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MICROPLASTIC ABUNDANCE IN EDIBLE CRABS AND GASTROPODS ON THE BLANAKAN COAST

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Abstract: Blanakan is a coastal area that is dominated by fishing areas, silvofishery ponds, and tourism areas, all of which can lead to pollution. Microplastics are one of the pollutants that can be formed due to the decomposition of plastic waste around the coast and they can contaminate the water, sediment, and biota. The small size of microplastics makes it easier for these particles to be carried away by currents and then trapped in the biota. Hence, this study aims to investigate the abundance of microplastics in the water, sediment, edible crabs and gastropods from the Blanakan coastal areas. The random purposive sampling method was used for the water, sediment, and biota samples, carried out at three stations with three repetitions. The total abundance of microplastics ranged between 320-380 particles/L in the water, 280-2200 particles/kg in the sediment, 3.5-25 particles/individual in crabs, and 5.5-8 particles/individual in gastropods. The forms of microplastics found in the water, sediment, and biota on the Blanakan coast were fragments, films, fibres, and pellets. The pellets were commonly found in the sediment samples and the fibres were found in the water samples, crabs, and gastropods.

Keywords: Abundance, Blanakan Coast, crab, gastropod, microplastic.

Introduction

Over time, more and more garbage has accumulated in water bodies, especially downstream, namely the sea and the coast, which are at the end of the river flow. Wastes are categorised into mega-debris, with a size of more than 100 mm; macro debris, with a size of 20-100 mm; mesodebris, with a size of 5-20 mm; and, micro debris, with a size of 0.3-5 mm (Hastuti *et al.*, 2014). Micro debris, such as microplastics, is an emerging threat. Microplastics that harm ecosystems and existing biota are currently estimated to have polluted up to 7,000 to 35,000 tonnes of water (Cózar *et al.*, 2014). About 9% of plastic waste is recycled, 12% is used to recover energy, 8% is disposed of in landfills, and 71% is disposed of directly into the environment (Foerster, 2017). Plastic waste that does not decompose will pollute water bodies and is harmful to aquatic organisms. Chemically, marine debris increases as plastic particles (microplastics) decrease, and the physical effects increase with the increase in macro debris size (UNEP, 2011).

Microplastic is the smallest part of plastic and has a size of less than 5 mm. It has been found in many glasses of water around the world, and has various types, shapes, and variations in terms of size, density, colour, and others (Boerger *et al.*, 2010). Microplastics come from the decomposition of large plastics and can be caused by waves, sand or sediment grinding, photodegradation or degradation caused by sunlight, biodegradation caused by living things, and other processes (Boucher, 2017). The types of microplastics themselves include fragments, fibres, pellets and films (Sari *et al.*, 2015). The small size of microplastics can make it easier for these particles to be carried away by currents and trapped in aquatic biota (Datu *et al.*, 2019), one of which is crustaceans. Studies have found that microplastics have the ability to absorb toxic hydrophobic compounds from the environment (Cole *et al.*, 2011). Microplastics have carcinogenic properties that can interfere with the endocrine glands in an organism (Rochman *et al.*, 2015). This raises concerns about the adverse effects of consuming seafood that contains microplastics. Contaminated biota and sediments in water bodies can cause damage to internal organs and disrupt the digestive system. Microplastics can contaminate pond commodities, such as milkfish, tilapia fish, vannamei shrimp, giant prawns, and even macrozoobenthos that live in sediments, such as crabs, snails, and even shellfish (Bangun, 2017).

The Blanakan sub-district is located in Subang Regency, West Java Province. The Blanakan area covers nine villages from the west to the east. Blanakan is a coastal area, where the people's livelihoods are mainly derived from fishing activities and tourist areas, with one of them being aquaculture farming in coastal areas. The ponds owned by the fishermen are generally located at the mouth of the river. The river that empties into the coastal waters of the Blanakan district is the Ciasem river (Wahyuni, 2009). The Ciasem river passes through densely populated settlements, so it can be assumed that it has been polluted by plastic waste that will accumulate at the mouth of the river before heading to the sea (Boerger *et al.*, 2010). The Blanakan river and ponds area need to be studied, as the presence of microplastics exposes nearby residents to harm and poses a threat to the river's ecosystem.

Materials and Methods

Study Area

The research was carried out from April to August 2021 in the Blanakan river and ponds in Subang Regency, West Java. Water in the Blanakan ponds comes from the Blanakan river flow (Wahyuni, 2009). Along the Blanakan riverside, there are residential settlements, which raises the possibility that the Blanakan river water has been contaminated by plastic waste from the settlements (Novianti *et al.*, 2017). In addition to plastic waste, the Blanakan river may also be polluted by livestock waste and industrial waste found along the Blanakan river flow (Wahyuni, 2009). The sampling points for microplastics as shown in Figures 1 and 2 were chosen using the random sampling method by taking samples from the right, left, and centre points of each station on the Blanakan river and Blanakan ponds in Subang Regency, West Java. Sampling was carried out at a distance of ±2 km per point.

Tools

The tools used for the sampling of the water, sediments, and crabs include bottles, plankton nets with a length of 1.5 m and diameter of 45 cm, stainless steel scoops, jars, GPS, and cooler boxes. Meanwhile, the tools used to measure water quality data include a dissolved oxygen

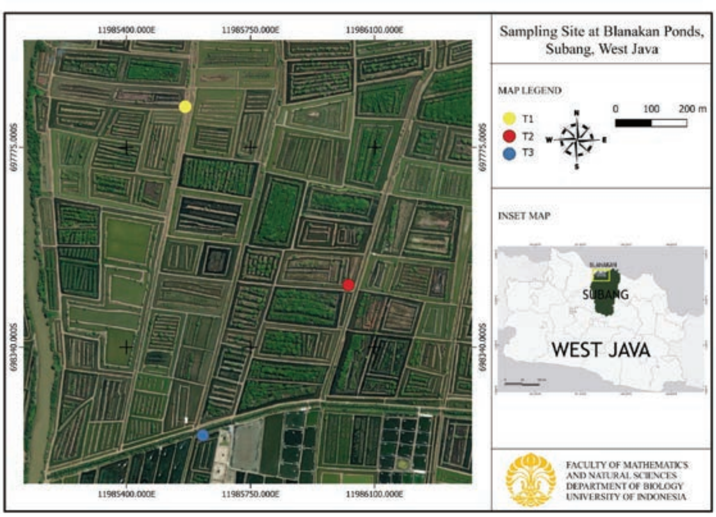

Figure 1: The sampling sites in Blanakan ponds in Subang Regency, West Java

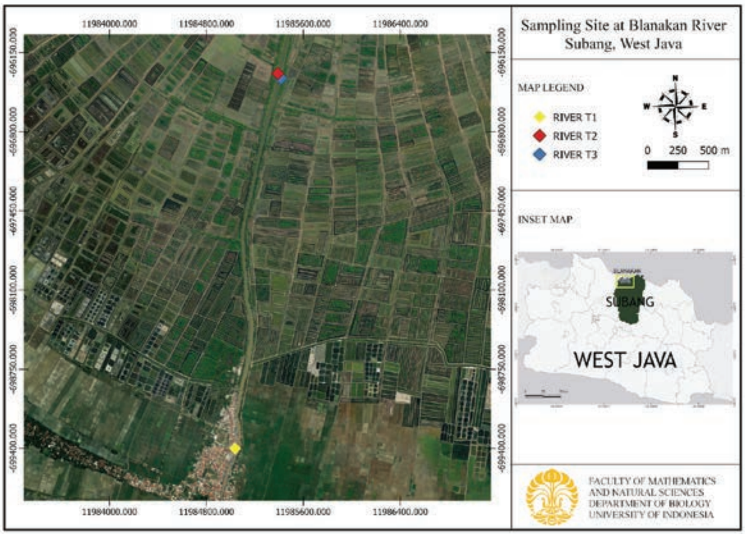

Figure 2: The sampling site in the Blanakan river in Subang Regency, West Java

(DO) meter, pH meter, and thermometer. The tools used during the isolation of microplastics were Petri dishes, a freezer, an oven, scales, vacuum pumps, an Olympus CX21 microscope, mortars, pestles, beakers, measuring cups, droppers, scissors, tweezers, rulers, porcelain dishes, hot plates and stir bars.

Materials

The materials used during sampling were ziplocks, aquades, tissues, and ice cubes. Meanwhile, the materials used during the isolation of microplastics were NaCl salt crystals, aquades, hydrogen peroxide (H_2O_2), and Whatman Cellulose Nitrate filter papers with a pore size of 0.45 m and a circle diameter of 47 mm.

Environmental Parameter Data Collection

Environmental parameter retrieval is carried out with the initial stages of preparing tools and materials for data collection. The environmental parameter data collection was carried out at three stations with three repetitions at the centre, right, and left sections. The environmental parameters taken are pH, DO, temperature, turbidity, current strength, and redox, using a pH meter, DO meter, thermometer, refractometer, current meter, and oxygen meter.

Water, Sediment and Crab Sampling

Sediment sampling was taken at each station by doing three repetitions on the right, left, and middle of the river. The sediment samples were taken using an ekman grab. The tool was dropped to the bottom of the river and lifted back onto the ship. The sample that was lifted was then put into a scrub pot. The scrub pots containing the sediment samples were then given a label denoting the station in which the samples were collected and put into the cooler box.

Water sampling was carried out by doing three repetitions at each station, namely on the right, left, and middle of the river by using a plankton net on the surface of the river for 15 minutes. The plankton net used has a length of 1.5 m with a diameter of 45 cm and a mesh size of 300 m, which is installed against the flow of water (Kovac *et al.*, 2016). All water material in the plankton net is then put into HDPE bottles. The sampling of the crabs was carried out using hands with the protection of cloth gloves. These crabs live on the riverbanks and can be collected by hand.

Microplastics Isolation and Quantification

In the Telescopium telescopium sample, the shell and flesh were separated. In samples of Sylla Serata and river crabs, the meat, gills, and digestive tract were separated. Isolation of biota meat begins with soaking the meat part using saturated H2O2 for 72 hours. The ratio of crab weight (grams) to the volume of H_2O_2 (mL) is 1:10. The immersion causes the crab meat to be crushed. The crushing results are then diluted with saturated NaCl solution in a ratio of 1:4 and 1:1 for 24 hours.

For 24 hours, it produces microplastic particle deposits on the surface of the liquid. Next, floating particles were taken using a 50 mL dropper pipette and transferred into a measuring cup. The measuring cup, which already contains 50 mL of crab liquid, is then heated on a hot plate at 80^{o}C for approximately 30 minutes (Lusher et al., 2016). The heating is intended so that there are no organic crab residues that still settle in the liquid. After 30 minutes, the heated liquid was allowed to stand for 5 minutes and then the filtering process was carried out with the help of a vacuum pump and Whatman Cellulose Nitrate filter paper.

Microplastics were observed and identified using an Olympus CX21 microscope at a magnification of 10x4 or 10x10. The petri dish containing Whatman Cellulose Nitrate filter paper was placed on the object table, and then the macrometer and micrometre were adjusted to focus the object. Indomicro View software makes it easier to see and document microplastic particles, which can be connected from a microscope to a laptop. When microplastic particles are obtained, these particles are documented and then measured using the Indomicro View software. Visual identification of microplastics using an Olympus CX21 microscope is grouped into four forms: films, fibres, fragments, and pellets (Cordova et al., 2018).

The abundance of microplastics present in water was expressed by comparing the number of particles found with the volume of water (particles/L). The abundance of microplastic in the sediment was noted by comparing the number of particles found with dry weight of the sediment (particles/Kg). The abundance of microplastic in biota is calculated by comparing the number of particles found with the number of biotas (particles/individual).

Results and Discussion

Microplastic Forms

Microplastic Forms in the Blanakan River

Microplastic forms, like fragments, fibres, films, and pellets, were detected in all samples collected at the Blanakan river. The composition of the microplastic forms from the highest to the lowest in the Blanakan river was fibres (55%), pellets (23%), films, (19%) and fragments (3%). The large number of microplastics in the form of fibres may be due to debris from ship ropes at the ports, as well as textile industry waste (Farrell & Nelson, 2013).

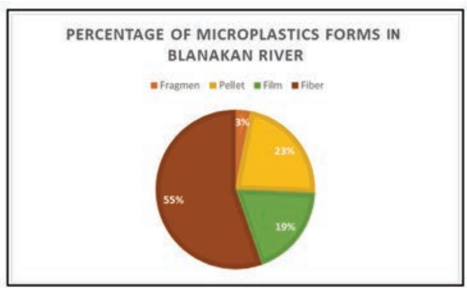

Figure 3: Percentage of microplastic forms in the Blanakan river

Microplastic Forms in Blanakan Ponds

Microplastic forms, like fragments, fibres, films, and pellets, were also detected in all samples collected in Blanakan ponds. The composition of the microplastic forms collected at Blanakan ponds from the highest to the lowest was pellets (54%), fibres (40%), fragments (4%), and films (2%). The reason why microplastic in the form of pellets was high is that microplastic pellets are more easily suspended in pond waters (Wright *et al.*, 2013).

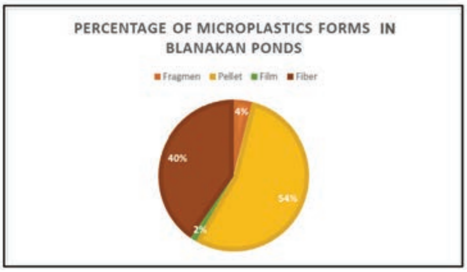

Figure 4: Percentage of microplastic forms in Blanakan ponds

Microplastic Size

Microplastic Sizes in the Blanakan River

Microplastics in the Blanakan river were categorised into four sizes, namely < 300 µm, 300-500 µm, 500-1000 µm, and > 1000 µm. Based on the results, the size of microplastics in the Blanakan river is dominated by size < 300 µm, with the lowest being size > 1,000 m. This is due to the fragmentation process, both physically and chemically, which involves hydrolysis or oxidation, and these processes are expedited due to microbes, heat, and light (Chamas *et al.*, 2020).

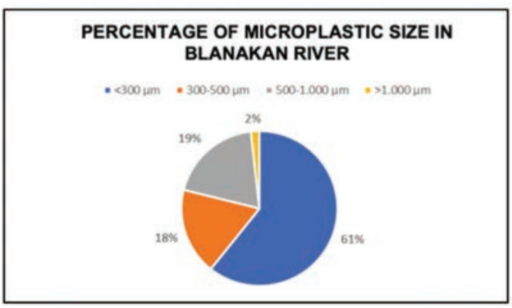

Figure 5: Percentage of microplastic sizes in the Blanakan river

Microplastic Sizes in Blanakan Ponds

Based on the samples collected from the three ponds, the mircoplastics were categorised into four sizes, namely < 500 µm, 500-1000 µm, 1000-1500 µm, and > 1500 µm. Based on the order, the highest category is size < 500 µm and the least is 1000-1500 µm and > 1500 µm. Over time, plastic waste will fragment (Kershaw & Rochman, 2015). The formation of microplastics in water depends on environmental factors and the nature of the plastic polymer itself. UV radiation from sunlight is the main environmental factor that degrades plastics so that larger fragments break up into smaller pieces (Diaz-Mendoza *et al.*, 2020).

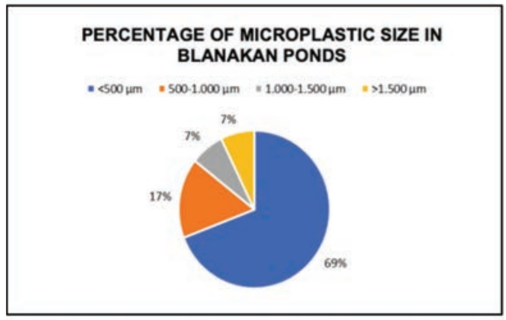

Figure 6: Percentage of microplastic sizes in Blanakan ponds

Microplastic Abundance

The Abundance of Microplastics in Water and Sediments Samples

The highest microplastic abundance was discovered in the water samples belonging to the Blanakan river, with an average value of 386.6 particles/L. In contrast, the abundance found in Blanakan ponds averaged at 326.6 particle/L (Table 1). In both sites, the fibre form dominated.

However, microplastic abundance within the sediments is much higher. Microplastic abundance in the sediments in the two sites averaged at 100 particles/L (Table 2). This is because plastic have higher density than water, which will cause them to sink and accumulate in the sediments. Also, Blanakan ponds accumulate higher amounts of microplastic compared with the Blanakan river. This is because the waters in the ponds are more stagnant compared with the river, and with fewer disturbances, the microplastic particles can sink more readily.

Table 1: Abundance of microplastics in the water samples

Location	Station	Abundance (particle/L)	Average
Blanakan ponds, Subang, Jawa Barat	T1	340	326.6
	T2	320	
	T3	320	
Blanakan river, Subang, Jawa Barat	T1	360	386.6
	T2	480	
	T3	320	
Total Average			356.6

Table 2: Abundance of microplastics in the sediment samples

Location	Station	Abundance (particle/kg)	Average
Blanakan ponds, Subang, Jawa Barat	T1	2880	2440
	T2	2600	
	T3	2640	
Blanakan river, Subang, Jawa Barat	T1	280	573.33
	T2	680	
	T3	760	
Average			1506.6

Table 3: Abundance of microplastics un river crab (*Parathelphusa convexa*)

River Crab Weight	Abundance (Particle/Individual)
0-10 gr	19
10-20 gr	5.53
20-30 gr	16.9
30-40 gr	32

Table 4: Abundance of microplastics in pond crab (*Scylla serrata*) and gastropod (*Telescopium telescopium*)

Samples	Abundance (particle/individual)			Average
	T1	T2	T3	
Scylla serrata	6	7	3.5	5.5
Telescopium telescopium	5.33	3.67	4.33	4.44

The Abundance of Microplastics in Crab and Gastropod Samples

For the crab samples from the Blanakan river, as show in Table 3, the abundance value was between 5.53 and 32 particles/individual, with the average being 18.35 particles/individual. The abundance in *Scylla serrata* is 5.5 part/ individual, while the average for *Telescopium telescopium* is 4.44 part/individual (Table 4).

Conclusion

The forms of microplastics found in all samples of the water, sediment, and biota from Blanakan pond are fragments, films, fibres, and pellets. The pellet form is commonly found in sediment samples and the fibre form is found in the water and biota samples. Based on the size, the microplastics found were classified into < 500 m, 500-1000 m, 1000-1500 m, and > 1500 m. In the samples of the water, sediment, and biota, the highest percentage was found in the three ponds, being microplastics with a size of <500 m, follow by sizes 500-1000 m, > 1500 m and finally > 1500 m. The abundance values of microplastics obtained from the water, sediment, and biota samples vary widely. The sample with the highest abundance value is the sediment sample, when compared with the water and biota samples.

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