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Study of Microplastic Contamination in the Digestive Organs of Parrotfish (*Scarus rivulatus*) Caught in Ekas Bay

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ABSTRACT

Microplastics have become a major concern in global environmental research due to their significant impact on marine ecosystems. Microplastic pollution has been detected in almost all aquatic environments, including oceans, rivers and lakes. This study aims to evaluate the level of microplastic contamination in the digestive organs of old parrot fish caught in Ekas Bay. Focusing on the digestive organs is important because ingested microplastics can have detrimental effects on fish health, including digestive disorders and bioaccumulation of harmful chemicals. The research method used was descriptive with a sample size of six parrot fish. Based on research conducted on the digestive organs of parrot fish, it was found that the types of microplastics found were in the form of fragments, films, pellets and fibers. The total abundance of microplastics in the intestinal organs ranges from 290 par/gr to 410 par/gr, while in the stomach organs it is 272 par/gr to 310 par/gr. The highest percentage of microplastics in the intestinal organs was pellets at 47% and in the stomach organs it was fragments at 54%.

INTRODUCTION

Microplastics have become a major concern in global environmental research due to their significant impact on marine ecosystems. Microplastics, plastic particles less than 5 mm in size, come from various sources such as consumer products, industrial waste, and the degradation of larger plastics (Yona *et al*., 2020). Microplastic pollution has been detected in almost all aquatic environments, including oceans, rivers and lakes. One area showing significant levels of microplastic pollution is Ekas Bay, an important bay in West Nusa Tenggara, Indonesia, known for its biodiversity and productive fishing activities.

Old parrot fish (*Scarus rivulatus*) is one of the species that is often found in the waters of Ekas Bay. As a fish that has an important ecological role in maintaining the balance of coral reef ecosystems, the health of the parrot fish population is an important indicator of the quality of the marine environment (Shafani *et al*., 2022). This study aims to evaluate the level of microplastic contamination in the digestive organs of old parrot fish caught in Ekas Bay. Focusing on the digestive organs is important because ingested microplastics can have detrimental effects on fish health, including digestive disorders and bioaccumulation of harmful chemicals.

These microplastics will enter directly or indirectly through the food network. Plastic that enters the aquaculture environment will be suspected as fish food, due to its ubiquitous presence and micro form (Kazour *et al*., 2020). Microplastic particles ingested by fish will affect the fish's physiology, especially their digestive system, because according to Margaretha *et al*. (2022), microplastic particles are difficult to decompose in the fish's body. This agrees with research by Purnama *et al*. (2021) which states that if microplastic particles accumulate in large quantities in the intestines, they will have a harmful effect on fish and block the digestive system.

This study is important because it provides insight into the extent to which microplastics have polluted the marine food chain in Ekas Bay and the potential risks posed to marine ecosystems and the health of humans who consume these fish. With increasing attention to plastic pollution and its impact on the environment, it is hoped that the results of this research can become the basis for policy making to reduce plastic pollution in the waters of Ekas Bay and the surrounding area.

This research will involve collecting samples of parrot fish from various locations in Ekas Bay, laboratory analysis to detect and identify microplastics in digestive organs, as well as evaluating the potential impact of microplastics on fish health. With this approach, it is hoped that this study can provide a comprehensive picture of the level and impact of microplastic contamination on parrot fish in Ekas Bay.

METHODS

Time and Place

This research was carried out from May to October 2023. Samples of parrotfish were obtained from the waters of Ekas Bay, East Lombok Regency, West Nusa Tenggara Province. Sample preparation and sample observations were carried out at the Aquaculture Environmental Laboratory, Department of Fisheries and Marine Sciences, Faculty of Agriculture, University of Mataram.

Sample Collection Method

Fish samples were obtained by fishing around floating net cages. All fish samples obtained were then placed in styrofoam containing ice cubes to maintain the quality of the fish before being tested for microplastics in the laboratory. To ensure the identification of the elder parrot fish, apart from being based on information from fishermen, identification was also carried out referring to journal references related to the identification of the elder parrot fish.

Laboratory Analysis

The method for observing fish samples refers to research by Digka *et al.* (2018), Senduk *et al.* (2021) and Yona *et al.* (2020). Before surgery, fish samples were measured for length (cm) and weight (gr). Surgery is performed to remove the digestive tract (stomach and intestines). After carrying out the surgical process, the digestive tract is taken and weighed on a digital scale and recorded as the wet weight. The next stage is that the digestive tract is coated with aluminum foil first, then baked in the oven at 75°C for 24 hours. After the oven process is complete, the digestive tract is weighed again to determine the dry weight and recorded. The dried sample was put into a test tube which had previously been sterilized using distilled water so that the sample was not contaminated with dust, then 30% H_2O_2 solution was added with a ratio of 1:20. This comparison means that 1 gram of dry weight from the digestive tract sample is added to 20 ml of 30% H_2O_2 solution and then incubated for 24 hours. Next, heating and homogenization were carried out using a hot plate at a temperature of 65°C until the solution turned clear. The next stage is filtering the sample solution using a vacuum pump and Whatman filter paper no. 41 with a mesh size of 20 µm. The filter paper containing the sample was re-oven at 65°C for 24 hours to facilitate identification using a binocular microscope.

Data Analysis

The data analysis used in this research is descriptive analysis. This descriptive analysis was carried out by describing the type and abundance of microplastics based on the number of particles at each location in the form of graphs and tables. Microplastic abundance calculations were carried out to determine the presence of microplastics in each sample. Microplastic abundance was calculated based on the number of each microplastic particle found per dry weight of the sample. The calculation of microplastic abundance in this study refers to research by Guntur *et al.* (2021).

$$\text{Microplastic Abundance} = \frac{\text{Number of microplastic particles (particles)}}{\text{Sample dry weight (gr)}}$$

RESULTS

Fish Size Variations

Based on measurements on 6 samples of old parrot fish, the measurement results were obtained, namely fish length (cm), fish weight (gr) and digestive tract dry weight (gr) which were almost the same (Table 1). It can be seen in Table 1 that the minimum value for the length of a fish sample is 15 cm and the maximum is 23 cm. The minimum weight of fish samples is 142 gr and the maximum is 192 gr. The minimum weight of the intestinal digestive organs is 1.58 grams and the maximum is 2.1 grams. The minimum weight of the stomach digestive organ is 0.22 grams and the maximum is 0.39 grams. The average length, weight of the fish, weight of the intestinal organs and weight of the stomach were 17.5 cm, 158.7 gr, 1.9 gr and 0.33 gr.

Table 1. Morphometrics of Parrotfish (*Scarus rivulatus*)

	Minimum	Maximum	Average
Fish Length (cm)	15	23	17.5
Fish Weight (gr)	142	196	158.7
Weight of Digestive Organs (Intestines) (gr)	1.58	2.1	1.9
Weight of Digestive Organs (Stomach) (gr)	0.22	0.39	0.33

Total Abundance of Microplastics in Intestinal Organs

The total abundance of microplastics in fish was calculated from 6 samples of parrot fish (*g*), the digestive organs taken were the intestines and stomach. Based on the research results, the total abundance of parrotfish can be seen in Figure 1 below.

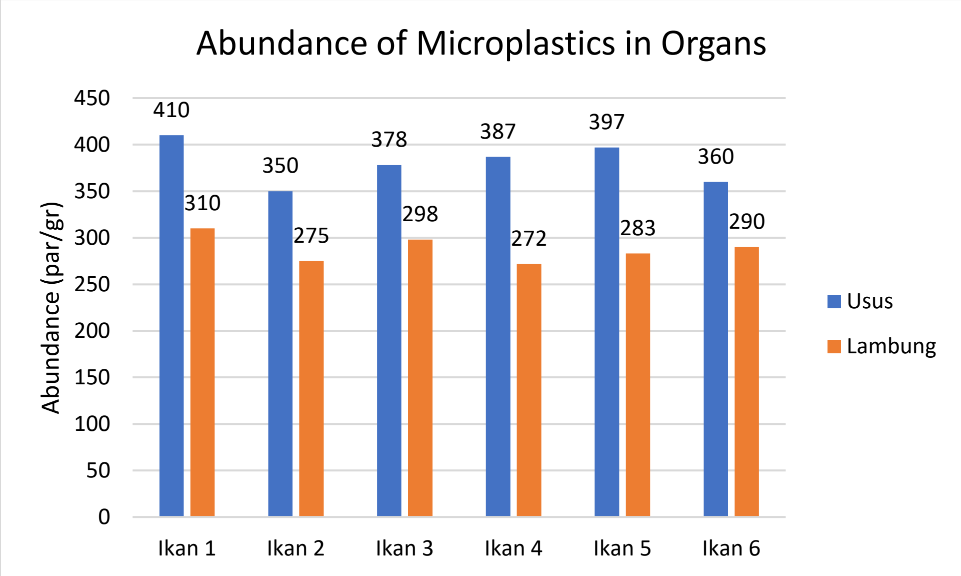
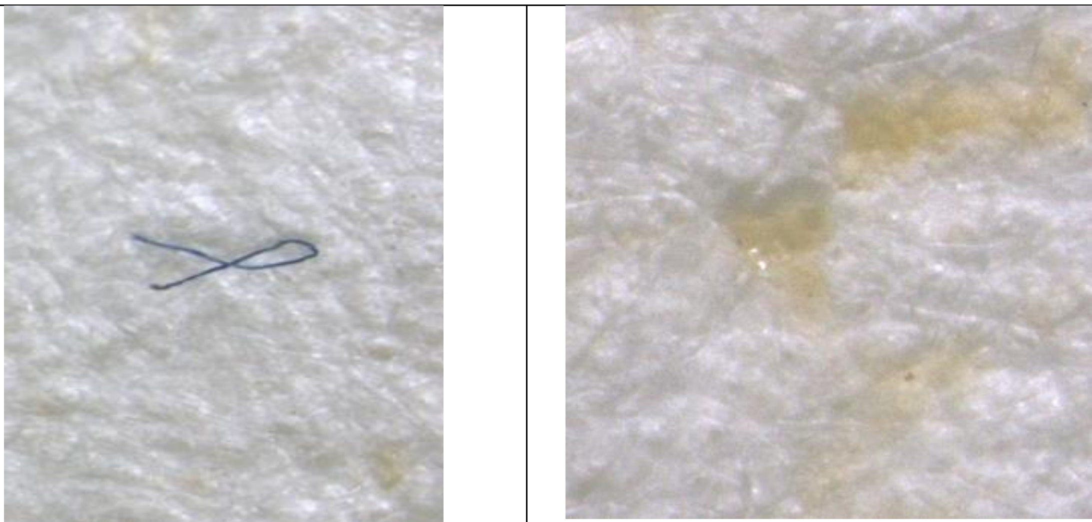


Figure 1. Graph of the Total Abundance of Microplastics in the Intestines and Stomach

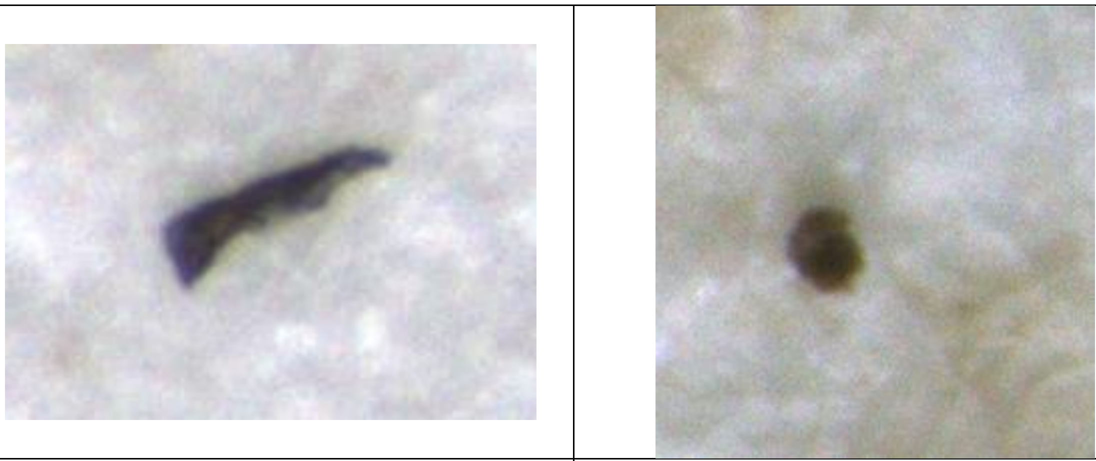
Based on the graph in Figure 1, it shows that the average total abundance in the intestinal organs is higher than that found in the stomach organs. The highest total abundance in the intestinal organs was found in fish sample 1 amounting to 410 par/gr, fish 5 amounting to 397 par/gr, fish 4 amounting to 387 par/gr, fish 3 amounting to 378 par/gr, fish 6 360 par/gr and the lowest was in fish intestine 2 at 350 gr/par.

Types of Microplastics in Organs

Based on the results of research conducted on the organs of parrot fish (*Scarus rivulatus*), several types of microplastics were identified in the form of fibers, films, fragments and pellets. The types of microplastics identified are thought to originate from various anthropogenic activities around the Ekas Bay area, this is because the parrot fish (*Scarus rivulatus*) is a coral fish so its habitat will be greatly affected by community activities in coastal areas. The types of microplastics found in the digestive organs of parrotfish (*Scarus rivulatus*) can be seen in Figure 2 below.



a. fiber	b. film



c. fragment	d. pellets

Figure 2. Types of Microplastics Found in Fish Digestive Organs

Percentage of Abundance of Microplastic Types in Intestinal Organs

In this research, after obtaining the total value of microplastic content in the digestive organs of parrotfish (*Scarus rivulatus*), the percentage of microplastic types obtained was then calculated. This aims to obtain the highest type of microplastic so that we can estimate the origin of the microplastic contamination. The results of the percentage of microplastic types in the intestines of parrotfish (*Scarus rivulatus*) can be seen in Figure 3 below.

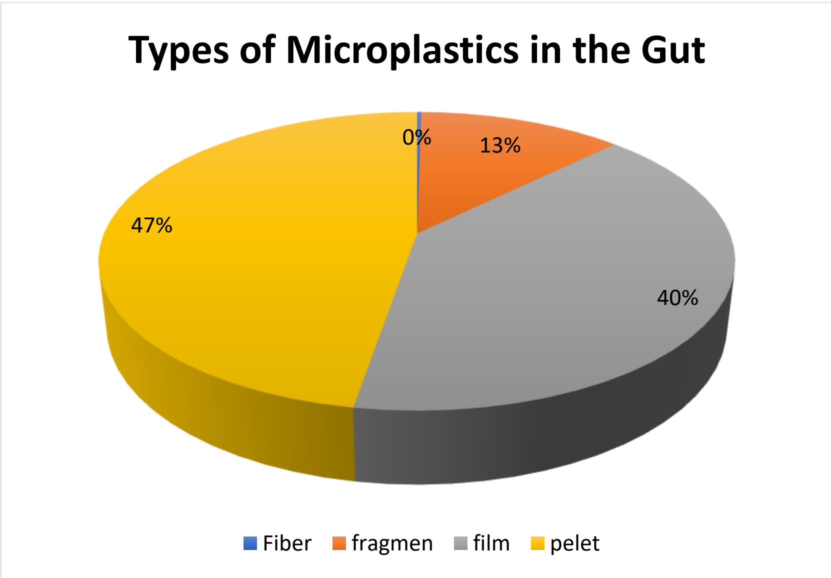


Figure 3. Percentage of Microplastic Types in the Intestine

The most dominant type of microplastic found in the intestines is pellets, which account for 47% of the total microplastics found. Film is the second most common type of microplastic found, with a percentage of 40%. Fragment type microplastics account for 13% of the total microplastics found in the intestine. Fiber was found in very small amounts in this study because based on the percentage above it was only worth 0.03% of the total microplastics found.

Percentage of Abundance of Microplastic Types in Gastric Organs

The percentage value of microplastic types found in the stomach organs of parrot fish (*Scarus rivulatus*) can be seen in Figure 4 below.

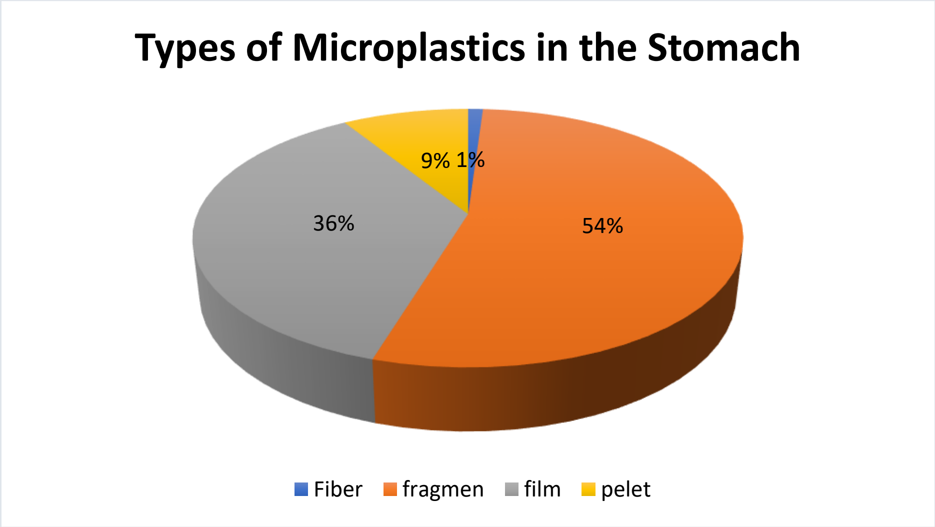


Figure 4. Percentage of Microplastic Types in the Stomach

The most dominant type of microplastic found in the stomach was the fragment type which reached 54% of the total microplastic found. Microplastic film is the second most common type found, with a percentage of 36%. Pellet type microplastics were found in 9% of the total microplastics found in the stomach. According to the diagram above, fiber is only found in 1% of the total microplastics found in the stomach of parrot fish (*Scarus rivulatus*).

DISCUSSION

Based on the results of observations of microplastics in the digestive system, namely the intestines and stomach, it shows that fragment type microplastics are mostly found in the stomach and pellet type in the intestines of parrot fish (*Scarus rivulatus*) sample. This type of microplastic fragment is often found in the digestive system in the stomach, allegedly because many human activities around Ekas Bay still throw rubbish directly into the sea. This is in accordance with research by Al-Fatih (2021), which states that fragment type microplastics are most often found in fish samples because these fragment type microplastics come from rubbish piles located around the sample collection which is dominated by plastic waste packages and inside there are collections of plastic bottles, food wrappers and other product packaging.

Microplastics found in the fish's digestive system can enter via 2 routes, namely directly or indirectly. The direct process is when fish mistakenly assume that microplastics in the water are their food, while the indirect process is through the food chain process, namely when plankton eat microplastics, then the plankton are eaten by fish and the fish are contaminated by microplastics too. This is in line with the statement of Yona *et al*. (2020), which states that microplastics found in the digestive tract of fish can come from water directly in the process of fish getting food or from the food chain.

Microplastics contained in the fish's digestive system can affect the fish's appetite, can cause complications in the fish's reproductive system, decrease the function of the fish's digestive system, and will also affect people who consume fish containing these microplastics. This is in line with the statement by Margaretha & Fauzi (2022), stating that the negative impact can hinder the growth of organisms that indirectly consume microplastic particles, apart from that it can also cause complications in the fish reproductive system. Additives or dangerous compounds from plastic that bind to waste in reservoirs can cause negative biological effects such as decreasing the function of the fish's digestive system. Biota that consume microplastics for a long time can cause death because the microplastic particles cannot be digested. According to Carbery (2018), microplastics also have an impact on humans, if they accumulate in organisms and are then transferred to humans through the food chain, this can cause disease in humans. Health impacts resulting from the bioaccumulation of microplastics in the human body include skin irritation, respiratory problems, digestive problems, reproductive problems and even cancer.

Pellets are small plastic granules used as raw material in plastic production. The high percentage of pellets suggests that plastic industry waste may be a major source of microplastic pollution in this environment. Pellet-type microplastics can be easily ingested by fish due to their small size and uniform shape, which may look like fish eggs or other food pellets. The main sources of microplastic pellets in the aquatic environment include, among others, leaks during production which result in pellets often being spilled and released during the manufacturing and shipping processes. Pellets that are improperly disposed of during the production or transportation process can enter waterways (Labibah & Triajie, 2020; Sarasita *et al*., 2020; Senduk *et al*., 2021; Suprijanto, 2021; Utami *et al*., 2014).

Pellet type microplastics can cause physical disorders in fish intestines. Their small size allows them to enter the digestive tract and cause blockage or irritation. Plastic pellets can absorb toxic chemicals from the surrounding environment, such as pesticides and industrial pollutants. When fish swallow these pellets, these toxic substances can enter the fish's body and cause internal damage or physiological disorders. The buildup of microplastic pellets in fish intestines can reduce the volume available for real food, which can interfere with digestion and nutrient absorption. The presence of microplastics in fish is greatly influenced by the type of microplastics in the water, as well as their eating habits (Senduk *et al*., 2021; Suprijanto *et al*., 2021; Utami *et al*., 2014). This can cause malnutrition and affect overall fish growth and health (Crichell & Hoogenboom, 2018; Tobing *et al*., 2020; Sarasita *et al*., 2020; Senduk *et al*., 2021).

CONCLUSION

Based on research conducted on the digestive organs of parrot fish, it was found that the types of microplastics found were in the form of fragments, films, pellets and fibers. The total abundance of microplastics in the intestinal organs ranges from 290 par/gr to 410 par/gr, while in the stomach organs it is 272 par/gr to 310 par/gr. The highest percentage of microplastics in the intestinal organs was pellets at 47% and in the stomach organs it was fragments at 54%.

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