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Microplastic concentration in column seawater compartment in Burau, Luwu Regency, South Sulawesi, Indonesia

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Abstract. Microplastics are very persistent particle and found to float in the waters due to its low density. Anthropogenic activities greatly affect the presence and contamination of microplastics in waters, including Burau Seawater, Luwu Timur Regency, South Sulawesi. This study aims to analyze the composition and concentration of microplastics in the water column of Burau Sea, Luwu Regency, South Sulawesi. The station was determined based on the purposive sampling method. Sampling was performed by using a neuston net. There were four stations for collecting microplastic samples. Laboratory analysis was carried out by mixing the sample with 30% H₂O₂ and left at room temperature for 24 hours. Sample water was filtered by membranouse filter paper. Identification of microplastics using a stereo microscope with a 40× magnification. The results showed there were 810 items of microplastics in the form of fragments, films, fibers and granules with the dominant form of microplastics is fragment. The microplastic colors found were transparent, blue, red, white, green, brown and black with the dominant color being transparent. The microplastic sizes found ranged from 0.01 to 5 mm. The most common sizes are 0.1-1 mm. The average concentration of microplastics was 56.2 items/m³. There is no significant difference in the concentration of microplastics between stations (P value >0.05), which means the distribution of microplastics in the water column at Burau Sea is evenly distributed.

1. Introduction

Plastic waste is one of the hot issues in the world. The World Bank collaboration with research institutions in Indonesia on 2018 stated that more than 150 million tons of plastic have polluted the oceans [1]. One of the continents with the fastest growing production of plastic waste is Asia, especially East Asia. From the results of research, Jambeck et al. [2] also stated, from 192 countries studied, the largest contributor to waste was the Asian continent, where there are five countries that contribute the largest plastic waste in the ocean. The fact, of the five countries Indonesia was after China. Plastics have made a major contribution to human activities. Plastics are popular because they are easy to obtain, light, strong and cheap so that their use has been widespread in various daily activities as packaging such as bottles, lunch boxes, plastic bags and other forms of packaging which are single use plastic. Anthropogenic activities greatly affect the presence and contamination of microplastics in waters. This is what causes plastic to be discussed in the world because plastic is a non-degradable material or cannot be decomposed by bacteria, both in soil and in water. Plastics only be degraded into smaller particles or commonly known as microplastics.



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Microplastics have a maximum particle size of 5 mm, have a low density, and are not easily removed from terrestrial or aquatic environments. Microplastics have the potential to threaten aquatic ecosystems because the presence of microplastics can accumulate toxins. The smaller particles more efficient in accumulating toxins [3]. This is very dangerous, especially for animals with little movement such as groups of detritivores, deposit feeders and filter feeders. Microplastic particles at sea level reached 85% [4]. Microplastic is often found on the surface, because low density so that it floats on the surface water. Commonly found microplastics are the types of fragments that come from the degradation of the larger particles such as drink bottles, the remains of wasted jars, gallons and small pieces of paralon pipes that come from domestic activities. Several studies suggest that microplastics are found in estuary areas [5], tourist areas [6], cultivation areas and around mangrove forests [5].

Burau, Luwu Regency is one of the seawater that has an estuary area, tourist area, mangrove area and cultivation area with high anthropogenic activity. This indicates that Burau waters have the potential to contain microplastics, especially in the water column. However, from several literature reviews conducted, there is no information about the concentration of microplastics in Burau waters. Based on the description, research on the concentration of microplastics in the water column of Burau, Luwu Regency, South Sulawesi is considered important. The purpose of this study was to analyze the concentration of microplastics in the water column of Burau District, Luwu Regency, South Sulawesi. This research can contribute data and knowledge in understanding the microplastic distribution in aquatic environments.

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2. Materials and Methods

2.1. Sampling

Sampling was performed on Burau waters, Luwu Regency, South Sulawesi. Seawater sample were collected from four stations (Table 1). Location of sampling used purposive sampling method. Determination of location using GPS (Global Positioning System). Sample were collected by the volume reduce method using a Neuston net (75×60×15 cm) with 330 μm mesh size. Neuston net was pulled as long as 200 m along the coastline. After that, the Neuston net is rinsed with clean water. The water sample transferred to the sample bottle and then put into a cool box for analysis in the laboratory.

Table 1. Coordinates of station.

No	Coordinate	Station
1	02° 38' 11" S 120° 43' 41" E	Station I Singeni estuary
2	02° 38' 16" S 120° 43' 23" E	Station II Lemo beach
3	02° 38' 44" S 120° 42' 44" E	Station III Around mangrove
4	02° 38' 43" S 120° 42' 00" E	Station IV Saluanna estuary

2.2. Extraction and identification of Microplastics

Sample water was carried out by mixing the sample with 30% H_2O_2 and left at room temperature for 24 hours [7]. The use of hydrogen peroxide serves to dissolve and bleach organic matter. Sample water was filtered by membranouse filter paper 47 mm with 0.45 μm pore size under a vacuum pump. Identification of microplastics using a stereo microscope with a 40× magnification. The identification of microplastics in the filter paper was carried out to see morphological characteristics such as color, shape and size. Measurement of microplastic particles using the Image Raster 3.0. The microplastics found were taken using tweezers and transferred to a glass petri dish for the FTIR (Fourier Transform Infrared) test.

2.3. Statistic Analysis

Statistic analysis was performed using the one way ANOVA to analyze the comparison of microplastic concentrations at four different locations. Analisis of varience used Graphpad Prism application.

3. Results and Discussion

The observations of water samples from the water column of Burau Seawater, Luwu Regency, indicate microplastic contaminated. There were four shapes of microplastic, namely fragmen, film, fiber and granule (Figure 1).

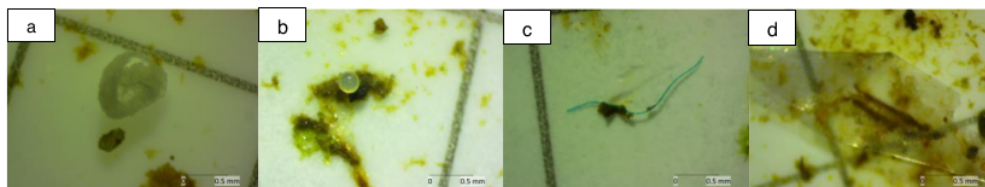


Figure 1. Microplastic shapes in Burau Seawater a). fragmen, b). granule, c). fiber and d). film.

Fragmen is the dominant identified microplastic with a concentration of 3.1 items/m³ or about 56% of microplastics was found, while the least form of microplastics is granules, which are only 12 particles or with a concentration 0.083 items/m³, or about 1% of microplastics was found. Fragments called secondary microplastics because they come from larger particle of plastic or macroplastics. Macroplastics will become smaller particles aided by the oxidative of plastics, UV rays or the hydrolytic of seawater [3]. In addition, it could also be due to the time span of physical, biological and chemical processes that can destroy plastic structures [8]. Granule is microplastics that are not derived from larger plastics or called Primary microplastics. The existence of granules are least found. The results are similar with the research of Zhang et al. [9] in the Bohai Sea, China, which is less than 1% granule. This is presumably this microplastic form is generally produced by the factory industry, while in Burau sub-district there are no factory industrial areas that have the potential to produce granular. This is confirmed by the statement of Cole et al. [10] stated that these granular types of microplastics are used to manufacture cosmetics, soap, and tooth paste which enter the water through industrial waste. Granular type microplastic particles are generally not as much as other types of microplastics such as fragments, films or fibers.

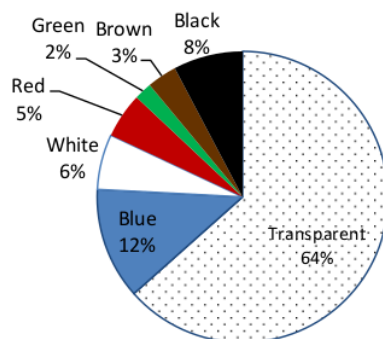


Figure 2. Percentation of Microplastic colours in Burau Seawater.

Transparent is the dominant identified microplastic in Burau Seawater (Figure 2). The transparent fragments come from larger, transparent colored plastic fragments or can also come from brightly colored plastics that have been in the waters for years so that the microplastic particles undergo a significant color change until they become transparent. This is supported by the statement of Hiwari et

al. [11], namely microplastic particles that are transparent in color indicate the length of time the microplastic is in the water so that it changes color by UV rays.

The size range of microplastics found is 0.01-0.5 mm and the dominant size is range 0.1-1mm. This is presumably because microplastics have broken down into smaller (micro) particles for quite a long time. One of the causes of fragmentation from larger particles to smaller particles is due to the presence of ultraviolet light [12] and the oxidative properties of plastics and the hydrolytic properties of seawater [3].

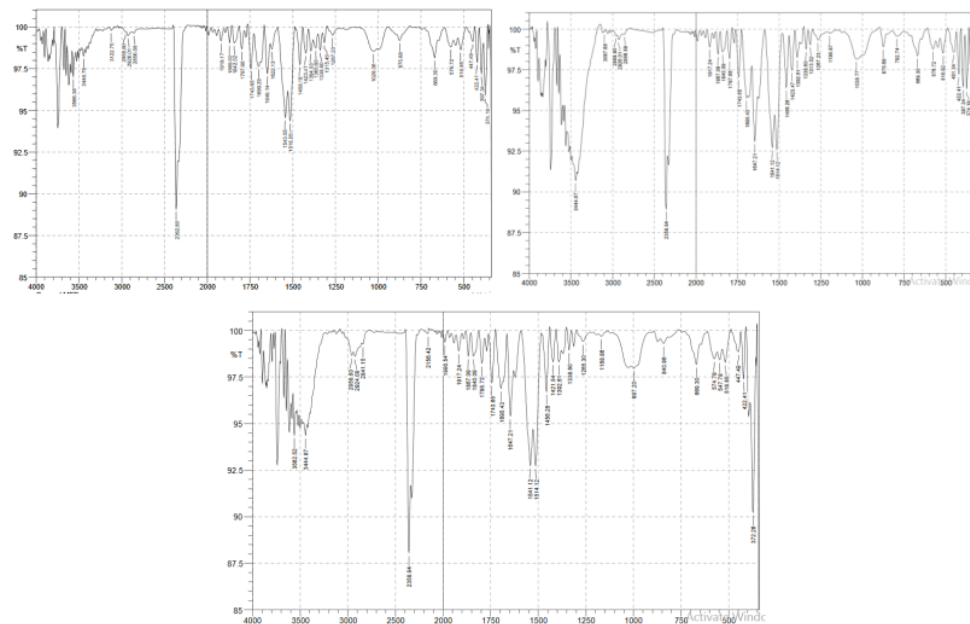


Figure 3. The result of FTIR microplastics in the seawater.

FTIR test results showed that from three forms of microplastic polymers tested, it was found that the sample contained polyester (Figure 3). Polyester is thought to come from anthropogenic activities of local residents, such as laundry waste that enters water bodies as well as from waste from cultivation activities. This is because polyester is a type of polymer which is often used as a raw material for fishing gear and synthetic fabrics. According to Lusher et al. [13], polyester is a type of polymer commonly used in fisheries activities. In addition, polyester is also a constituent of textile fibers. Several other journals say that polyester is also used in making films [14], as well as plastic bottles [3].

The concentration of microplastics is the ratio between the number of microplastic particles obtained with the volume of filtered water. The comparison of microplastic concentrations for each station can be seen in Figure 4.

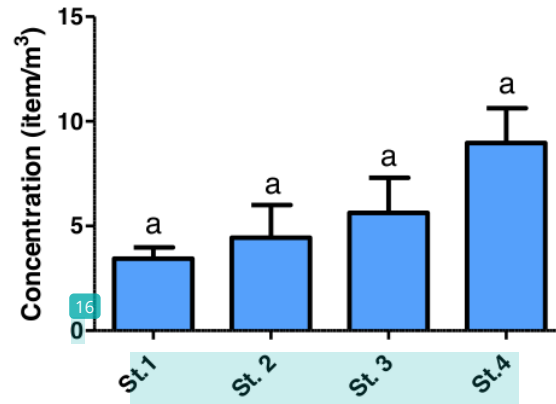


Figure 4. Microplastic concentration in Burau Seawater. The same letter indicated no significant difference between stations statistically ($p > 0.05$).

The results showed, the highest microplastic concentration was at station IV (Saluanna estuary), which was 9.00 items/m³. The lowest microplastic concentration was at station I, that 3.47 items/m³. The high concentration at station IV is thought to be because the Saluanna estuary have long river and along the river is close to residential areas so that the possibility of a large amount of garbage entering the river through anthropogenic activities and empties into the Saluanna estuary is greater. Meanwhile, the low concentration of microplastics at station I, which is around the Singgeni estuary, is suspected because there are no residential areas along the river, so the possibility of plastic waste entering the river body is very small. This can also be influenced by oceanographic factors such as current patterns in Burau waters (Figure 5).

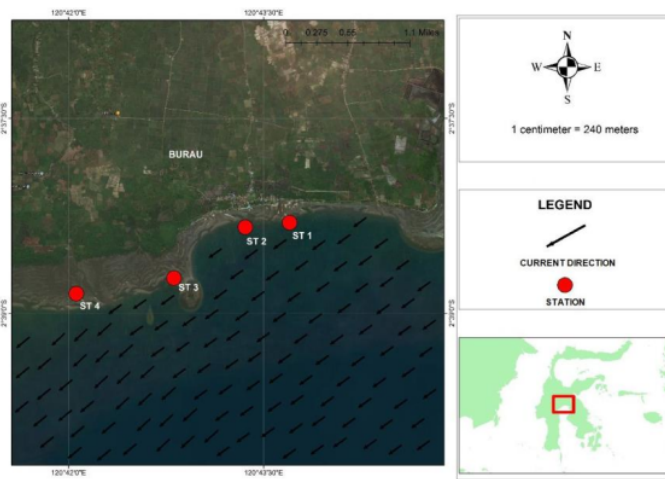


Figure 5. Current pattern of Burau Seawater. Source: Aviso Altimetri.

The current pattern in Burau waters tends to the west (Figure 5). This may indicate that the microplastics in the water column are moving westward due to the influence of currents. Based on the

statement of Cincinelly et al. [15], one of the factors that influence the presence of microplastics is the flow of waters that can move waste from one place to another or from puddles to distant places.

The average concentration of microplastics in the waters in Burau District, Luwu Regency is 5.62 items/m³. The value obtained is greater than previous research conducted in the coastal waters of the Western Mediterranean, which is 0.116 items/m³ [16] and in the Stockholm Archipelago research, which is 1.37 items/m³. However, it is smaller than the concentration of microplastics in research in Banyuurip waters, which is 711 items/m³ [5] and research in Jakarta Bay, there are 2881-7472 items/m³ [17]. There are differences in microplastic concentrations in several waters according to Zhao et al. [18], can be caused by the use of different methods and the use of net sizes.

4. Conclusion

The study suggested that the waters in Burau, Luwu Regency have been contaminated with microplastics. There were four shapes (fragments, fiber, film and granules) and seven colors (transparent, blue, black, red, green and white). Fragments were the dominant form (56%) and granules were the least type (1%). Meanwhile, the dominant color of microplastic particles was transparent (64%) and the least color was green (2%). The type of polymer that makes up the microplastics in Burau waters was polyester (PES). The highest microplastic concentration was at station IV, while the lowest concentration was at station I. Based on the results of statistical tests, there was no difference in microplastic concentrations between stations ($P > 0.05$).

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