplastics was found in the waters of the Musi River Estuary of approximately 700 particles/L [11]. Microplastic particles that are commonly found on the surface and water column make no significant difference when consumed by anchovies.

The content of microplastic particles contained in the gulamo's samples showed a significant difference, this was due to the entry of microplastic particles in the gulamo's not only from the surrounding environmental factors, but also from the amount of prey eaten. The results of the Spearman correlation also state that the heavier the body mass of the gulamo's, the greater the number of microplastic particles contained. The body weight of gulamo's also depends on the amount of prey eaten, so that these things cause significant differences in the number of microplastic particles in each individual gulamo's.

## 4. Conclusion

Microplastic abundance was found in Anchovies and Gulamo's. The most dominant type of microplastic were found are Fiber, then followed by film and fragments. Microplastic Abundance in Anchovies were not have correlation with its body mass and the distribution of the number of microplastic have not significant difference. Microplastic Abundance in Gulamo's were directly proportional with its body mass and have significant difference in number of distributions of microplastic particles.

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