Microplastic in the Karapyak Beach Area, Indonesia

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ABSTRACT

Microplastics are defined as plastic particles 1 m to <5mm in diameter that is widely distributed on beaches and oceans. Microplastics are composed of synthetic polymers. Synthetic polymers are widely used in various needs, especially in food and beverage packaging. The aim of the study was to determine the amount and type in Karapyak Beach and microplastic in the Holothuria digestion track. The research method used is a survey in the field and observations in the laboratory. The samples used are sediment, seawater, and Holothuria. The results showed that the number of microplastics in Karapyak Beach was 4 – 68 particles/m^2. Microplastics are divided into 4 types, namely films, fibers, fragments, and pellets. The total microplastic in the digestive tract of sea cucumbers is between 3.28 – 3.47 particles/gram and microplastics in waters between 4.03 – 7.13 particles/liter.

Keyword: *Microplastic, Karapyak, Sediment, Water, Holothuria, Types, Density*

1. INTRODUCTION

Microplastics are defined as plastic particles 1 m to <5 mm in diameter that is commonly found on beaches and oceans [1]–[4]. Microplastics are grouped into two based on the source origin, namely primary and secondary microplastics [5], [6]. Microplastics are grouped into seven based on shape, namely pellets, fragments, foam, fiber, flakes, films, and sponges [7]. Microplastics are composed of synthetic polymer chains so it grouped 5 types of microplastic polymers commonly encountered such as polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), polyurethane (PUR) and polystyrene (PS). Frias et al.'s research. (2010) found that generally synthetic microplastic polymers are polyethylene (PE) and polypropylene (PP).

High concentrations of microplastics in water can cause a decrease in environmental quality and impact marine biota [3]. Marine biotas such as albatrosses, fulmar birds, shearwater birds, and petrels are contaminated with microplastics in their digestion due to eating microplastics [8]. Other study on invertebrates in aquariums with microplastics measuring <2 mm, and the results showed the presence of microplastics in marine worms, shellfish, and amphipods. This shows the potential for marine biota to eat microplastics [9].

The Karapyak beach for tourist spot with quite a lot of visitors every day, causes this beach to have the potential to contribute to waste or garbage from human activities to the coastal and marine environment, which can have an impact on the waters and the biota that live in them. One of the wastes that are feared to pollute the environment is plastic waste, because of the nature of plastic waste that is difficult or cannot be decomposed by microorganisms (non-biodegradable). Plastic waste is a contributor to 60-80% of the total marine debris. Plastic waste that is often found in tourist areas, both on the beach and at sea, is food and beverage packaging made of plastic material. This waste comes from tourists and the bad habits of people who throw plastic waste into rivers.

One of the marine biota found on beaches is a sea cucumber. Sea cucumber is a member of the echinoderm group that has important economic value. Sea cucumbers during their life are on the bottom of the water or in sediments.

Based on their eating habits, sea cucumbers include deposit feeders and suspension feeders. Sand grains also dominate in the digestive organs of the genus Holothuria which has a percentage of 22% [10]. The main food of sea cucumbers from the Holothuride genus is plankton from the diatom group, one of which is Bacillariophyceae.

So the observation of the presence of microplastics on the beaches of Karapyak and Holothuria, because they have the potential to be contaminated with microplastics. Monitoring the quality of coastal conditions needs to be carried out as a pollution control material so that negative impacts that may arise on the preservation of the marine environment can be anticipated as early as possible.

2. METHOD

The research was conducted at Karapyak Beach with 2 stations. Stations that are visited by many tourists and stations that have no tourists. Sampling was carried out with 3 coastal zones, it can be seen clearly in Figure 1.

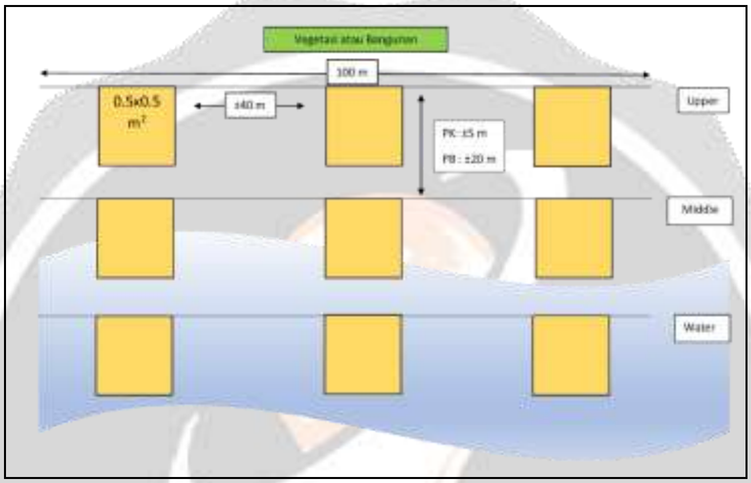

Fig -1: Sampling illustration

Sampling was carried out using a combination of the methods of Frias et al. (2010) and Eo et al. (2018) with some modifications[5], [11]. Three lines 100 m long run parallel to the shoreline. Each beach is divided into three zones, namely high tide line, intertidal, and water. Each zone has three replications so that on each beach there are nine samples. The purpose of selecting the three layers is to see the differences in the accumulation of microplastics in sediments between coastal zones and to minimize sampling bias, so that sampling is not limited to locations where there are a lot of microplastics. The distance between the high tide line, intertidal and water zones is adjusted to the condition of the width of the beach. The difference in beach width is not biased towards differences in the abundance of microplastics between stations, this is because the sampling distance between zones is based on the location of the intertidal zone of each station. Sediment is taken in the quadrant area on the surface area. Samples were taken from a 0.5x0.5 m quadrant transect, so the area was 0.25 m2. Sediment was taken in a quadrant area, then sieved sequentially using 5 mm and 2 mm metal sieves. Then the microplastic retained in the 2 mm sieve was collected and put into a glass jar, then all samples were brought to the laboratory using a cool box. Identification of the amount, shape and type of microplastic polymer was carried out at the Biogeochemical Laboratory of FPIK Universitas Padjadjaran.

2.1 Sea Cucumber Sampling

Observations of sea cucumbers at each station were carried out directly using the line transect method with size (10 m x 100 m). To collect data on the abundance of sea cucumbers and find out the types of sea cucumbers found, it is by exploring the area along the coast that is dominant with its sea cucumber biota. Time Sampling of sea cucumbers was carried out in the afternoon and evening when the water was receding. Each observation is assigned 5 points, each point is assigned a size of 100 m/observation points using the observation method. Each observation point that is seen is then counted and recorded, the abundance of sea cucumbers and their types. The sample of sea cucumbers that will be analyzed for microplastics in their digestive tract is the dominant type of sea cucumber. Samples were taken from each station, each as many as 3 (three) individual samples of sea cucumbers from the dominant species.

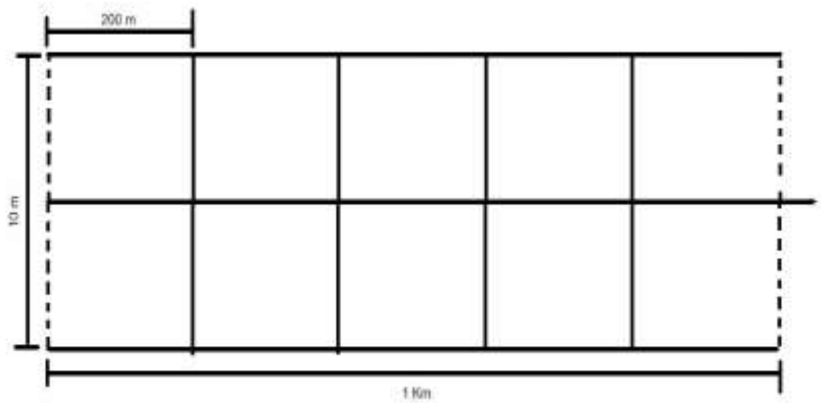

Fig -2: Illustration of Sea Cucumber Sampling

The microplastic method in Holothuria has several stages, including: (1) Sea cucumber samples that have been taken from the research location are identified morphologically using an identification book guide; (2) the surgical stage, the part taken is the digestive tract from the base of the esophagus to the anus; (3) The digestive tract that has been taken is then immersed in 20% alcohol; (4) The digestive tract is removed from the alcohol bath and 70 ml of Hydrogen peroxide is mixed. The mixture is then left for 24 hours in the incubator; (5) The suspension is diluted with 250 ml of NaCl, then allowed to stand for 10-15 minutes; (6) filtered through a 0.5 mm sieve; (7) The filtered microplastic was then transferred to a petri dish and identified using a monocular microscope [12].

3. RESULT AND DISCUSSION

3.1 Total Microplastic

The microplastics found on Karapyak Beach were only found in the high tide line zone. Based on sampling in 3 quadrants of the high tide line zone, the number of microplastics sequentially at the Karapyak Beach station was 4 - 68 particles/m^2 (average 28.00 ± 34.87 particles/m^2). The weight of microplastics at Karapyak Beach is between 0.23 – 2.14 grams/m^2. The total microplastic in the digestive tract of sea cucumbers is between 3.28 – 3.47 particles/gram and microplastics in waters between 4.03 – 7.13 particles/liter (Table – 1).

Table-1 : Average of Total Microplastic in Karapyak Beach

Station	Average of Total Microplastic		
	Water (partikel/L)	**Sediment (partikel/gram)**	**Holothuria (partikel/gram)**
Station I	7.13	28	3.28
Station II	4.03	34.84	3.47

The results showed that the different sampling zones resulted in the presence of significant microplastics. Microplastics measuring 2 mm to < 5 mm were only found in the high tide line zone. The high tide line zone is the highest tidal zone, closest to coastal vegetation and buildings. The highest abundance of microplastics was in the high tide line zone compared to the intertidal zone and land zone. The absence of microplastics in the intertidal and water zones could be due to the fact that these two zones are partly influenced by waves and oscillations (tidal) so that microplastics have not been deposited in sediments or carried back to the ocean[5], [7], [13][14], [15].

The factors for the deposition of microplastics in sediments is influenced by the grain size of the sediment. The high abundance of microplastics on the West Coast is due to the characteristics of the beach having fine silt sand sediments. Silt sand is the topmost layer, very fine, brownish-gray-black in color, fine-coarse in size, circular in shape – half-angled, loose, containing volcanic material and mollusk shell fragments, evenly distributed with a thickness of approximately 1-15 m. The East Frisian Island Coast confirmed that fine sediments generally contain a high abundance of microplastics [16].

3.1 Type of Microplastic

The composition of the microplastic form of Karapyak Beach did not vary. This can be attributed to sources of microplastic originating from human activities on the coast, such as tourism, marine aquaculture, construction of embankments and river ports, fishing ports, and beaches that have not been managed properly [17]. In addition, during the field sampling process, macroplastics >5 mm in size were found, such as straws, food wrappers, bottle caps, fishing nets, rubber and cigarette filters, indicating the potential for microplastic particle intake from the macroplastic fragmentation process into microplastics. This is reinforced by several studies that the process of macroplastic fragmentation is higher on the coast than in the ocean as ultraviolet radiation increases, the presence of mechanical forces such as wave energy, abrasion with sand, and contact with animals [3], [18].

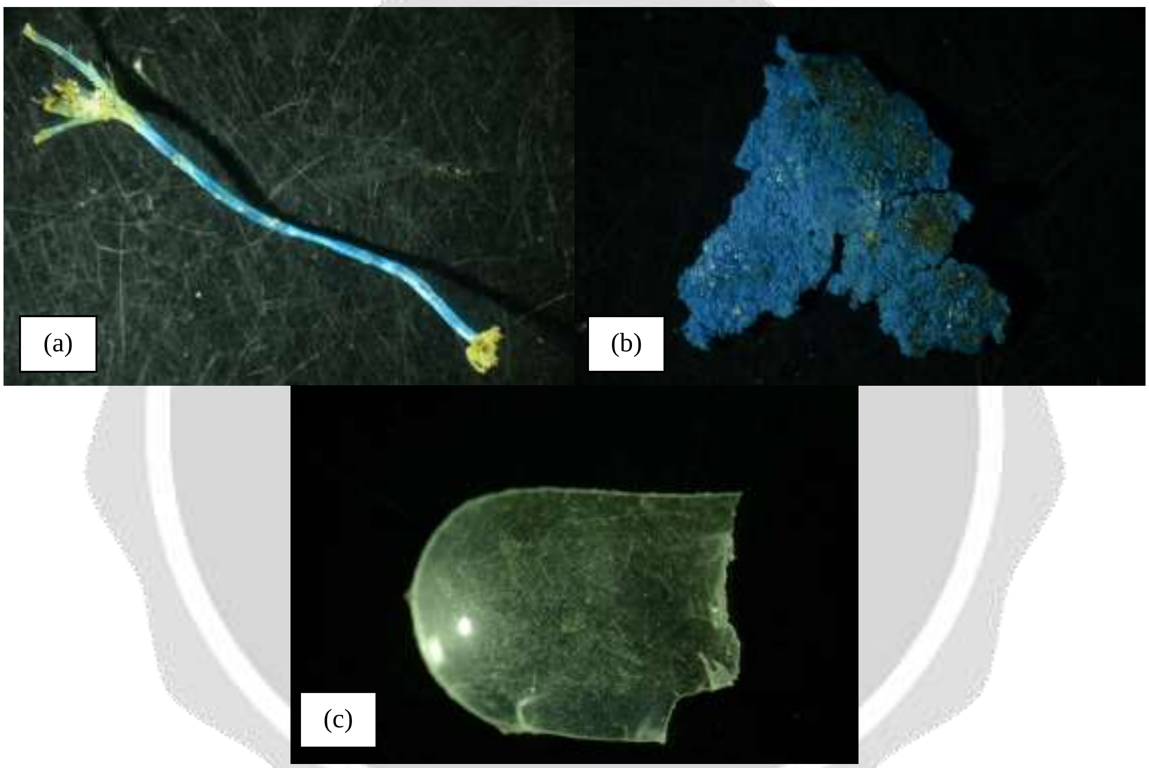

Fig-3 : Types of Microplastic; (a) Fibre; (b) Fragment; and (c) Film

The type of microplastic in the waters, the type of fragment is more dominant than the type of fiber and film. Many types of microplastic fragments were found at station 1, there were many pieces of plastic objects such as drink bottles, plastic waste from the surrounding stalls that came from human activities on Karapyak Beach.

In the Tripang Digestive Tract, many types of microplastic fragments were found at station 1 and a few were found at station 2. This proves that the type of microplastic fragments in the Tripang digestive tract is the most dominant, explaining that the type of microplastic fragment is the result of pieces of plastic products with very strong synthetic polymers [19]. Many types of microplastic fiber were found at station 2 and a few at station 1. While the type of microplastic film was found at station 2. That microplastic film types have a lower density so they are easy to transport compared to microplastic types other [3].

4. CONCLUSIONS

The conclusion that can be drawn from this research is that the beach of karapyak has been contaminated with microplastics, besides that sea cucumbers that live on the beach of karapyak have also been exposed to microplastics. The microplastics in Karapyak Beach were 4 – 68 particles/m2. Microplastics are divided into 3 types, namely films, fibers, and fragments. The total microplastic in the digestive tract of sea cucumbers is between 3.28 – 3.47 particles/gram and microplastics in waters between 4.03 – 7.13 particles/liter

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