The density of microplastic in sea cucumber (Holothuria sp.) and sediment at Tidung Besar and Bira Besar island, Jakarta

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Abstract. Plastic waste is the dominant type of marine waste found. The plastics are degraded in physics, chemistry and biology to a size of <5 mm. Sea cucumbers are deposit feeder type animals that get food by stirring up sediments so that there is microplastic content in sea cucumbers. This research aims not only to analyze the microplastic density in sediments and sea cucumbers but also to analyze the correlation between microplastic density in sediments and sea cucumbers. This research was conducted from February to April 2018. The research data was the descriptive with purposive random sampling and correlational studies method. Based on calculation analysis, microplastic found in sediments and sea cucumbers on Tidung Island and Bira Besar Island, consists of 4 (four) types. There are fiber with 2722 particles/g; 1982 particles/g, fragment 254 particles/g; 547 particles/g, film 100 particles/g; 50 particles/g and pellets 14 particles/g; 9 particles/g. Microplastic found in sea cucumbers consists of Tidung Island and Bira Island. Consist 4 (four) types, which are fiber, 2033 particles/g; 1247 particles/g, 137 particle fragments/g; 183 particles/g, film 60 particles/g; 69 particles/g and pellets 9 particles/g; 4 particles/g. Correlation results showed a positive correlation with microplastic in sediments and in sea cucumbers.

1. Introduction

Waste is one of the complex problems in the areas that are near the coast [1]. Plastic waste is the dominant type of marine waste found (CBD-STAP, 2012). Marine waste define as solid items, produce and process by humans, discarded or left by accident in the marine environment. Kepulauan Seribu is part of DKI Jakarta territorial waters. The dominant ecosystems in Kepulauan Seribu are coral reef and seagrass which are important habitats for marine life [2].

One of the islands that has these characteristics is Tidung Island and Bira Island. Most tourists visiting Tidung Island and Bira Island aim to enjoy the beauty of the sea and the biota on the island. However, human activities in the island cause negative impacts from these activities [3]. These plastics are degraded physically, chemically, and biologically to the size of <5 mm [4].
According to Ivan do Sul & Costa [5] stated that microplastics found in marine ecosystems have become a focus in the field of environmental science for the last 15 years. Reports on biota containing microplastics include amphipods [6], barnacles [7], sea cucumbers [8], to zooplankton [9]. One of the many biota encountered in Kepulauan Seribu is sea cucumbers. Sea cucumbers are one of the specific and easily recognized groups of biota. Sea cucumbers are deposit feeders which have the meaning of eating sediment [10]. The existence of sea cucumbers in the ecosystem to help fertilize the substrate by stirring the bottom of the water [11]. Sea cucumbers are important organisms in the ecosystem. Aside from being an environmental fertilizer, sea cucumbers are food from shrimp, fish and turtles. Sea cucumbers are thought to swallow microplastics because these animals cannot choose food. Then, need reasearch to be done to find out how the density of microplastics in sea cucumbers.

2. Research methods

This research was conducted in February - April 2018 on Tidung Besar Island and Bira Besar Island. The research data was the descriptive with purposive random sampling and correlational studies method.

2.1. Collecting data method

2.1.1. Determination of research station. Determination of research stations on Tidung Island and Bira Besar Island by dividing the Island into 4 quadrants based on wind direction (north, east, south, and west).

2.1.2. Retrieval of environmental parameter data. The parameters measured at each research station are temperature, pH and salinity. Each parameter is taken with a measuring instrument like a thermometer, pH meter, and refractometer.

2.1.3. Sea cucumber sampling and sediment sampling. Holothuria atra samples were taken by purposive sampling method. Retrieval of sea cucumbers is done directly without using tools. Furthermore, sea cucumbers are measured with a length of 15-30 cm, then sea cucumbers are preserved by immersing them in glass jars. Sediment samples were taken at a depth of 0-10 cm from the sediment surface. Sediments taken amounted to 0.5-1 kg per sea cucumber collection. Sediment samples will be taken using Ekman grab and then stored in glass jars.

2.1.4. Microplastic calculations in sea cucumbers. Microplastic analysis in sea cucumbers is done by isolating microplastics from sea cucumbers in several steps. First, sea cucumbers are obtained from nature directly put in 70% alcohol solution to be preserved and confirmed no metabolic activity anymore. Second, the separation of sea cucumber intestinal tissue from the skin of sea cucumbers and their wet weight was measured. Third, the sea cucumber's intestinal tissue is destroyed by immersion in a 69% nitric acid solution for 24 hours. Fourth, drying results are observed under a microscope to determine the presence of microplastics while grouping them according to microplastic groups. Finally, the microplastic calculation is divided by the wet weight of the sea cucumber's intestine.

2.1.5. Microplastic calculations in sediments. The microplastic analysis contained in sediments was carried out in several steps. First, the process of drying the sediment using an oven with a temperature of 110 C for 24 hours. Second, the stage of microplastic separation based on density. Separation is done by soaking taking 50 g of each sediment sample into a saturated NaCl solution, then stirring for 2 minutes [12]. The separation process will separate polystyrene, polyethylene and polypropylene plastics. Third, the stage of filtering the supernatant with filter paper. Fourth, visual observation of particles using a...
monocular microscope for microplastic grouping into several groups, namely films, fibers, fragments, and pellets [13].

2.2 Data analysis methods

2.2.1 Calculation of microplastic data analysis in sea cucumbers and sediments. Microplastic calculations in sediments and sea cucumbers *Holothuria atra* produce quantitative data. Quantitative data obtained in the form of the number of microplastic particles contained in each of these samples. Next, the quantitative data obtained were analyzed using the Spearman test correlation equation between microplastics contained in each sample.

3. Result and discussion

3.1 Microplastic density in sediments contained in sea cucumbers.

Based on the analysis, the amount of microplastic found in the sediments can be seen through the following figure.

![Figure 1](image_url)

**Figure 1.** Microplastic density in sediments at sea cucumber collection sites.

Microplastics found in sediments are types of fibers, fragments, films, and pellets. Based on the results, fiber type microplastic is a type that has a density of 3.63 particles/g on Tidung Besar Island and 2.64 particles/g on Bira Besar Island, the highest among the 3 other types of microplastics. This is because the type of fiber is a type of microplastic with a low level of constituent density [14], so it is easily carried by currents. In addition to fiber types, microplastics found in sediments in Tidung Besar Island are fragments and films with a density of 0.34 particles/g and 0.13 particles/g, respectively, in Tidung Besar Island, 0.73 particles/g and 0.07 particles/g on Bira Besar Island.
Figure 2. Microplastics found at site. A. fiber type, B. fragment type, C. film type, D. pellet type.

This is because fragments come from plastic objects that can be degraded for a long time such as bottles, buckets, or other objects made of PVC. Film-type microplastic is a type of microplastic that originates from plastic waste and food packaging plastic [15][16]. Micro Plastic pellet type has a density of 0.02 particles/g on Tidung Besar Island and 0.01 particles/g on Bira Besar Island. This is due to the plastic forming material which is a material for making plastic objects used by industries. There are no plastic manufacturing industries on these two islands.

3.2. Microplastic density in sea cucumbers

Figure 3. Microplastic density of sea cucumbers on Tidung Besar Island and Bira Besar Island, Kepulauan Seribu. Jakarta

Microplastic types found in sea cucumbers are the type of fiber, fragment, film, and pellet. Based on the analysis of the results, the type of microplastic fiber and fragment is a type that has a density of 7 particles/gr and 0.5 particles/gr on Tidung Besar Island, 3.7 particles/gr and 0.6 particles/gr on Bira Island respectively. Large, the highest among 4 types of microplastic. This is because Fiber is a type of
microplastic that is easily carried by currents, and enters the digestive tract, accumulates in the digestive organs of sea cucumbers resulting in blockages in the eating utensils and digestive tract [12][17]. Then, fragments come from plastic objects that can be degraded for a long time such as bottles, buckets, or other objects made of PVC [18][15].

The microplastic size which is smaller than sediment causes microplastic to be digested. This was proven in [19] research on sea cucumber feces, found microplastic particles. This event is suspected because the fiber type microplastic is a type of microplastic that is found in sea cucumber habitats so that sea cucumbers can swallow plastic microparticles as their food.

3.3. Correlation between the microplastic density of sea cucumbers and those present in sediments

The results of the Spearman test correlation analysis between microplastic density in sea cucumbers and sediments are in Table 1 which shows that there is a positive correlation between types of microplastics in sea cucumbers and sediments. This is caused by how to eat from sea cucumbers which are deposit feeder type animals [10]. Deposit feeder animals are animals that take food without being able to choose food, so 4 types of microplastic can be found in the digestive organs of the sea cucumber's body.

Table 1. Correlation between microplastic density

| Correlation of abundance | Tidung Island | Bira Besar Island |
|--------------------------|--------------|------------------|
| **The fiber** in sea cucumbers - fiber in sediment | 0.393 | Positive correlation |
| Fragment in sea cucumbers - Fragment in sediment | 0.756** | Positive correlation |
| Film in sea cucumbers - Film in sediment | 0.826** | Positive correlation |
| Pellet in sea cucumbers –pellet in sediment | 0.258 | Positive correlation |
| **The fiber** in sea cucumbers - fiber in sediment | 0.304 | Positive correlation |
| Fragment in sea cucumbers - Fragment in sediment | 0.139 | Positive correlation |
| Film in sea cucumbers - Film in sediment | 0.130 | Positive correlation |
| Pellet in sea cucumbers –pellet in sediment | 0.201 | Positive correlation |

Based on the analysis of correlation results, the type of fragment and film are two types of microplastic that have a significant correlation compared to the other two types of microplastic. This is due to the factor of human activity on Tidung Island. Tidung Island is designated as a settlement of 40% and tourist attractions 50%. Most of the tourists visiting Tidung Island produce waste where fragments of microplastic originating from plastic objects can be degraded for a long time such as bottles, buckets, or other objects made of PVC. Also, film type microplastic is a type of microplastic that comes from plastic bag waste and food packaging plastic [15][16]. Based on the 2014 Jakarta BPS data, the largest percentage of types of waste in Jakarta is a plastic waste with 14.02%. The Indonesian Ministry of Industry (2013) states that plastic consumption reached 1.9 million tons during the first 6 months of 2013.
4. Conclusion
Tidung Island is an island that has the largest microplastic density. In this research microplastics found in sediments and sea cucumbers consist of 4 (four) types, namely fiber, fragment, film, and pellet. Based on the results of the analysis, there is a positive correlation between microplastic abundance in sea cucumbers and sediments.

Acknowledgments
This research was supported by the Directory Research and Community Engagement, Universitas Indonesia (PITTA B Grant No NKB-0642/UN2.R3.1/HKP.05.00/2019) to MPP.

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