Microplastic contamination extent on *Strombus* sp. in North Bintan Waters

Kafabihi¹, F Idris¹, R D Putra², A H Nugraha¹, T Apriadi³ and A D Syakti⁴⁺

¹Marine Science Department, Marine Science and Fisheries Faculty – Raja Ali Haji Maritime University, Jl. Politeknik Senggarang-Tanjungpinang, Riau Islands Province 29100, Indonesia
²Shipping Engineering, Faculty of Engineering – Raja Ali Haji Maritime University, Jl. Politeknik Senggarang-Tanjungpinang, Riau Islands Province 29100, Indonesia
³Aquatic Resource Management, Marine Science and Fisheries Faculty – Raja Ali Haji Maritime University, Jl. Politeknik Senggarang-Tanjungpinang, Riau Islands Province 29100, Indonesia
⁴Environmental Sciences Department – Raja Ali Haji Maritime University, Jl. Politeknik Senggarang - Tanjungpinang, Riau Islands Province 29100, Indonesia

*Corresponding author: agungsyakti@chemist.com

Abstract. Microplastics, which are crumbled plastic waste measuring less than 5 mm, are known to have contaminated the conch snail species *Strombus* sp. and sediments in the waters of North Bintan. This study aims to provide a basic report on the number of stranded plastic crumbs (micro) and the contamination level in conch Snails (*Strombus* sp.) In North Bintan waters. The methods used in this research are survey and quantitative methods. Determination of the location point by purposive sampling. The procedure is divided into two stages: quadrant sampling in the field and analysis of microplastic particles in the laboratory with H₂O₂ liquid as an oxidizing agent and ZnCl₂ solution as a microplastic determinant with a floating system. 16.4 ± 31.6 particles/individuals. Meanwhile, the level of contamination that occurs in *Strombus* sp. experienced in Pengudang Village by 88%, which means that on average each individual at the Pengudang station has the potential to be contaminated with 22 microplastic particles. The high level of contamination is a threat to the safety of seafood because there is the contamination of microplastic particle pollutants in one of the marine biota consumed by *Strombus* sp.

Keyword: Bintan; contamination; microplastics; plastic waste; *Strombus* sp.

1. Introduction
Solid Waste is a problem for people around the world, whether it comes from land or sea [1]. One type of waste that is present in the oceans and land is dominated by plastic waste [2]. This is supported by Plastic Europe [3] which states that plastic production is estimated to have reached 311 million cubic tons in 2014 and this number is certain to continue to increase every year.

Plastic waste is waste that comes from synthetic materials from polymerization (polycondensation) of various kinds of monomers (styrene, vinyl chloride butadiene, and acrylonitrile) and Plastic polymers are very stable materials so that they remain intact as polymers for a long time. 2016). Plastic particles that are less than 5 mm in size are defined as microplastics [4]. According to Ericksen et al., [5] identified microplastics are divided into four classes, namely: nano-, micro-, meso-, and macroplastics originating from fishing activities and other anthropogenic plastic waste.
Microplastic is a type of plastic waste that is smaller than 5 mm and is grouped into 2 types, namely primary and secondary microplastics [6]. Primary microplastics are the product of plastics made in micro-forms, such as microbeads in skincare products that enter waterways. Secondary microplastics are fragments, parts, or results of fragmentation of larger plastics [7]. Microplastics present include size, shape, color, composition, density, and other properties [8].

Bintan Regency is part of the Riau Islands Province with an area of 1,318.21 km² and has 10 sub-districts, one of which is Teluk Bintan District in North Bintan. This sub-district is the sub-district that has the most populous population in Bintan Regency as many as 22,274 people with a land area of 219.25 km² and a sea area of 198.57 km² [9]. Seeing the condition of the waters around North Bintan which is polluted by plastic waste is the basis for knowing the level of contamination by looking at its presence in marine biota in the area. Dowarah and Devipriya, [10] mention that many activities occur in shipping lanes, this has the potential to leak plastic waste in the waters of Bintan, causing ecological problems in the waters.

The conch snail or Strombus sp. is one type of gastropod species that is quite often found in the coastal waters of the Riau Islands. It should be noted that Strombus sp. is a marine biota belonging to the mollusk phylum of the gastropod class which has an important role in the aquatic environment in the food chain and as an indicator of water quality [11]. The results of the study stated that microplastics can be ingested by marine organisms [12]. Ingestion of microplastics by marine biota is due to the size and color of microplastics resembling food [13]. Microplastics can also accumulate in organisms at higher trophic levels through food chain processes [14].

Therefore, research is needed on the level of microplastic contamination of Strombus sp species in the waters, to see and examine the shape and abundance of microplastics between stations that have different characteristics. The results of this study can also be used as educational material for the public about the dangers of microplastics in barking snail seafood.
2. Material and methods

2.1. Data collection
Data collection was carried out during the months of June-July in the waters of North Bintan. Sampling was carried out at 3 sample points (figure 2) around the waters of North Bintan, including Sebong Pereh, Sebong Lagoi, and Pengudang. While the sampling method is determined from the long-distance interval of about 100 meters between the substations and the sampling is done randomly according to the availability of barking snails in low tidewaters (figure 1).

2.2. Research methods and sampling
The methods used in this research are survey and quantitative methods. Determination of station points are selected based on the characteristics of the waters and the sub-stations are marked by purposive sampling. This is done to see the extent of the differences in the level of contamination between regions that have their characteristics. The research stage is divided into 4 stages, namely; (1) Sampling, (2) removal of organic matter using \( H_2O_2 \), (3) floating stage using \( ZnCl_2 \), and (4) identification using a microscope. All stages are carried out at the location of the station and FIKP UMRAH laboratory.

2.3. Processing of Strombus sp and sediment samples
The snails were removed from their shells and split vertically and then weighed before being put into a 500 ml measuring cup. Samples were extracted with \( H_2O_2 \), heated in an oven. This is to remove organic residues attached to the sample [15] (Then the sample was floated with \( ZnCl_2 \) solution, then filtered using a vacuum pump. Each sample was observed microscopically to obtain data on aspects of abundance, size, species, and color.

2.4. Data analysis
The statistical analysis method used is two-way analysis of variance (ANOVA) to determine 2 factor variables so that it can determine the level of contamination of biota in the waters between station points. The number of microplastics was expressed as mean ± standard deviation (SD). All statistical data analysis was performed using Microsoft excel. [16].

2.5. Microplastic Electivity Index
The preference of each organism or type of mesoplastic & microplastic contained in the digestive tract of fish is determined based on the level of preference using the index of electivity (E) referred to by Effendi [17] as follows:

\[
E = \frac{r_i - p_i}{r_i + p_i}
\]  

Information: E= index of choice, ri= relative amount of plastic crumbs eaten by biota and pi= relative amount of plastic debris in the sediment. According to Effendi (1979), if the value 0 <E<1 means the food is favored, -1<E<0 means the food is not liked and if E=0 means there is no selection by the fish for the food.

3. Results and discussion

3.1. Overview of research sites
The total sample obtained in the data collection was 72 samples, each of which obtained 36 samples of Strombus sp and 36 samples of sediment in the waters of North Bintan (table 1 and table 2). The amount of population growth will certainly increase in the number of activities in North Bintan District. Several activities and activities are found around the coastal waters of North Bintan. Fishery activities are dominated by shrimp stations followed by Sebong Pereh and Sebong Lagoi stations located in Kampung
Baru. In addition, tourism activities are also dominated by the Sebong Lagoi and Sebong Pereh areas. According to Barnes et al. [18], the density of plastic waste is strongly correlated with the number of people in an area.

3.2. Microplastic abundance in Strombus sp and sediment

The spread of microplastics in the water column and sediment is widespread with high abundance values [13], size [19], and usually the observed color resembles prey (white, yellow bunches) increasing the potential for microplastic consumption by various aquatic organisms. In this study, the value of the abundance of sedimentary microplastics was higher than the value of the abundance of microplastics in the Conch Snail [20]. The possibility of ingestion of microplastics in Strombus sp also depends on the abundance of microplastics in the sediment.

Comparison of data (table 1) Strombus sp between Pengudang station and Sebong Pereh station which is quite significant. Meanwhile, with Sebong Lagoi station, the data difference is quite far compared to the two stations. This happens because the eating habits of Strombus sp are prone to not sorting the type of food, causing an increased possibility of ingesting microplastics mixed in the sediment [20]. The possibility of ingestion of microplastics in Strombus sp also depends on the abundance of microplastics in the sediment.

In addition to the surface of the water, microplastics are also found at the bottom of river sediments. Based on research conducted by Hidalgo-Ruz [21], the results of the review showed that the highest concentration of microplastics was found at the bottom of the sediment compared to the surface of the

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### Table 1. Table of Proportion of Microplastic Abundance in Strombus sp

| Location       | Total Samples (n) | Total Particles | Mean abundance (± std) |
|----------------|-------------------|-----------------|------------------------|
| Pengudang      | 12                | 506             | 42.16 ± 12.2           |
| Sebong Pereh   | 12                | 462             | 38.5 ± 10.58           |
| Lagoi          | 12                | 263             | 21.9 ± 7.06            |
| Total          | 36                | 1231            | -                      |
| Average        | -                 | -               | 34.19 ± 13.37          |

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Figure 3. Abundance of microplastics in several locations in Indonesia and Southeast Asia.
The presence of microplastics at the bottom of the sediment is influenced by the force of gravity and the plastic density which is higher than the density of water causes the plastic to sink and accumulate in the sediment. The total sediment samples obtained at the three sampling points (table 2) were 48 samples. The results of the abundance of microplastics in the sediment, based on the research that has been carried out, (figure 12) the overall data is obtained with a total of 1,545 particles with an average of 1.71 particles gram\(^{-1}\). The highest abundance among the 3 locations was dominated by Sebong Pereh station of 50.33 ± 15.84 with a total abundance of 604 particles. While the Pengudang station was 47.91 ± 10.15 individual particles \(\text{gram}^{-1}\) with a total abundance of 575 particles. While the lowest abundance was shown at Sebong Lagoi station of 30.5 ± 8.2 individual particles \(\text{gram}^{-1}\) with a total abundance of 366 particles.

3.3. Aspects of microplastic types in Strombus sp. and sediment

In the identification process, determining the type of microplastic is something that is important to observe. Microplastic in each type sinks and accumulates at the bottom of the sediment, which allows it to be digested by benthic organisms [24].

In a previous study conducted by Fitri and Patria [25], the dominant type of microplastic found in the blood clam species (Anadara granosa) was fiber. This is due to the fact that the density of the fiber is lower than that of the fragments and the blood clams are classified as filter feeders. In addition, different results were found by Mohsen et al. [26] which supports this study by finding microplastics in the stomach of sea cucumbers and dominated by fragments. As is known, sea cucumbers are classified as deposit feeders.

Meanwhile, in the sediment data, the highest abundance among the 3 locations (figure 3) was dominated by fragments with a total of 703 particles and an average of 0.78 particles gram\(^{-1}\). In a previous study conducted by Hastuti [27] in the mangrove area of PIK, it was shown that film was the more dominant type with a percentage of 67.7-74.1% of the total number of microplastics found. Overall, the microplastics in each of these types sink and accumulate at the bottom of the sediment, which allows them to be digested by benthic organisms [24].
3.4. Aspects of microplastic color in Strombus sp. and sediment
Muzahar [28], stated that Strombus sp has a habit of eating by sweeping and sucking up sediment at the bottom of the waters. The barking snail's diet consists of: microalgae, plankton, and detritus. Until it can be ascertained that Strombus sp does not sort/select its food, so that microplastics are easily eaten.

In previous studies, the most commonly found microplastic colors were white, transparent and blue [13]. The same result with dominated by blue, yellow, red and black. So that Strombus sp indirectly, microplastic can be eaten at a higher trophic level. According to Nadal et al., [29] this is due to eating fouling organisms attached to plastic or organisms that previously consumed microplastics.

Meanwhile, the highest abundance in sediments among the 3 locations (figure 4) is dominated by blue at the shrimp location, the Sebong Pereh location is dominated by yellow, and the Sebong Lagoi location is dominated by blue. The dominant color difference found in each type of microplastic in some of the studies above is influenced by the source of the microplastic, for example the red and blue colors in the fiber are artificial colors as a result of anthropogenic activities [30].

3.5. Microplastics size on Strombus sp. and sediment
Size is a major factor in the problem of high doses of microplastics that are ingested by organisms to lower trophic levels. This indicates that the bioavailability of microplastics can contaminate first-level producer organisms.

According to Syakti et al., [31], mentioning that the size of microplastics is important to discuss considering the widespread level of pollution. Therefore, many environmental and health problems occur, including the possibility of plastic being ingested by various organisms.

Nor and Obbard [32], microplastics are divided into 7 groups, namely; group 1, 20–40 m; group 2, 40–60 m; group 3, 60–80 m; group 4, 80–100 m; group 5, 100–500 m; group 6, 500–1000 m; group 7, 1000–5000 m. So in this study using size groups in each sample.
The abundance of sizes that occurs in general, the biota of the carnivorous group tends to have a smaller size range compared to the biota of the herbivorous group which has a fairly large size range. This happens because the herbivore group has a habit of sucking the maximum volume of water containing food into the body [33].

In a previous study conducted by Boerger et al., [34] found planktivorous fish containing microplastics with sizes ranging from 1000-2790 m (group size 7). While the size range of microplastics is quite large in the herbivore group compared to the carnivore group due to differences in eating habits and ways. As a result of the food habits of Strombus sp (figure 5), it provides the potential for the presence of various sizes of microplastics.

Table 3. Microplastic electivity values on Strombus sp.

| Stasiun          | Object Sample | Indeks Choices (E) | Status   |
|------------------|---------------|--------------------|----------|
| Desa Pengudang   | Conch Sedimen | 0.913              | Favorite |
| Sebong Pereh     | Conch Sedimen | 0.901              | Favorite |
| Sebong Lagoi     | Conch Sedimen | 0.895              | Favorite |

Figure 7. Percentage level of microplastic contamination in Strombus sp and North Bintan waters at each station.

Figure 8. Correlation the relationship between the number of microplastics in the sediment and Strombus sp.

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3.6. Contamination level
The results of this study showed that the average abundance of microplastics in the barking snail (Strombus sp) was 34.19 individual particles \(-1 and the sediment was 1.71 particles gram\(-1.

This happens because of the factors that support the potential abundance of microplastics. The highest level of contamination was experienced by Strombus sp at the Pengudang location at 88\% (figure 6). That means that on average, each individual at the Pengudang station has the potential to be contaminated with 22 microplastic particles. While at the Sebong Pereh location the level of contamination that occurs is 76\% and Sebong Lagoi station is 72\%.

3.7. Electivity index and total correlation between microplastics in Strombus sp and sediment.

In general, the food that enters the Conch Snail (Strombus sp) has a habit of eating by taking the substrate without any sorting. So it takes an electivity value to see eating habits (eating psychology) on Strombus sp.

The level of microplastic contamination in strombus sp at the three locations. Explain that the barking snail biota has an interest in the food it gets. This is illustrated by the value of the electivity index (table 3) at the Pengudang location of 0.913, at the Sebong Pereh location of 0.901 and at the Sebong Lagoi location with an electivity index of 0.895. Overall this explains that the plastic crumbs that enter the body are favored by the Conch snail (Strombus sp).

The data distribution pattern (figure 7) shows the relationship between the number of microplastics in the sediment and Strombus sp in the existing distribution pattern, the total number of Strombus sp has no relationship with the total number of mycorplastic abundances in the sediment. As well as the consumption of microplastics in Strombus sp there was also no difference with the abundance in sediments.

3.8. Directions for hygenic food processing of conch snails (Strombus sp.)

In food processing, it is necessary to handle and take preventive measures to prevent the entry of microplastics into the human body. Deng et al., in Prasetyo [35], proved the dangers of microplastics using exposed mice (Mus musculus). Then there is accumulation in the liver, kidneys and intestines of mice which causes several adverse effects on the liver, such as impaired energy and lipid metabolism, oxidative stress, and neurotoxic responses. So that the problem faced is in the digestive part of the conch snail.

4. Conclusion

Microplastic particles can be found in all waters of North Bintan in Teluk Sebong District which consists of several villages including Pengudang Village, Sebong Pereh Village, and Pengudang Village. The right direction of food processing is needed so that the Conch Snail is safe for consumption. So the researchers suggest that it is safe to consume without the digestive part and boiled using salt.

Microplastic crumbs in Strombus sp and sediments were dominated by 506 particles in Pengudang Village with an average concentration of 42.16 ± 12.2 individual particles\(-1 and 604 particles in sediments with an average concentration of 50.33 ± 15.84 gram\(-1 particle. Types of microplastic crumbs identified in Strombus sp and sediment are fragments, each with 269 particles with an average concentration of 22.41 ± 8.75 individual particles\(-1 and 328 particles with an average concentration of 27.33 ± 6.73 gram\(-1 particles. The level of pollution that occurs in Strombus sp. experienced in Pengudang Village by 88\%, meaning that on average each individual at the Pengudang station has the potential to be contaminated with 22 microplastic particles. The high level of pollution is a threat to the safety of marine products (Seafood) due to the contamination of microplastic particles in one of the marine biota consumed by Strombus sp.

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