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ANALYSIS OF THE ABUNDANCE, SHAPE, AND COLOR OF SEDIMENT MICROPLASTICS IN THE PANGKAJENE RIVER PANGKEP AND ISLANDS DISTRICT

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Abstract

Plastics that are samller than 5 mm are called nicroplastics. This research was conducted on the Pangkajene River, Pangkep and Islands Regencies in November 2022. This study aimed to analyze the abundance, shape and color of microplastics in the Pangkajene River. The samples taken were river sediment samples which were divided into 8 sample points. The sediment sampling method is based on the National Oceanic and Atmospheric Administration (NOAA) and Microplastic in Water. The sample is the result of a combination of places (integrated samples). Each sample was dried, weighing dry weight, density separation and sorting visually using a microscope. The results showed that the abundance value of microplastics at this location was in the range of 2.59 – 5.37 particles/100 g dry weight of sediment. The highest abundance value at this location is at sample point 5, this location is close to markets, people's homes, and tourist attractions. The lowest abundance value is at sample point 8 which is adjacent to the location of plantations and agriculture. The type of microplastic based on the shape found is in the form of fibers, fragments and films that have several colors such as red, yellow, blue.

Keywords: Microplastics, Abundance, Sediments, Forms of microplastics, Rivers

INTRODUCTION

One of the most abundant types of waste found on land is plastic waste. About 80% of plastic waste comes from the mainland, some of which comes from residential areas, public places, trade, industry, or agriculture [1]. Plastic waste is a material that is difficult to decompose in nature and takes tens to hundreds of years to decompose [2]. The process of decomposing plastic waste can become a problem when the plastic turns into microscopic particles called microplastics [3]. The process of decomposing plastic waste into microplastics enters the water through chemical, physical, and biological processes [4]. In general, microplastics have sizes ranging from <5 mm [5]. Microplastics, based on their formation process, can be divided into two types, namely primary and secondary. Primary microplastics are plastics that have been microsized earlier and are usually found in cleansers and cosmetic products. Secondary microplastics are formed from plastic in the environment and then fragmented into micro-sized particles [6]. Several types of microplastics can be categorized based on their shape, including fragments, filaments, films, foams, and pellets [7]. The existence of microplastics in the waters is influenced by the waste produced by the community. Microplastics can come from community activities around rivers and in coastal areas [8]. Microplastics are not only found in water but also in sediments on the riverbed [9]. Microplastics that enter water bodies will precipitate in aquatic sediments [10] because microplastic transport tends to be slower in sediments than in the water column [11]. If deposition occurs continuously, the microplastic

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will accumulate in the deepest layers of sediment [1]. Factors that cause microplastics to collect in sediments are hydro-oceanographic factors, fishing activities carried out by fishermen, and gravity [12]. The Pangkajene River is a river that is located in the middle of Pangkep Regency and divides Pangkep Regency into two parts. Along with the high activity of the community, the Pangkajene River has been polluted. Sources of pollution in the Pangkajene River include domestic, agricultural, and market waste [13]. The existence of anthropogenic factors, which include population density and population activities, can affect the abundance of microplastics in water [14]. Based on the description above, this study aims to analyze the abundance and types of microplastic sediments based on predetermined sample points in the Pangkajene River, Pangkep, and Islands Districts. This research is expected to provide information related to the presence of microplastics at the research location and can be used as material for further research development.

2. METHODOLOGY

A. Research sites

The sampling locations in this study were the Pangkajene River, Pangkajene District, Pangkep, and Islands District. The process of determining sample points at this location is based on the purposeful Sampling method, where the determination is based on locations or areas suspected of having activities that have the potential to contribute to microplastic waste along the Pangkajene River. The number of sample points used is eight. Sample point 1 is at the head waters of the Pangkajene River; sample point 2 is around mangrove forests and plantations; and sample point 3 is around sparsely populated residential areas, plantations, and rice fields. Sample point 4 is around densely populated residential areas; sample point 5 is around densely populated residential areas, markets, tourist attractions, and public facilities; sample point 6 is around densely populated residential areas and plantations; and sample points 7 and 8 are close to agricultural areas and plantations as in Figure 1.

Figure 1: Sampling Locations

Source: Google Earth 2022

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B. Materials and Methods of Sampling

Sampling was carried out on November 7, 2022, in clear weather conditions. Abundance analysis and sediment microplastic sampling methods were carried out according to the National Oceanic and Atmospheric Administration (NOAA) Guidelines for the Monitoring and Assessment of Plastic Litter in the Ocean [15], Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods [16], Microplastic in Water [17], and Guidelines for Sampling Methods, Analysis, and Identification of Microplastics in Coastal and Marine Ecosystems [18]. The sediment microplastic sampling method uses a random method [17]. The tool commonly used to take sediment samples at the bottom of the river is the Ekman Grab [19]. Samples were taken at a depth of 0–10 cm because at this depth many microplastics were found [20].

Laboratory analysis methods for sediment samples are of the same order as analytical methods for water samples. The difference lies in the process of separating the density of the sediment twice and filtering the sample three times [14].

Sample preparation includes the initial weighing of sediment samples, drying of sediments, pre-screening of sediments, and weighing of sediments. Sediment used in the analysis stage generally does not have a standard amount or weight; however, the weight of each sediment sample must be known. Equalizing the weight of sediment samples used for analysis is useful for determining microplastic abundance units in sediments [17]. Drying of sediment samples using an oven at 900 °C for 24 hours [14]. Screening of the initial sediment samples was carried out using a mesh filter size of 5mm. Separation of the density of sediment samples was done using a saturated salt solution of 300 ml for 24 hours [16]. The second screening of the solution that has been carried out by density separation uses a mesh size of 5 mm and a mesh size of 0.3 mm, which are arranged in stages [17]. Particles retained on a mesh size of 0.3 mm were used as samples, which were dried again in the oven and degraded by organic matter.

Fenton solution consisting of 20 Ml of 30% H_2O_2 and 20 mL of Fe(II) into a glass beaker then stirred using a 750^0C hotplate stirrer [14]. The second density separation uses the same salt solution after the degradation of organic matter is complete and the sample has shown sediment of organic matter at the bottom of the sample container [17]. Sample selection was carried out after precipitate and supernatant were formed using a mesh size of 0.3 mm and then using a vacuum pump that had been placed on glass filter paper. so that the drying process occurs quickly in sedimentary microplastic samples that are dried using an oven for 24 hours [14]. The samples were observed using an XSZ 107 BN binocular microscope.

C. Data analysis

Data analysis in this study used descriptive quantitative data analysis based on processed data (values) in the form of tables and graphs using Microsoft Excel software. Furthermore, the values obtained based on the results of the analysis will be described in the form of paragraphs.

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3. RESULTS AND DISCUSSION

A. Microplastic Abundance

Based onTable 1 and Figure 2, the highest average value of sedimentary microplastic abundance was successively at sample point 5 (5.23 particles/100 g), sample point 3 (4.83 particles/100 g), sample point 6 (4.62 particles/100 g), sample point 4 (4.57 particles/100 g), sample point 2 (3.41 particles/100 g), sample point 1 (3.07 particles/100 g), sample point 7 (2.8 particles/100 g), and finally at point 8 (2.46 particles/100 g). Based on the results of direct observations at the locations around the research location, at locations around sample point 5, there are markets, public roads, densely populated housing, and wharves on the banks of the Pangkajene river. The condition around sample point 5, which has higher activity than other sample points, is a factor in the high abundance value. Sample point 8, which is the lowest abundance value sample point compared to other sample points, is located around agricultural and plantation areas. At this sample point, the lack of activity towards the use of plastic by residents around agricultural and plantation areas can be a factor in the low value of sediment microplastic abundance at sample point 8. High population activity and population density in an area affect the abundance value of microplastics found [21].

Table 1: Abundance value of each sample point.

Sample Point	Number of Mps	Abundance (Particles/100 Gr)
TS.1	307	3.07
TS.2	341	3.41
TS.3	483	4.83
TS.4	457	4.57
TS.5	523	5.23
TS.6	462	4.62
TS.7	280	2.8
TS.8	246	2.46

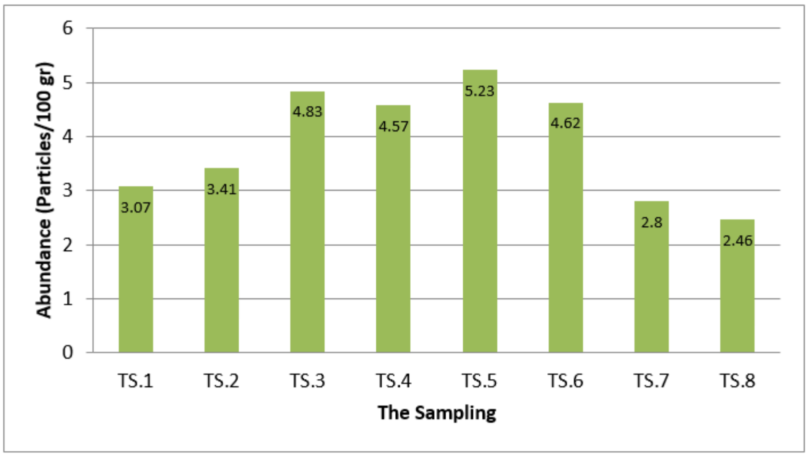

Figure 2: The abundance value of each sample point

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B. Microplastic form

Table 2 and Figure 3 show the abundance value of sedimentary microplastics based on the shape of the microplastics. Line or fiber-type microplastics were found at all sample points at this location. Sample point 5 had the highest value found for line or fiber-type microplastics, namely 2.34 particles per 100 g, or 20.29%. Then the lowest value is at point 8, which is 0.7 particles per 100 gr, or 6.07%. Fragment-type microplastics were found at all sample points. The highest value for microplastic fragments was found at sample point 3 (2.10 particles/100 gr, or 19.09%), while the lowest value was at sample point 7, namely 0.82 particles/100 gr, or 7.45%. The type of film at this location was sample point 8 (0.8 particles/100 gr, or 9.46%). Microplastic types of foam and pellets were not found at this research location. Based on all sample points at this location, microplastic types dominated successively, namely line/fiber by 37.20%, fragment by 35.49%, and film by 27.30%. The presence of microplastics in sediment samples of line/fiber, fragment, and film types at this location was caused by unloading activities. loading boats around the river, lowering the ship's anchor ropes, direct household waste disposal to the river, the Pangkajene market garbage collection site near the Pangkajene river, community activities disposing of garbage around the banks of the Pangkajene river, and the existence of tourist attractions around the Pangkajene river.

Table 2. Number of particles and percentage of microplastic forms at each research sample point

Sample Point	Microplastic Forms									
	Line/Fiber		Fragment		Film		Foam		Pellet	
TS.1	110	9.54%	99	9.00%	98	11.58%	0	0%	0	0%
TS.2	135	11.71%	105	9.55%	101	11.94%	0	0%	0	0%
TS.3	173	15.00%	210	19.09%	100	11.82%	0	0%	0	0%
TS.4	155	13.44%	185	16.82%	117	13.83%	0	0%	0	0%
TS.5	234	20.29%	163	14.82%	126	14.89%	0	0%	0	0%
TS.6	195	16.91%	160	14.55%	107	12.65%	0	0%	0	0%
TS.7	81	7.03%	82	7.45%	117	13.83%	0	0%	0	0%
TS.8	70	6.07%	96	8.73%	80	9.46%	0	0%	0	0%
NUMBER of MPs	1153	100.00%	1100	100.00%	846	100.00%	0	0%	0	0%

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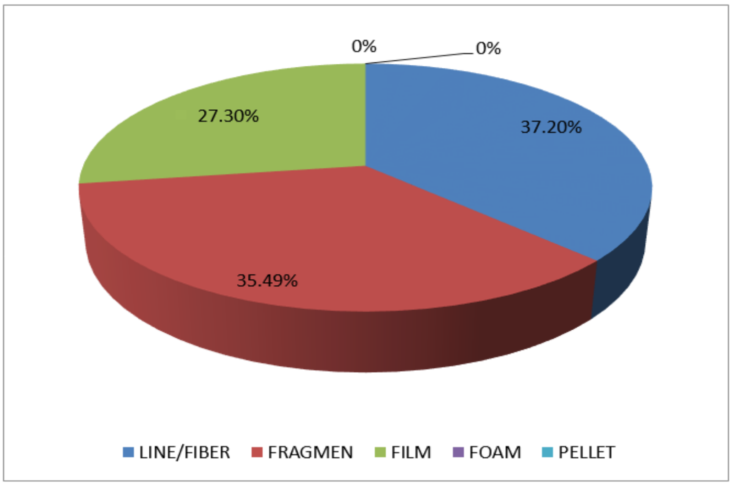

Figure 3: Percentage comparison of microplastic forms at study sites

Fiber, fragment, and film microplastics [22]. There are ship loading and unloading activities, fishing, mining, agriculture, plantations, and household activities [12], and the input of plastic waste originating from cities and then entering aquatic friends [23]. The high abundance value of microplastics in sediment samples compared to microplastics in water samples is influenced by the presence of gravitational forces and the high-density value of plastic compared to the density of water. Plastic that enters the water will sink and accumulate in sediment [24].

Fiber-type microplastic sediments are due to fishing activities such as fishing nets, which are undergoing a degradation process, or waste resulting from human activities in the form of leftover clothing threads originating from washing clothes and plastic ropes, which have undergone a degradation process [25]. The abundance value of microplastic fragments is influenced by garbage on river banks, such as plastic bottles or household waste [26]. The process of fragmentation and size degradation of macro-sized plastic waste will occur as long as the plastic waste is in the river flow and eventually becomes fragment-type microplastic waste [24]. Microplastic film types come from plastic bags and plastic packaging by framagtation process [27].

C. Microplastic Color Identification

The results of identification (Figure 4) using a rock microscope tool, sedimentary microplastics were found with characteristics of red, green, yellow, blue, black, transparent, gray, brown, purple, and orange colors. The dominant colors found were transparent, with as many as 535 particles, or 17.26%, and microplastics with a brown color (60, or 1.94%), which were the fewest colors found at this location. The red color is thought to come from household washing waste, fishing gear, plastic bottles, and other plastic waste [27]. The blue color comes from blue plastic bags, fishing rods, and ropes [26]. The yellow color comes from plastic bags, mica paper book covers, and plastic straws [27]. The black color generally comes from disposable plastic that is used every day [15]. The transparent color comes from clear plastic, which absorbs clothing, fishing gear, straws, packaged beverage bottles, and food and beverage

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containers. In addition, the transparent color indicates how long the microplastic has been photodegraded by UV light. Gray, green, brown, purple, and orange colors come from household washing waste due to the release of clothing fibers, paint chips, and the presence of anthropogenic activities around water locations [27].

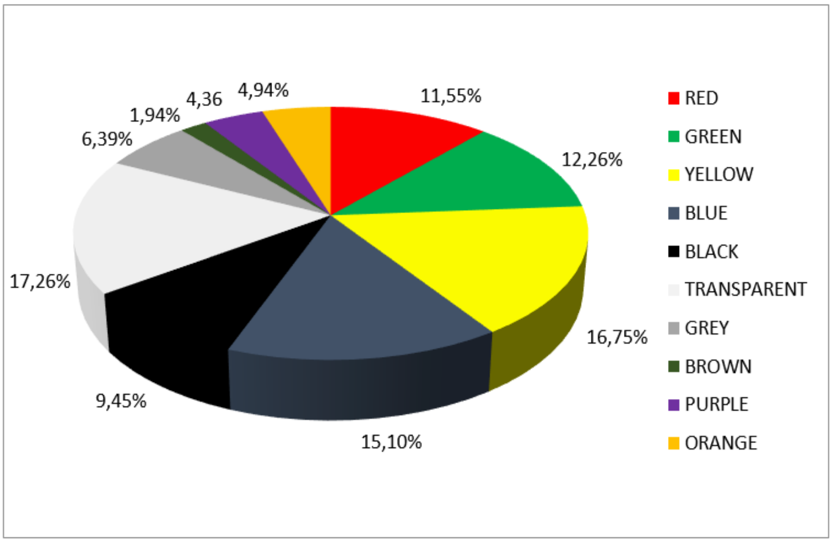

Figure 4: Percentage of microplastic forms at each research sample point

4. CONCLUSION

Based on the results of research at the Pangkajene River location, the sediment microplastic abundance values were in the range of 2.59–5.37 particles per 100 grams of dry sediment. The types of microplastics are based on the forms found at this location, namely line or fiber, fragments, and films. The colors of the microplastics found were red, green, yellow, blue, black, transparent, gray, brown, purple, and orange. There is a need for serious management efforts related to plastic waste that has polluted the environment, both from the community and the relevant government, so that the preservation of river waters is well maintained and does not have negative effects on the community and living things around it.

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