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Microplastics in the Gastrointestinal Tract of Blue Crab (*Portunus pelagicus*) Caught by Bandaran, Bangkalan Fishermen at Different Sizes

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ABSTRACT

Microplastics are plastic waste that is degraded into small sizes that float in water bodies and can be ingested by aquatic biota. This study aims to determine the shape, color and abundance of microplastics in the digestive tract of blue swimming crab (*Portunus pelagicus*) caught by fishermen in Bandaran Village, Bangkalan at different sizes. Swimming crab sampling was carried out 3 times with different sizes, namely small, medium and large. Identification of microplastics using a solution of H_2SO_4 and H_2O_2 with a concentration of 30% with a ratio of 3:1. Microplastic forms found include fiber, fragments and films. The highest abundance of microplastics was found in large crabs with a value of 3.13 particles/g. The simple regression test results obtained a relatively small R^2 value of 0.0003 meaning that the size of the crab has a very small correlation with the abundance of microplastics in the digestive tract.

Introduction

Plastic waste is a problem of environmental pollution that has occurred to date. The amount of waste produced by the Indonesian population is found to be 15% or 28.4 thousand tonnes per day[1]. Plastic waste is a problem because the degradation process takes a long time. Garbage in the oceans comes from land, rivers or shipments from other areas which will eventually end up in the sea, thus making plastic a type of waste that dominates in waters. Plastic waste can turn into smaller pieces due to exposure to sunlight and air exposure, these plastic pieces are often referred to as microplastics[2]. Microplastics found in aquatic environments can move into the body of biota through the digestive system if microplastics are ingested[3,4]. States that marine mammals, shellfish, fish and crabs can ingest microplastics indirectly[5]. Microplastics with a small size cause microplastics to contaminate biota in the waters. Microplastics that are ingested by biota when filtering water will cause disturbances in reproduction, blockage of the digestive tract and growth of these biota. In physiological processes, other impacts caused by microplastics are inhibiting enzyme production, reducing levels of steroid hormones, and increasing the toxic properties of exposure to plastic additives[4].

Rajungan (*Portunus pelagicus*) is a type of sea crab that is commonly found in Indonesian waters. Blue swimming crab is one of the fisheries resources that has important economic value, this is because blue swimming crab is an export commodity. Indonesian crab export volume in 2018 reached 21577.3037 tonnes with an export value of US$ 370 million[6]. Swimming crabs are also widely used by humans for food and animal protein sources. Bangkalan is one of the areas where the biggest fish catches are crabs[7]. One area that has caught small crabs is in the waters of the western part of Bangkalan, namely the people of Kampung Bandaran, where it is found that many people have a livelihood as special crab fishermen.

The blue swimming crab has a habit of eating its prey whole. Research result showed that the composition of the food groups in the crab stomach consisted of four groups, namely plankton, meat, molluscs and Unidentified Material (MTT)[8]. While research results found an abundance of microplastics of 0.58 part/L in Bancaran waters where these waters are located not far from the fishing location of Bandaran fishermen in catching blue crabs[9]. There are founding about a number of microplastics in crabs caught in Kwanyar waters[7]. Therefore it is important to carry out research related to the identification of microplastics in the digestive tract of blue swimming crab from Bandaran waters of Bangkalan Regency, as a first step to determine the presence of microplastic pollution in blue swimming crabs.

Method

Time and Place

Data collection was carried out in October-November 2022. Sampling was carried out at the crab fishermen's landing sites where the crab samples were obtained from three different fishermen (Figure 1). The fishermen's landing site was in Bandaran Village, Pejagan Village, Bangkalan. Sample preparation and microplastic identification activities were carried out at the Basic Laboratory, Trunojoyo University, Madura. Swimming crab sampling was carried out 3 repetitions with one week interval.

Figure 1. Location of crab sampling

Tools and Materials

The tools used in this study included pipette pumps, volume pipettes, petri dishes, measuring cups, Erlenmeyer, funnels, pastels, mortar, dissecting sets, sample bottles, hot plates, calipers and microscopes. The materials used include 30% H_2SO_4, 30% H_2O_2, distilled water, Whatman filter paper, label paper and aluminum foil. Crab samples taken for each repetition included 5 small sizes, 5 medium sizes and 5 large sizes.

Morphometric Measurement of Blue Crab Samples

The morphometric measurements of the crab included carapace length, carapace width and weight. Carapace length and width were measured using a caliper with an accuracy of 0.01 cm. Weighing crab weight using an analytical balance with an accuracy of 0.1 g. The classification of crab sizes is based on the provisions of the Minister of Maritime Affairs and Fisheries Number 12 of 2020 Article 8 Paragraph 1 which reads "The provisions for catching and/or releasing (*Portunus* spp.) as referred to in paragraph (1) are excluded for the activities of organizing education, research, development, study, and/or application, in the territory of the Republic of Indonesia. Small crabs weighing 0-60 g are categorized as small, crabs weighing 61-120 g are categorized as medium-sized and crabs weighing more than 120 g are categorized as large.

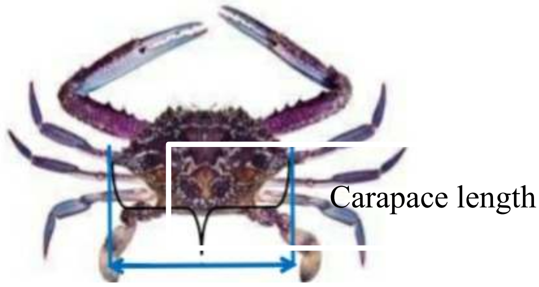

Figure 2. Measuring the length and width of the carapace

Microplastic Identification

Sample preparation begins with cleaning the surgical instruments that will be used first. The swimming crab samples, after measuring their morphometrics and sorting them based on size, were washed first, then performed surgery with a dissecting set. The digestive tract of the crab was taken and placed in an erlenmeyer, then given a solution of H_2SO_4 and H_2O_2 with a concentration level of 30% with a ratio of 3: 1 as much as 30 ml. Next, the samples were incubated for 24 hours at room temperature. Furthermore, the steam bath process is carried out by heating the sample for 2 hours with a hot plate. Samples that have been in the steam bath are cooled and filtered using whattman filter paper. Samples were placed in petri dishes and identified using a stereo microscope and counted using the census method. Microplastics are counted based on shape and color to calculate their abundance.

Data Analysis

The results of the microplastic count found showed the number and type of microplastics presented in a descriptive quantitative manner in the form of tables and graphs which were processed using Microsoft Software (Microsoft Excel). A simple linear regression test was carried out to find out whether there is a relationship between the abundance of microplastics in the digestive tract and differences in the size of the crab weights by looking at the R^2 value according to Table 1.

Table 1. Correlation level classification[10]

Correlation coefficient	Correlation Level
0,00 -0,199	Very low
0,20 – 0,399	Low
0,40 – 0,599	Medium
0,60 – 0,799	High
0,80 – 1,000	Very high

Results and Discussion

Morphometric Measurements

The results of the morphometric measurements of blue swimming crab (*Portunus pelagicus*) from the three fishermen during the study obtained an average value which can be seen in Table 2.

Table 2. Morphometric measurements

Repetition	Size	Weight (g)	Carapace length (cm)	Carapace width (cm)
P1	Small	58,48	4,66	9,87
	Medium	84,18	5,25	10,84
	Large	176,56	6,21	12,74
P2	Small	42,58	3,94	8,70
	Medium	97,6	5,29	11,38
	Large	174,34	6,23	13,32
P3	Small	39,56	3,95	8,37
	Medium	86,58	4,93	10,54
	Large	177,76	6,32	13,04

Based on the morphometric measurements obtained on the weight of the crab in the small category showed the highest average value of carapace length and carapace width in the 1st repetition, namely carapace length of 4.66 cm and carapace width of 9.87 cm. Medium-sized crabs with weights ranging from 60-120 g on the 2nd repetition showed high scores with an average carapace length of 5.29 cm and a carapace width of 11.38 cm. Large crabs weighing more than 120 g in the 2nd repetition also showed large results with a carapace length of 6.23 cm and a carapace width of 13.32 cm. at each sampling at fishermen found different size variations in the composition of the number of crabs caught. Differences in morphometric characters can be due to crab adaptation resulting from changes in habitat and food[11]. While differences in the size of the crabs caught can be influenced by several factors including sex, age, parasites and diseases, water quality, food availability, seasonal differences, loss of limbs, crab preferences for their habitat, and fishing intensity levels[12]. Research result shows the size obtained by blue swimming crab fishermen in Bandaran Village, Bangkalan has an average carapace width ranging from 10.46 cm with a weight of 76.5 g, and the most caught crabs are in the 10.75-11.0 cm size class interval[13]. This size is almost the same as that found in this study.

Microplastic Abundance

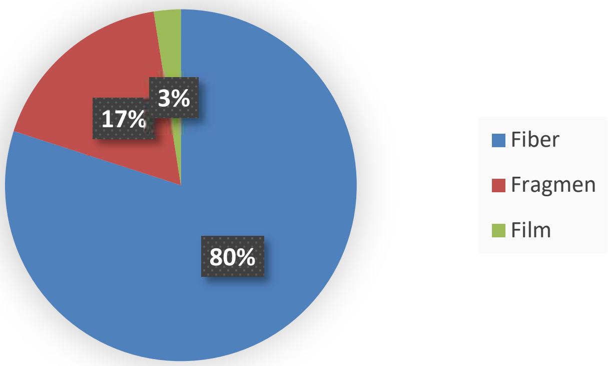

Figure 3. Percentage of microplastic forms

The microplastics found in the crab digestive tract for three repetitions were microplastics in the form of fibers, fragments and films. The percentage of microplastic in fiber form is 80%, fragment form is 17% and film form is 3%. The most commonly found microplastics are microplastics in the form of fibers, which is in accordance with the statement that microplastic in the form of fiber is the most common microplastic found in the digestive tract of marine biota[14]. Fiber is a form of microplastic which is commonly found in the digestive tract of crabs, this is related to the statement that fiber is a form of microplastic that dominates in waters[15]. Fiber is a form of microplastic that comes from fishing nets, synthetic fibers, and rope[16]. stated that fishing activities by fishermen affected the distribution of fiber-shaped microplastics due to degraded fishing nets and lines[17]. The presence of microplastics in the crab digestive tract is thought to be due to the crab's habitat in waters where there are many fishermen's activities using nets as fishing gear. Microplastics in the form of fragments are rigid plastic pieces with irregular shapes[18],while the shape of the film is characterized by being in the form of plastic shards or sheets[19]. Microplastic film form comes from degraded single-use plastic[20].

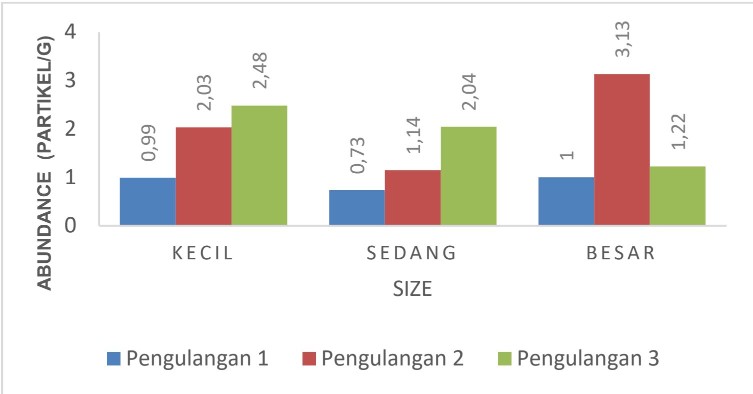

Figure 4. Microplastic abundance in the crab digestive tract

The highest abundance of microplastics in the digestive tract of small crabs was found in the second large crab with 3.13 particles/g repetition, while in the 1st repetition the small crab with 0.99 particles/g showed the lowest abundance. The existence of microplastics in the digestive tract of crabs is due to the eating habits of crabs that live actively in the waters and will prey on whole food, this makes small microplastics easier for the crab to swallow. The digestive tract is a part of the organ where microplastics are commonly found because this organ is related to the eating process, that the entry of microplastics occurs due to the small size of plastic that can be ingested when looking for food [21]. As well as research results which shows the percentage value of MTT (Undetectable Material) in crabs of 17.32% in Purirano waters whose value is higher than MTT found in Lakara waters[22], Southeast Sulawesi[23]. This MTT can be a collection of debris material that is in a body of water which is also ingested and one of its components is microplastic.

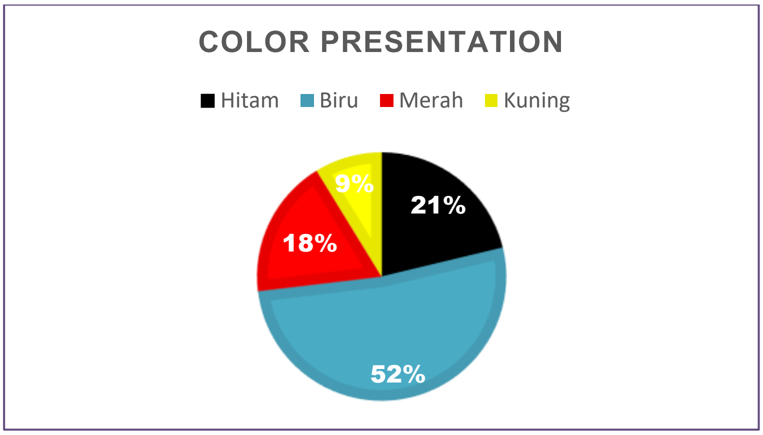

Figure 5. Percentage of microplastic color in the digestive tract

The percentage of microplastic colors found in the digestive tract of the blue swimming crab obtained from fishermen from Bandaran Village in the western waters of Bangkalan with a total percentage of microplastics with a blue color of 52%, black of 21%, red of 18%, and yellow of 9% as presented in Figure 5. The color of microplastics can provide information about the source of existing waste or the condition of microplastics. The blue color is found in many microplastics found in crab samples. The black color on microplastics can indicate that these microplastics absorb a lot of contamination and come from other organic particles, this is because the black color can absorb pollutants[23]. The form of microplastic found in the crab samples can be seen in Figure 6.

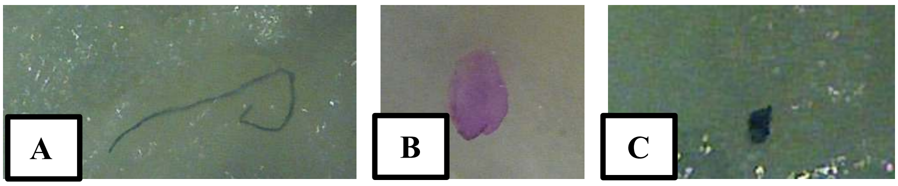

Figure 6. Microplastic form (A) Fiber, (B) Fragment and (C) Film (Primary documentation, 2022)

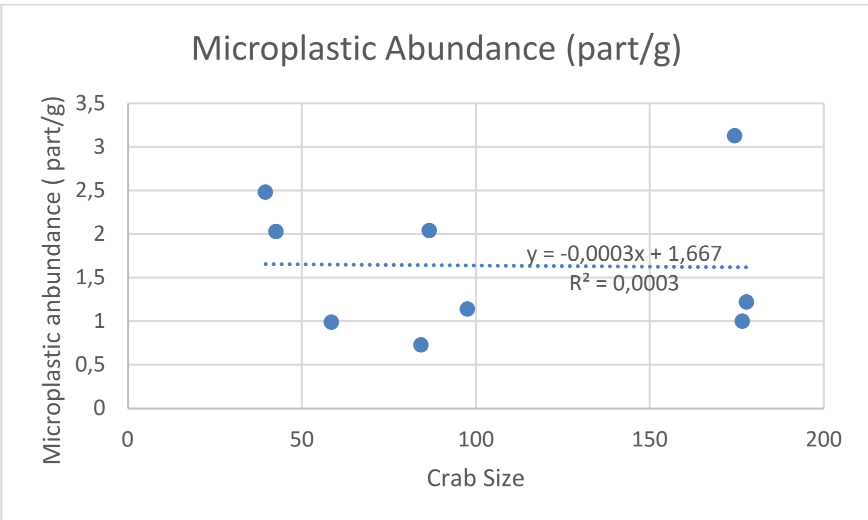

Figure 7. Graph of the relationship between microplastic abundance and crab size

Simple linear regression analysis was used to find the relationship between the abundance of microplastics in the digestive tract and the size of the crabs. Based on the results obtained, it shows the R Square value from simple linear regression of 0.0003 where the size of the crab affects the abundance of microplastics by 0.03%. The correlation coefficient of 0.00-0.199 is included in the very low level of correlation[10]. This shows that the body size of the crab does not affect the abundance of microplastics in the digestive tract of the crab caught in the coastal area of Kampung Bandaran, Bangkalan Regency.

Conclusion

Based on the research that has been done, it can be concluded that the microplastics found are in 3 forms, namely fiber, fragments and films. The highest abundance of microplastics in the digestive tract was found in large crabs on the 2nd repetition of 3.13 particles/g. The level of correlation of crab size is very low in influencing the abundance of existing microplastics.

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